The International Journal of Digital Curation
Issue 2, Volume 6 | 2011

Digital Curation Education in Practice: Catching up with Two Former Fellows

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Abstract

From 2008-2010, as part of the grant: 'DigCCurr I: Preserving Access to Our Digital Future: Building an International Digital Curation Curriculum' (DigCCurr I) funded through the Institute of Museum and Library Services, a number of fellows at the School of Information and Library Science (SILS) at the University of North Carolina at Chapel Hill (UNC-CH) were comprehensively trained by library and archive professionals in digital curation theory and practice. This paper examines the curriculum skill areas matrix of the DigCCurr I program from the perspective of two former fellows, now employed in professional positions that utilize digital curation principles. Each fellow offers an analysis of digital curation functions and subfunctions as they relate to her current position, deriving suggestions for future iterations of the DigCCurr program and other graduate programs meant to prepare digital curators. While DigCCurr has been reported by its creators, a group of seasoned digital curation professionals and educators from around the world, this paper provides a fresh perspective from graduates of the program who are applying their newly learned digital curation skills and knowledge in the workforce.[1]

[1] This paper is based on the paper given by the authors at the 6th International Digital Curation Conference, December 2010; received December 2010, published July 2011.
The *International Journal of Digital Curation* is an international journal committed to scholarly excellence and dedicated to the advancement of digital curation across a wide range of sectors. ISSN: 1746-8256 The IJDC is published by UKOLN at the University of Bath and is a publication of the Digital Curation Centre.

Introduction

In recent years, Library and Information Science (LIS) schools in the United States have been catching up in the development of curricular concentrations, tracks and certificates that feature light to intensive training in digital curation and digital preservation. Supplying adequately trained employees to libraries and archives that are often described as being in crisis with the influx of digital products and content can represent a tsunami of a sea change. Some of these schools focus on "digital libraries" (Drexel University, Syracuse University, University of Illinois at Urbana-Champaign, Indiana University-Bloomington), "digital curation" (University of North Carolina at Chapel Hill), "data curation" (University of Illinois at Urbana-Champaign) or "preservation of information" (University of Michigan). The extent to which the programs' preparation maps to actual positions can be open to interpretation unless graduates provide feedback regarding their experiences.

This paper aims to do just that, specifically related to the project: 'DigCCurr I: Preserving Access to Our Digital Future: Building an International Digital Curation Curriculum' (DigCCurr I) at the University of North Carolina at Chapel Hill (UNC-CH).[2] This program jump-started a Digital Curation Curriculum (DigCCurr) that was initially tested on five fellows, including the two authors. Herein, the authors describe their structured analysis of the program's functional elements compared with their coursework and their current positions, as well as the conclusions about and suggestions for the program derived from this analysis. "The digital curation framework holds the promise of linking research, practice, and education relating to digital resources in all forms and all disciplines, as well as the potential for better aligning data management across all types of repositories, from science data centers to cultural heritage organizations" (Ray, 2009). While by no means the only program formulating competencies for digital curators (see also Choi & Rasmussen, 2006; Hank & Davidson, 2009; Pomerantz et al, 2006, 2009; Pryor & Donnelly, 2009; Ray 2009; Swan & Brown, 2008) DigCCurr I fellows are some of the few to date who have actually been educated under such an intensive curricular framework.With one fellow involved in academic library data services and the other in a cultural heritage organization, this paper shows how a digital curation framework can indeed translate to positions with different responsibilities and in different contexts.

DigCCurr I Project: Overview and Method of Curriculum Development

DigCCurr I (2006-2009) was a three-year Institute of Museum and Library Services-funded project that took place at UNC-CH with cooperation from a group of partners on the DigCCurr I International Advisory Board. The project objective was "to develop an openly accessible, graduate-level curricular framework, course modules, and experiential and enrichment components and exemplars necessary to prepare students to work in the 21st century environment of trusted digital and data repositories." In support of this objective, the principal investigators engaged in a number of activities; foremost among them was the development of the curricular framework and testing of such with sponsored graduate students, called Carolina Digital Curation Fellows (Fellows). Five students were part of the first cohort. Over two years, these students were enrolled in a prescribed set of courses within UNC-

[2] DigCCurr: http://www.ils.unc.edu/digccurr/index.html

CH's School of Information and Library Science (SILS) and were also given practicum placements.

During the first year of the project, the DigCCurr I principal investigators solicited input regarding desirable and necessary skills for digital curators through multiple outlets, including "an extensive review of course syllabi and existing curricula from accredited information and library science (ILS) programs offering specializations in digital preservation and/or data curation, and review of other ILS courses and courses in the field of computer science" (Hank, 2010). Professional training programs, job postings, syllabi, advisory board interviews, and survey responses from attendees of the DigCCurr 2007 conference were also used.[3] The following questions guided design of the master's-level curriculum:

> "1) What knowledge and competencies do professionals need to do digital curation work?
> 2) What should students learn in the classroom?
> 3) What should students learn through field experiences?"
> (Hank, 2010)

Additionally, the curricular framework was constructed based on several design principles, including "build from modules, rather than entire courses" and "emphasize core, generalizable modules...aim[ing] to teach units that address a large number of cells simultaneously" (Lee et al., 2007b). These two principles in particular are important in contextualizing any assessment of the curriculum or its effectiveness.

