Report on the context of the DigCurV Curriculum Framework

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***Abstract*—This paper presents an overview of current or recently completed initiatives to create, structure, or help foster curricula for the on-going vocational training of information professionals with the aim of informing the implementation of DigCurV's curriculum framework. The initiatives examined include the Digital Curation Centre, DaMSSI (Research Data Management Skills Support Initiative), DigCCurr (Carolina Digital Curation Curriculum Project), Closing the Digital Curation Gap, Digital Curation Exchange, International Digital Curation Education Action (IDEA) Working Group, Digital Preservation Coalition, Digital Preservation Training Programme, the Library of Congress' Digital Preservation Outreach and Education, the Society of American Archivists' Digital Archives Specialist (DAS) Curriculum and Certification and nestor, the German competence network.**

Keywords - DigCurV; Digital Curation curriculum

I. INTRODUCTION

Digital curation is a complex and rapidly evolving field with an on-going requirement for continuous vocational training for those working in the field. The landscape of available training opportunities is equally complex, presenting challenges for both educators and working professionals trying to keep abreast of the increasingly diverse and sophisticated curation knowledge. One of the major products of the DigCurV project is a curriculum framework, which was produced with the intended purpose of providing structure and guidance to the development vocational education curricula for digital curators [1, 2]. Previous reports produced by this project have surveyed existing training opportunities, and defined the curriculum framework itself [3, 4, 5]. These outputs have focused on bridging the gap between the current state of skills in the workforce and those necessary for professional excellence.

This report shifts the focus by addressing the implementation and exploitation of the DigCurV curriculum framework within the current training environment. To do so, it presents an overview of the major attempts to construct a portable and broadly applicable curation curriculum. The discussion of these initiatives does not attempt to be exhaustive or comprehensive, but instead illustrates the current state of digital curation curriculum development into which the DigCurV framework fits. In doing so, it draws attention to the weaknesses, limitations and gaps in these efforts. To maintain consistency with the overall orientation of DigCurV, initiatives that seek primarily to develop curricula to train digital object producers or users in curation rather than information professionals, have been excluded. The inclusion of producers and users in the definition of curation programmes is essential.

II. CURRICULUM INITIATIVES

This survey is not a catalogue of training opportunities. Instead it is an overview of current or recently completed attempts to create, structure, or help foster curricula for the on-going vocational training of information professionals. These projects were selected because they attempt to move beyond an *ad hoc* approach to training. Some are included because they promote the development of useful tools or foster collaboration. Others are discussed because of the prominence they have achieved. Likewise, training programmes that provide instruction only in specific tools or as dissemination for otherwise targeted projects have been excluded. In some cases spin-off projects that directly relate to the objectives of the initial projects have been included. We have not included discussions of older initiatives such as ERPANET [6], DigitalPreservationEurope, or the series of summer schools run by the DELOS Digital Preservation Cluster [7]

A. *Digital Curation Centre*

The UK-based Digital Curation Centre (DCC) is involved in a number of projects related to education and training. These initiatives are generally focused on research data in a wide range of domains. The cornerstones of the DCC's training efforts are two workshop series: *Digital Curation 101*, which consists of workshops providing general introductory

instruction; and *Tools of the Trade*, that provides more detailed exploration of specific tools. Both series are offered at various venues throughout the UK as free half-day workshops targeted at curators and researchers. The DCC also plays a prominent role in many other collaborative training projects. Examples of these can be seen in the Incremental project led by the University of Cambridge[12], and the Sudamih project at the University of Oxford[13]. These focus on educating research data creators about the value of efficient data management, and providing the necessary skills to facilitate their work.

For the structure of their educational activities, the DCC has produced a tool around which they construct curriculum. The "Core Skills for Data Management", is a visualization created as a follow up to the second DCC Research Data Management Forum in 2008 that identifies four roles in the management of research data: data creator, data scientist, data manager, and data librarian[14]. It associates competencies with these roles and identifies areas of overlap. One of the major strengths of this model is that it embraces a holistic approach to curation that traces data from creation to long-term storage and incorporates producers and users. Curation programmes undoubtedly benefit from the education of non-curatorial staff although broadening the audience in this way limits the depth at which material can be explored, detracting from the potential benefit to curators.

Similarities exist between these core skills and the attributes described for each role in DigCurV's curriculum framework. Several of the same concerns and areas of interest have been identified in both projects. These range from technical skills, such as those related to the use of metadata, to soft skills linked to managerial functions. In contrast to the curriculum framework, the roles outlined by the DCC reflect a horizontal delineation that mirrors stages in the lifecycle of data. The four roles all operate on a similar level in regards to the overall functional hierarchy of curation programmes and each role is associated with tasks that range from high-level planning to specific actions. However, the greater degree of abstraction presented by the core skills model hinders the delineation of responsibilities vertically and prohibits the concise statement of attributes that defines the DigCurV output. In this way, the core skills model reflects the DCC's interest in training curators as well as producers, and its narrow focus on a specific genre of digital objects, research data.

B. DaMSSI (Research Data Management Skills Support Initiative)

DaMSSI, a DCC-led project, co-funded by the Joint Information Systems Committee (JISC) and the Research Information Network (RIN), facilitates the use of Vitae's Researcher Development Framework (RDF) and the Society of College, National and University Libraries (SCONUL) Seven Pillars of Information Literacy model, as frameworks for training programmes[15]. It was launched as a support project for the JISC-funded RDMTrain[16]. As part of a skills framework, this project produced a series of career profiles to conceptualize training needs. In keeping with the objectives and research data orientation of the DCC, these documents are designed to demonstrate how data management skills integrate and benefit professionals working in different domains. Career profiles have so far been established for conservators, social science researchers, archaeologists, clinical psychologists, and data managers. The last of these is the only profile that directly targets information professionals; the others integrate curation knowledge into other knowledge domains.

The DaMSSI conception of data managers is restricted to curators of research data and distinguishes them from other types of information professional. While this fits within the scope of curation, and could be mapped to roles in the DigCurV curriculum framework, the profile covers a wide range of responsibilities that cross the divide between practitioner and manager. This inclusiveness limits the usefulness of the profile in curriculum development, although it clearly demonstrates the importance of curation skills in the work of data managers. Despite this limitation, the skills framework is of considerable benefit in the context of curriculum development for training non-information professionals in the selected domains. Aside from demonstrating the relevance of data management training, the career profiles function as a tool for advocacy and link these curation abilities to the broader area of information literacy.

The second phase of this initiative, DaMSSI-ABC (Assessment, Benchmarking, and Classification) [17], began in August 2012 and is scheduled for completion in August 2013. This phase builds on the previous work of DaMSSI; it classifies course offerings, identifies benchmarks, and makes training materials from RDMTrain projects available through the JORUM portal. With the project currently in progress, most of its outputs are not yet available. However, draft versions of a classification scheme as well as checklists for developing and evaluating information literacy training programmes have been made public. The classification scheme holds potential as a tool for aiding in curriculum development. The classification of courses allows for more informed selection by audiences, the planning of targeted training programmes, and provides boundaries for course instructors. At present, the classification scheme is in an underdeveloped