The survey conducted at the DigCCurr 2007 conference, before the initial five fellows arrived at UNC-CH, investigated stakeholders' attitudes and observations about needed skills for digital curation. This survey revealed many key themes about the current state of digital curation practice and preparation for practice that were ultimately incorporated into the curriculum framework. Among them were "the need for basic and shared understanding of terminologies to facilitate communications between different discipline-specific languages of professionals engaged in DC [digital curation]," support for "emphasis of digital life cycle stages in the core curriculum," and identification of the preservation planning and implementation subfunction as a core function, deserving of "the greatest, or heaviest, emphasis" (Tibbo, Hank, & Lee, 2008). The same survey examined perceived challenges for local digital curation:

> "Nearly all (96%) agreed or strongly agreed that the 'need to better incorporate digital curation considerations into the institution's organizational structure, protocols or policies,' was a barrier to implementation, followed by 'insufficient communication and coordination between different groups of stakeholders' (91%), and the 'need to better identify and operationalize the necessary functions and skills' (89%)."
> (Tibbo, 2008).

[3] DigCCurr 2007: http://www.ils.unc.edu/digccurr2007/.

Respondents also identified "practical experience" and "technical competencies" as vital professional characteristics when evaluating candidates for vacancies. This survey was critical to informing the design of the DigCCurr I curriculum, but it is also of particular significance to this paper because it directly addresses the state of working digital curation professionals and the institutions where they are employed.

One product of the sources explored during DigCCurr I was a highly vetted and iteratively developed six-dimensional matrix of digital curation knowledge and competencies.[4] This matrix includes the following dimensions: (1) Mandates, Values and Principles; (2) Functions and Skills; (3) Professional, Disciplinary, Institutional, Organizational or Cultural Context; (4) Type of Resource; (5) Prerequisite Knowledge; (6) Transition Point in Information Continuum. It is this matrix that informed the fellows' prescribed selection of courses and fellowship practica.

Much assessment was done during the DigCCurr I grant period using periodic evaluations from fellows and their practicum supervisors. The principal investigators have also spoken broadly on their analysis of the DigCCurr program (Hank & Tibbo, 2010; Hank, Tibbo & Schaffer, 2007a; Lee, 2008, 2009a, 2009b). Immediately after DigCCur I ended, exit interview and outcome data were used to create a final report (Hank, 2010). This report includes reflections from all fellows on what they perceived to be the most critical and useful aspects of the curriculum and their various practicum placements. While this is useful in its own right for continued revision of the DigCCurr program, the five fellows were recent graduates when they completed this evaluation. Several had already been hired, but they were very new employees at the time. This paper aspires to provide the perspective of fellows with more than a year of employment, and specifically in regard to the Functions and Skills section of the DigCCurr I matrix.

Methodology

For the purposes of this paper, the authors isolated the second dimension of the matrix, Functions and Skills, and looked at how this was reinforced by classes and/or their practica. A combination of syllabi issued for the courses as well as the much more subjective impressions of what was actually taught were used to determine to what extent specific functions and skills were addressed. Although many of the functions were mentioned in numerous classes, a function was only assigned to a course if the authors felt it featured prominently as either a recurring theme, or if one or more class sessions were devoted to the function (Figure 1).

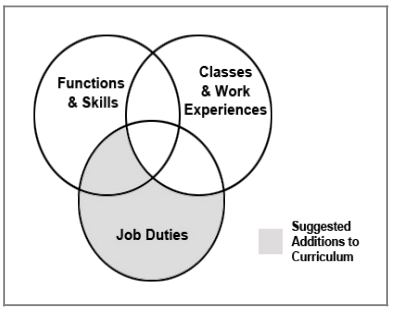

Figure 1. Points of analysis.

[4] The full DigCCurr matrix is available at: http://www.ils.unc.edu/digccurr/digccurr-matrix.html

Next, these functions were mapped to each fellow's current job duties to explore the level of preparation they received for their current positions. Finally, job duties that either did not map to a function or whose functions were not covered in the program were reviewed. Figure 1 simply explains the entire process. Through this procedure, the fellows distilled what they feel would be useful additions to the DigCCurr I curriculum (or any curriculum with a digital curation concentration) and also compiled several other general observations regarding how the DigCCurr I experience prepared them for their first professional positions.

Fellows' Background upon Entering Program

To clarify exactly what knowledge and skills the fellows gained during their DigCCurr I experience, it is useful to know a bit about their backgrounds before entering SILS.

Fellow A held a bachelor's degree in English with a minor in technical writing from the Pennsylvania State University. In addition to her major coursework, she also completed courses in agricultural sciences and in a variety of social science disciplines. Before coming to UNC-CH, she worked on the Pennsylvania Newspaper Project at Pennsylvania State University, preserving and microfilming historical Pennsylvania newspapers, and was an intern for the Hemingway Letters Project, a project aiming to collect and publish the complete correspondence of author Ernest Hemingway. Through these positions, she gained exposure to academic libraries, digital humanities research, and library preservation in a classic sense, but little experience in digital curation principles or user services activities.

Fellow B entered the master's program at UNC-CH with both a bachelor's degree and a master's degree in English. Her work experience to that point had mostly been in higher education, both in libraries and in administrative support and instructional positions. She had exposure to a university archives as an undergraduate student assistant, held a technical assistant job in the Bunting Visual Resource Library (University of New Mexico), and had also been a personnel technician at North Carolina State University Libraries. She had taken a preservation course for museum professionals while studying for her master's degree in English, but this course did not address digital materials. Her only exposure to activities related to digital curation included some digitization of slides, an introduction to the challenges of transitioning from analog to online access with visual resources, and experience with Standard Generalized Markup Language and Optical Character Recognition as a technical editor.

Both fellows arrived at SILS with Humanities-focused backgrounds, with little experience in information technology (IT) services, advanced programming, or general knowledge of the scope of digital curation as a discipline. Both had, however, been exposed to libraries, archival materials, digitization, and user services.

DigCCurr I Experiences

While at SILS, both fellows fulfilled the DigCCurr I project's requirements regarding coursework and practica. Courses required through the project included standard library and information science (LIS) requisites such as Human Information Interactions, Information Resources and Services (reference), Resource Selection and

Evaluation (collection management), Management for Information Professionals, Organization of Information, and Research Methods. Each fellow also completed courses related to archives (Introduction to Archives and Archival Appraisal). Digital curation courses (an introductory seminar for DigCCurr fellows*, Digital Libraries, Digital Preservation and Access*, and Digital Curation: Application and Challenges*) were supplemented by IT-focused courses like Understanding Information Technology for Managing Digital Collections*, and Systems Analysis (Table 1).[5]

LIS Core	DigCCurr Specific	Electives
• Human Information Interactions • Information Resources and Services • Information Tools (Fellow A) • Management for Information Professionals • Master's Paper • Organization of Information • Research Methods • Resource Selection and Evaluation	• Archival Appraisal • Carolina Digital Curation Fellows Introductory Seminar • Digital Curation: Application and Challenges • Digital Libraries • Digital Preservation and Access • Electronic Records Management (Fellow B) • Introduction to Archives • Systems Analysis • Understanding Information Technology for Managing Digital Collections	• Introduction to Databases (Fellow B) • Professional Field Experience (Fellow A)

Table 1. Courses taken by fellows for credit.

For their practica, each fellow completed 20 hours per week at one of several partner organizations at UNC-CH. Fellow A spent both years with the Data Archive at the Odum Institute for Research in Social Science.[6] The Odum Institute's Data Archive is one of the oldest in the country and holds significant collections of polling data, social science research data, census data, North Carolina vital statistics, and other collections, which are preserved and made available on a wide scale. Although it is a prestigious and well-respected archive, involved in a number of international projects and collaborations, the Odum Archive is a small organization where graduate assistants are encouraged to initiate new projects and participate in activities that align with their interests. During her time at the Odum Institute, Fellow A worked on a metadata cleaning and verification project, gained experience with statistical packages and research data management principles used in data-intensive research, and participated in a risk assessment of the archive using the Digital Repository Audit Method Based on Risk Assessment tool from the Digital Curation Centre and DigitalPreservationEurope.[7] Building on this experience, her final project was to design and conduct a training session to instruct researchers in good early-lifecycle practices to encourage archiving and sharing later.

[5] Asterisked (*) courses were developed for or perfected within the DigCCurr I project (Hank, 2010).
[6] Odum Institute for Research in Social Science: http://www.irss.unc.edu/odum/jsp/home.jsp.
[7] Digital Repository Audit Method Based on Risk Assessment: http://www.repositoryaudit.eu/.

It should also be mentioned that, external to her DigCCurr I requirements, Fellow A held part-time positions at the Burlington Textiles Library at North Carolina State University in Raleigh and the Health Sciences Library at UNC-CH, where she participated in front-line and behind-the-scenes reference and user service activities for these specialized populations.

For her practica placement, Fellow B was first placed in the University Library's Carolina Digital Library and Archives, in the production center responsible for scanning materials for special patron requests, online digital collections, and in-house exhibits. There she was exposed to scanning of photographic materials, large format maps and manuscripts, as well as the workflows attendant with processing such materials. During the second year, Fellow B's position was in the University Archives, where she researched website archiving best practices that would be feasible as part of the Archives' overall records management program. This involved installing and testing a number of open source tools and reporting on a suggested workflow that would fit the Archives' resources and requirements.

Both fellows completed their SILS experiences with a semester-long master's paper based on original research on digital curation topics. Fellow A explored the influence of institutional review boards on social science data archiving while Fellow B created and deployed a survey of university librarians and archivists regarding their impressions of website archiving. These research topics also dovetailed with both fellows' DigCCurr I work experiences.

Current Employment

After graduating from SILS with master's degrees in library science in May 2009, both fellows were employed within six months of graduation, in the positions discussed hereafter in this paper. Fellow A accepted a position as Data Services Librarian in the main library of New York University (NYU), a large private, not-for-profit research university. Fellow B accepted a position as Digital Projects Liaison in the Digital Information Management Program at the State Library of North Carolina (State Library), which serves as the official repository for state publications, supports state government employees as well as public libraries around North Carolina, and supplies resources for the blind and physically handicapped.[8]

The Data Services Librarian position (Fellow A) at NYU was a new position, created as part of a multi-year effort to build a comprehensive data services center in the library that would consolidate statistical computing and library services already offered by NYU IT Services and the NYU Division of Libraries, and provide a framework for new initiatives. This data services center, named the Data Service Studio (DSS), opened in fall 2008 with a dedicated computer laboratory and staff consisting of a librarian/coordinator, a statistician, a Geographic Information Science expert, and a half dozen graduate student consultants specializing in various statistical packages. Introducing another librarian to the DSS was meant to enhance reference and access for licensed and freely available data sets, but also to advance the goal of "developing services to assist faculty and students in managing and preserving research data either as a discrete and unique collections, or as contributions to a larger research universe" (Collard et al., 2007).

[8] Digital information management program: http://statelibrary.ncdcr.gov/dimp/index.html.

When Fellow A was hired in mid-2009, the DSS and its advisory group had already identified the Dataverse Network software developed by Harvard-Massachusetts Institute of Technology Data Center as a viable option to preserve its own numeric data collections, and Fellow A had experience with this software from her practicum at the Odum Institute's Archive.[9] The numeric data repository project is ongoing and Fellow A has also become heavily involved in a scoping and piloting project for a spatial data repository, both of which draw significantly on her digital curation background.

In addition to her duties as Data Services Librarian, Fellow A acts as liaison to NYU's Wagner Graduate School of Public Service, providing in-depth reference and instruction and selecting materials in the subjects of public administration and urban planning. While digital curation is an important theme in Fellow A's work, it is not prevalent in every task or assignment.

Digital Projects Liaison (Fellow B) is a position included in the Access to State Government Information Initiative grant, funded by Institute of Museum and Library Services under the provisions of the federal Library Services and Technology Act.[10] This position is with the State Library's Digital Information Management Program in North Carolina, which works to provide long-term, permanent, and open access to born-digital and digitized information produced by or on behalf of state government. Fellow B's particular responsibilities can be loosely divided into four parts. The first part includes managing a larger-scale digitization project in which some of the State Library's government materials are digitized off-site and then incorporated into the North Carolina Digital Collections repository.[11] For the second part, she assists with digital preservation activities, including a website archiving program and stewardship of the digital materials within the digital repository. She is also involved in creating digital preservation education resources for state employees, as well as increasing awareness of the State Library's digital services and initiatives. Finally, interface design and usability testing for the library's digital products round out her duties. For Fellow B, digital curation plays a prominent role not only in her department, but also in her particular job.

Fellow A and Fellow B accepted offers around the same time and, as of fall 2010, have both been in their current positions for just over a year. It is likely that this short time period has not revealed the extent to which the DigCCurr I curriculum will map to their job duties or career trajectory; however, it is close enough to their completion of the program that they remember what they learned and yet sufficiently long enough for them to have formed impressions of how the experience could be improved.

Functional Mapping to Positions

Both fellows began by comparing the DigCCurr I digital curation functions and subfunctions to their positions to determine which were applicable and which were not. For a full chart of this exercise, see Table 2 (Appendix).

[9] Harvard-Massachusetts Institute of Technology Data Center: http://hmdc.harvard.edu/.
[10] Access to State Government Information Initiative: http://digitalpreservation.ncdcr.gov/asgii/index.html.
[11] North Carolina Digital Collections repository: http://www.digital.ncdcr.gov.

When reviewing the DigCCurr I curriculum matrix, Fellow A identified seven functions that figure prominently in her current position and three more that are present but not as fundamental. The key functions are Administration; Analysis and Evaluation of Producer Information Environment; Management; Preservation Planning and Implementation; Reference and User Support Services; Selection, Appraisal and Disposition; and meta-level function Education and Sharing of Expertise or Guidance on Curation Functions.

Planning is a key theme in Fellow A's position in a relatively new department with two fledgling repositories: in particular, planning relating to standards, policies, facilities, levels of preservation, and repository service definition. Along with her colleagues, Fellow A places great importance on the Preservation Planning and Implementation function, especially monitoring the designated community; monitoring technology; and reconciling preservation requirements with preservation capabilities. In addition to "monitoring" the community of data users and creators, she is also engaged with what they do and how, in order to learn what their repository needs are – defined in the Analysis and Evaluation of Producer Information Environment function as "identification of digital curation requirements in production environment." As in any public services job, Fellow A's position emphasizes customer service, communication, help desk and other end-user support, and providing information to consumers. The selection subfunction comes into play in archive/repository endeavors but also in the context of being a subject specialist academic librarian.

Finally, the meta-level function Education and Sharing of Expertise or Guidance on Curation Functions is particularly important for Fellow A. She works with a variety of other professionals, many of whom have excellent knowledge and preparation in digital curation themselves, but finds that her broad understanding of digital curation functions and knowledge of the ongoing conversations and key players has been an asset to many discussions.

Equally significant but less pronounced in Fellow A's position are the functions Advocacy and Outreach; Systems Engineering and Development; and meta-level function Research and Development to Support Curation Functions. The functions of Advocacy and Outreach, such as public programming and promoting an archive's role within the larger institutional context, are seen in traces currently but will certainly play a larger role in the future for Fellow A as both repositories come to fruition and the DSS continues to mature and evolve. Systems development considerations, interface design, requirements definition, and specification, especially at a planning/conceptual level, have been factors in one repository project that Fellow A is involved with. Finally, research certainly plays a role in many of the planning and evaluation functions mentioned previously.

A number of functions in the DigCCurr I curriculum matrix map closely to Fellow B's position. Most prominently are Administration; Collaboration, Coordination and Contracting with External Actors; Preservation Planning and Implementation; Selection, Appraisal and Disposition; and the meta-level function Education and Sharing of Expertise or Guidance on Curation Functions. As coordinator for a grant-funded digitization project, the fellow identifies resources that meet user needs and selects them for digitization. She assists in her institution's preservation planning and implementation, including migration of file formats, development of standards,

assessment of significant properties, technology watch, and especially reconciling ideal requirements with realistic capabilities. Partly due to the size and culture of her department, this fellow has needed the know-how for a number of functions that might typically be done only by administrators, including policies and best practice development, problem solving when challenges arise, change management, project management, and analytics. Finally, whether with other areas of the library or with sister agencies or departments (such as the North Carolina State Archives), this fellow also has been involved in collaborative efforts in all stages of the curation lifecycle. Similar to Fellow A's experience, Fellow B has shared her knowledge of digital curation both with other library employees as well as with state agency employees throughout all of these activities.

Other functions that are not as intricately defined within the matrix but nonetheless make up a part of Fellow B's position include: Advocacy and Outreach; Archival Storage; Identifying, Locating and Harvesting; Systems Engineering and Development; and the meta-level function Research and Development to Support Curation Functions. Assessment and engagement with the user community regarding digital collections are increasingly prominent parts of Fellow B's duties. She also assists in the ongoing maintenance of archival storage and in her institution's website harvesting efforts. Interface design (part of Systems Engineering and Development) and usability testing (part of Research and Development to Support Curation Functions), as they relate to deployment of digital collections, are also within her professional responsibilities.

Discussion

When considering together how the matrix compares to their job duties and how their courses and practica also conveyed these functions, the strengths of the program and possible improvements to it come into focus. Unsurprisingly, the courses that mapped to the most digital curation functions were Digital Curation: Application and Challenges, Digital Preservation and Access, and Understanding Information Technology for Managing Digital Collections. Both fellows agreed that their practicum experiences and master's paper research projects were pivotal in reinforcing and enhancing topics covered in coursework. Whereas particular courses often touched on select functions, the master's papers and practica aggregated an entire spectrum of concepts and brought theoretical discussions into real life institutional contexts.

Table 2 (see Appendix) breaks down which digital curation matrix functions and subfunctions were a part of each fellows' job duties to date. Almost all of the functions feature in at least one of the fellows' positions, with many subfunctions featuring in both. Many that are excluded center around database and system management or relate to duties performed by those in management positions. Some do not apply due to the nature of the materials the fellows steward or the nature of their institutions. This table shows that Fellow B's position involves digital curation activities to a greater extent.

There were also a few themes heavily emphasized in the DigCCurr I experience that both fellows agreed were worthy of the hype. First, practical work in real institutional settings is almost as, if not just as, important as theoretical training. Many of the skills mapped out in the matrix were primarily or wholly developed in the practicum portion of the fellows' education. Fellow A's practicum experience duties often built directly on functions covered in her classes, particularly metadata

principles, risk management and policy discussions, and curators' involvement in the entire digital lifecycle. Fellow B's practicum experiences, particularly in the University Archives, gave her the opportunity to take a digital curation activity (archiving websites) and explore through a number of stages (defining requirements, assessing tools and content, suggesting workflows and policies).

Both fellows also agreed that having the vocabulary and confidence to communicate in areas traditionally relegated to IT professionals has been an asset. This was a refrain throughout the DigCCurr I curriculum, and both regularly find themselves in situations in which they have needed enough 'tech-speak' to legitimize their library and curatorial points of view, and to "reach across institutional lines and to work in teams that include information and computer scientists, and domain experts" (Ray, 2009). Having confidence comes partly from being equipped with a certain base of technical vocabulary and knowledge, but perhaps comes more from the repeated encouragement they received that digital curators do not have to be IT specialists in all areas, but rather have to be willing to and comfortable with acting as intermediaries with those whose technical skills exceed their own. The value of practical experience and the ability to communicate regarding more technical topics bear out the results of the DigCCurr 2007 survey in which "practical experience (32%) and technical competencies (29%) were selected as the most important attributes considered" by those hiring digital curators (Tibbo et al., 2008).

Third, access and preservation are two vital and *equally important* parts of digital curation. Many stakeholders, especially in the library contexts where both fellows are working, often focus on access as the most visible and immediate side of the object lifecycle. Many see digital preservation as divorced from access. The fact that digital curators are educated in the importance of the entire lifecycle is extremely useful, as both fellows have been in situations in which they have had to advocate different parts of that lifecycle.

A final aspect of the program that both found extremely valuable was the exposure to the international conversation about digital curation. Knowing the names of key practitioners and thinkers, the nature of the unresolved and in-development issues, and the major venues where these issues are discussed is often just as valuable as the skills and answers the fellows could bring to their organizations. Additionally, both personally met a number of digital curation professionals through guest lectures in courses and the international conference that accompanied their curriculum program. This has led to more confident interaction with leaders in the field as well as more targeted monitoring of new research and initiatives.

Both fellows believe that the DigCCurr I program prepared them well to perform many of the digital curation functions included in their job duties, but also feel that there were some other functions for which they received less preparation than they would have liked. One such function for Fellow A is project management. An important skill for many professionals across many fields, project management is especially critical in a large academic library, where a good deal of work is collaborative, cross-departmental, and project-based. Fellow A has also felt a steep learning curve in communicating directly with creators of research data, an activity that touches on many digital curation functions, despite the fact that many aspects of research data creation and communication with creators were covered by her

coursework and practicum. Finally, the preparation that Fellow A gathered through the DigCCurr I program was vital to securing her current position, but she would not have been a good candidate if not for the public services experience obtained through her other two internships in academic libraries. While training to be a digital curator, she was also purposely training to be an academic librarian, and was offered a job incorporating both as a result. This highlights the importance of electives in any curriculum to allow time and credits for students to develop the other interests that make each digital curator unique and valuable.

Despite the successful preparation from her practicum and coursework, there are some demands of Fellow B's current position that she has had to pick up on the job, and were less successfully addressed while in school. Like Fellow A, Fellow B also felt a deficit in project management preparation. Though perhaps less vital due to the smaller nature of her projects compared with that of Fellow A, Fellow B would have liked more components tailored to this concept because some digital initiatives are still transitioning from projects to programs at her institution. Fellow B also would have appreciated more preparation in metadata standards, interface design, usability, and evaluation of deployed services. In many institutions, a single individual would not be involved in all of these activities in addition to those described earlier, yet Fellow B is fortunate in being able to participate in a larger range of lifecycle activities. Finally, Fellow B would have appreciated more discussion of and instruction in change management, since she is a member of the newest department in the library.[12] Many of these concepts were touched upon in some courses, but either in a haphazard way or at a very high level.

Suggestions from Fellows

As result of this matrix mapping and critical reflection exercise, some areas for curriculum fine tuning came to light. Both fellows offer the following suggestions fully acknowledging the hours of labor involved in development of this curriculum as well as the institutional and departmental contexts that influence which courses can be taught and by whom. While these suggestions focus on a digital curation-specific track, several of the skills addressed are not specific to digital curators, but are in fact useful for all LIS professionals, or even professionals in any field. In addition, some areas might be better addressed in a practicum experience or through on-the-job training rather than in an LIS graduate program.

First, the fellows feel that more attention should be given to that traditionally maligned child of LIS programs: management. For digital curators, who often find themselves in an environment dominated for years by print and print-focused librarians or archivists, how a digital curator can address issues of management and institutional change can greatly impact his or her ease in the position. Practicum experiences can greatly augment this area, but certain components, such as project management, could also be incorporated as modules in an existing course. The Management course is most logical, but it could also be useful in a project-based course such as Digital Libraries.

Second, Fellow B felt that the inclusion of two entire courses devoted to selection and disposition of materials (Archival Appraisal as well as the collection subfunction of the Management course), in addition to touching on these subjects in other courses like Digital Libraries and Electronic Records Management led to an experience slightly

[12] The Digital Information Management Program was formally established in 2006.

overburdened with these skills. One possibility would be to replace one of the courses on appraisal and collection management with a course on interface design and evaluation. Fellow A has found the courses on appraisal and collection management/selection more useful and would elect to preserve this multi-faceted education in these related but not identical subjects, but agrees that training in interface design issues would have been useful.

Both fellows found some of the more basic courses – for instance, Introduction to Archives and Digital Libraries – a little bit redundant when taken in concert with the rest of the curriculum and with their practica. The series of more advanced digital curation seminars were also redundant in some ways; however, they felt that this higher level repetition, especially over time, was very helpful for reinforcing learning and the themes of the curriculum.

In light of these suggestions, Fellow A also finds it important to note that a certain degree of flexibility in the curriculum was critical to her exploration of LIS topics that ultimately led to the development of her career goals and prospects. A digital curation curriculum will necessarily be prescribed to a certain degree, but also should leave a few credits free for personalization. In addition, if Fellow B had sought out more flexibility, she might have supplemented her experience with the interface design and usability topics she has had to learn on the job.

Finally, for Fellow A, the majority of interactions she had with end users and creators of digital materials were via the positions she held in libraries outside of the DigCCurr I program. Fellow B had more exposure than Fellow A, yet still had little interaction with end users. Both feel that great emphasis was placed on the lifecycle model of digital curation throughout the coursework and practicum, and therefore requiring or incorporating hands-on practice or exposure to interactions with creators and end users would greatly enhance the theoretical learning and provide direct preparation for many positions held by digital curators.

Limitations of this Exercise

There are certainly drawbacks in the preceding comparative analysis. First, both fellows' impressions of DigCCurr I program coursework and what they learned are subjective and represent only 40% of their small cohort. The relative success of the program is also affected by the effort put in by the fellows – both attended classes regularly, completed assignments, earned passing marks, and took their practica seriously. Another factor contributing to the applicability of coursework is the course delivery. To be frank, the fellows found one or two of the courses (those that were part of the general curriculum and not directly related to digital curation or the program) delivered haphazardly. Had these courses been more successful, some of the gaps noted above might not exist.

Other ways this analysis might be seen as skewed relate to the positions these fellows currently hold. Although both participated in a program tailored toward archivists, they are now librarians. A good many of the skills required in archives and libraries overlap, but some do not. Both fellows have guidance and goals at work but they also have the benefit of operating with a good deal of flexibility. This suggests that the curriculum may match their work duties to the extent that it does because they have the flexibility to define their work goals and how they are accomplished. Finally, as mentioned earlier, some of the subfunctions related to managing archives do not map simply because they are librarians thus far in non-management positions.

Finally, and perhaps most obviously, employment in different positions might yield different conclusions. However, as both fellows are in currently existing positions that prominently incorporate digital curation functions, the gaps and suggestions attend the idea that a curricular experience should be well rounded to support a wide range of jobs with similar demands. If nothing else, this paper and the experiences of these two fellows underscore the fact that few, if any, positions will or should demand that a single person perform all digital curation functions regularly. Digital curation is too big a problem space to be managed by a single person and the most important need for digital curation professionals is to be exposed to and conversant with these concepts.

Conclusion

As subjective evaluations by a very small sample, the observations in this paper can be construed as of limited use. The authors contend, however, that their tailored curricular experience is relatively unique amongst current graduates, and that the extent to which their graduate school experiences prepared them for their current positions may help inform those still refining digital curation or preservation curriculum as well as those interested in following similar career paths. Continual revising and fine-tuning based on outcomes is especially important for a new curriculum in a field that is still actively being defined. In this case, a large sample simply is not available, meaning that the critical reflections of individuals is a useful exercise in the process of improving the curriculum. This particular sample, even if it is very small, is also diverse – the two fellows hold very different jobs in the wide space of digital curation. Completing this analysis side-by-side has allowed them to tease out digital curation functions that span their positions and those that do not emerge at all.

As more students complete programs with emphases in digital curation, their experiences in the workplace can be added to those described above to re-inform program development, allowing LIS programs to remain relevant and useful preparation for LIS careers rather than simply a means to a diploma. Both of the authors have been fortunate in the degree to which their LIS program experiences have translated into useful knowledge on the job, and hope that their reflections on this curriculum will both inform LIS program faculty and encourage LIS graduates to take a part in giving feedback about how well their education prepared them for the professional world after graduation.

Acknowledgements

The authors would like to acknowledge the guidance and support of Drs. Carolyn Hank, Cal Lee, Helen Tibbo and their colleagues at NYU's Division of Libraries and the State Library of North Carolina.

Appendix

Function or Function Category	Subfunctions Identified by Fellow A	Subfunctions Identified by Fellow B	Subfunctions Identified by Neither Fellow
Access	**Information retrieval**; Information discovery Viewing	**Information retrieval**; Generation of access collections	Coordination of access activities; Delivery of responses; Exposure; Generation of Dissemination Information Package (DIP); Legal discovery
Administration [of repositories, day-to-day]	**Communications; Customer service; Project management; Review and update of standards, policies and rules;** Establishing standards, policies, and rules**;** Facilities management and planning**;** Managing relationships between Administration and Management**;** Planning	**Communications; Customer service; Project management; Review and update of standards, policies and rules;** Implementing and enforcing standards, policies and rules**;** Management of and response to challenges or complaints**;** Organizational change management**;** Statistical analysis to support operations	Activation of requests; Archival information update; Assign responsibilities; Budgeting and resource allocation; Deliberation process; Human resource management; Leadership; Management of system configuration; Monitoring and proof of compliance with standards, policies and rules; Monitor changes in warrant; Risk management; Security
Advocacy and Outreach	**Engagement with local community; Outreach and public programming; Understanding and promoting Archive's role within the larger institutional context**	**Engagement with local community; Outreach and public programming; Understanding and promoting Archive's role within the larger institutional context**	Negotiation for resources; Standards development
Analysis and Characterization of Digital Objects/Packages			Characterization of digital objects within information package; Characterization of information package
Analysis and Evaluation of Producer Information Environment	**Assessment of existing systems; Identification of digital curation requirements in production environment**	**Assessment of existing systems; Identification of digital curation requirements in production environment**; Assessment of business activity	Preliminary Investigation
Archival Storage	**Holdings maintenance**	**Holdings maintenance**; Ensuring sufficient redundancy of copies; Error checking; Management of storage hierarchies; Providing data; Receiving data	Disaster planning, preparation and response; Replacing media
Collaboration, Coordination and Contracting with External Actors		Identifying, Establishing and coordinating specific types of collaborative relationships with other Archives; Negotiation and maintenance of effective relations with external actors	Conflict resolution involving Producers, Consumers and Archives; Establishment of succession, contingency or escrow arrangements with external actors; Management of agreements; Sourcing

Function or Function Category	Subfunctions Identified by Fellow A	Subfunctions Identified by Fellow B	Subfunctions Identified by Neither Fellow
Common Services			Network services; Operating system services; Security services
Data Management			Administering database; Generating reports; Linking/resolution services; Performing queries; Receiving database updates
Description, Organization and Intellectual Control		Analyzing existing Descriptive Information (DI), Preservation Descriptive Information (PDI) and Packaging Information (PI), and determining needs for DI, PDI and PI; Assigning unique, persistent identifiers; Creation and capture of DI and PDI; Establishing plans and conventions for descriptive, preservation and packaging information; Subject analysis	Creation and capture of PI; Creation and maintenance of representation information registry; Creation and maintenance of producer profiles; Creation and maintenance of policy/rule registries; Creation and maintenance of tools registry and tools service; Visualization
Destruction and Removal			Destruction and Removal
Identifying, Locating and Harvesting	Harvesting metadata from external sources or repositories; Making requests to appropriate locations to collect resources	Defining and setting parameters for harvests and file requests	Extracting identifier information to determine network locations of resources; Synchronizing content
Ingest	**Assigning preservation levels;** Receiving submissions	**Assigning preservation levels**	Committing AIPs to the archive; Coordinating updates; Generating AIPs; Matching content with rules and agreements; Scheduling items in queue to be ingested
Management [of repositories, high-level policies]	**Definition or approval of high-level policies**; Creation or approval of repository service definition; Definition or approval of archives mission, objectives, and goals	**Definition or approval of high-level policies**	Fund raising; Mandate and guidance for resource utilization
Preservation Planning and Implementation	**Developing preservation strategies and standards; Monitoring designated community; Monitoring technology; Reconciling preservation requirements with preservation capabilities**	**Developing preservation strategies and standards; Monitoring designated community; Monitoring technology; Reconciling preservation requirements with preservation capabilities;** Defining significant properties to preserve**;** Developing packaging designs and migration plans	

Function or Function Category	Subfunctions Identified by Fellow A	Subfunctions Identified by Fellow B	Subfunctions Identified by Neither Fellow
Production		Assigning to management class; Ensure production is authorized and ethically sound; Fixing to a medium Generating of digital content	
Purchasing and Managing Licenses to Resources	Encumbering and tracking expenditure of funds of purchased and licensed resources; Managing licenses		Establishing Archives intellectual property rights in support of preservation actions on digital objects
Reference and User Support Services	**Facilitating access to useful and appropriate digital objects**; Developing policies for reference services; Help desk and other end user technical support; Providing associated information to consumers	**Facilitating access to useful and appropriate digital objects**	
Selection, Appraisal and Disposition	**Enacting selection, appraisal, or disposition; Evaluation and monitoring of collections; Identifying needs; Identifying valuable information resources; Making selection, appraisal or deselection decisions; Selection/collection policy development**	**Enacting selection, appraisal, or disposition; Evaluation and monitoring of collections; Identifying needs; Identifying valuable information resources; Making selection, appraisal or deselection decisions; Selection/collection policy development;** Deselection	
Systems Engineering and Development	**Interface design**; **Requirements definition**; Analysis; Specification	**Interface design**; **Requirements definition**; Design	Coding, testing and implementation; Database analysis; Database design and specification; Operation and maintenance
Transfer		Detachment; Getting; Putting	
Transformation of Digital Objects/Packages		Transformation of Digital Objects/Packages	
Use, Reuse and Adding Value to Accessed Information		Use, Reuse and Adding Value to Accessed Information	
Validation and Quality Control of Digital Objects/Packages		Bitstream checks; Virus checks	Component checks; Digital object checks; Information Package checks
Meta-level Functions			
Analysis and Documentation of Curation Functions			Monitoring and logging; Process mapping
Education and Sharing of Expertise or Guidance on Curation Functions	Education and Sharing of Expertise or Guidance on Curation Functions		

Function or Function Category	Subfunctions Identified by Fellow A	Subfunctions Identified by Fellow B	Subfunctions Identified by Neither Fellow
Evaluation and Audit of Curation Functions			Audit of curation functions; Certification of repositories or programs
Research and Development to Support Curation Functions	**User needs analysis and usability assessment;** Research methods**;** Supporting and administering research and development	**User needs analysis and usability assessment**	Business process identification and analysis

Table 2. Digital curation functions and subfunctions featured in fellows' jobs. Subfunctions in bold were identified by both fellows. AIP: Archival Information Package.

References

Choi, Y., & Rasmussen, E. (2006, September). What is needed to educate future digital librarians. *D-Lib Magazine, 12*(9). doi:10.1045/september2006-choi.

Collard, S., Zimmerman, M., Estes, A., Gano, G., LoPresti, F., & Stewart, H. et al. (2007). Report of the Data Services Working Group: A data services model and implementation plans. Unpublished manuscript, New York University.

Hank, C., & Davidson, J. (2009, March). International data curation education action (IDEA) working group. *D-Lib Magazine, 15*(3/4). doi:10.1045/march2009-hank.

Hank, C. (2010). *DigCCurr I: Final report 2006-2009* (Institute of Museum and Library Services Award No. RE-05-06-0044-06). Chapel Hill, NC: University of North Carolina at Chapel Hill. Retrieved October 3, 2010, from http://www.ils.unc.edu/digccurr/digccurr_I_final_report_031810.pdf.

Hank, C., & Tibbo, H. (2010). Applying digital curation principles in practical settings. In *Annual Conference of the Association for Library and Information Science Education (ALISE) 2010. Boston, MA*. Retrieved October 3, 2010, from http://www.ils.unc.edu/digccurr/hank_alise_digccurr.pdf.

Lee, C. A., Tibbo, H., & Schaefer, J. C. (2007a). DigCCurr: Building an international digital curation curriculum & the Carolina Digital Curation Fellowship Program. In *Archiving 2007, Arlington, VA* (pp. 105-109). Retrieved October 3, 2010, from http://www.ils.unc.edu/digccurr/archiving2007_paper.pdf.

Lee, C. A., Tibbo, H., & Schaefer, J. C. (2007b). Defining what digital curators do and what they need to know: The DigCCurr Project. In *Proceedings of the 7th ACM/IEEE-CS Joint Conference on Digital Libraries (JCDL '07)* (pp. 49-50). Vancouver, BC, Canada, June 18-23, 2007. ACM, New York. Retrieved October 3, 2010, from http://www.ils.unc.edu/digccurr/jcdl2007_paper.pdf.

Lee, C. A. (2008, September 6). *High-level categories of digital curation functions*. Retrieved October 3, 2010, from http://www.ils.unc.edu/digccurr/digccurr-funct-categories.pdf.

Lee, C. A. (2009a). Curation junction, what's your function? Defining what it means to do digital curation in order to teach it. *Annual Conference of the Association for Library and Information Science Education (ALISE) 2009. Denver, CO.* Retrieved October 3, 2010, from http://www.ils.unc.edu/digccurr/alise2009-lee.html.

Lee, C. A. (2009b, December 1). Overview of DigCCurr matrix of digital curation knowledge and competencies. *IDEA Network Meeting, London, UK.* Retrieved October 3, 2010, from http://www.ils.unc.edu/digccurr/lee_idea_2009_digccurr_matrix.pdf.

Pomerantz, J., Oh, S., Yang, S., Fox, E. A., & Wildemuth, B. M. (2006, November). The core: Digital library education in library and information science programs. *D-Lib Magazine, 12*(11). Retrieved October 3, 2010, from doi:10.1045/november2006-pomerantz.

Pomerantz, J., Oh, S., Wildemuth, B. M., Yang, S., Fox, E. A., Hank, C., Tibbo, H., Lee, C. (2009). Comparing curricula for digital library and digital curation education. Paper presented at the Digital Curation Curriculum Conference, April 1-3, 2009, Chapel Hill, NC. Retrieved October 14, 2010, from http://www.slideshare.net/jpom/comparing-curricula-for-digital-library-and-digital-curation-education.

Pryor, G. & Donnelly, M. (2009). Skilling up to do data: Whose role, Whose responsibility, whose career? *International Journal of Digital Curation*, *4*(2). Retrieved October 3, 2010, from http://www.ijdc.net/index.php/ijdc/article/view/126.

Ray, J. (2009). Sharks, digital curation, and the education of information professionals. *Museum Management and Curatorship, 24*(4), 357-68. doi:10.1080/09647770903314720.

Swan, A., & Brown, S. (2008). *Skills, role & career structure of data scientists & curators: Assessment of current practice & future needs.* (Report to JISC). Truro, UK: Key Perspectives Ltd. Retrieved October 3, 2010, from http://www.jisc.ac.uk/publications/reports/2008/dataskillscareersfinalreport.aspx.

Tibbo, H., Hank, C., & Lee, C. A. (2008). Challenges, curricula, and competencies: researcher and practitioner perspectives for informing the development of a digital curation curriculum. In *Archiving 2008: June 24-27, 2008, Bern, Switzerland, Final Program and Proceedings* (pp. 234-238). Springfield, VA: Society for Imaging Science and Technology.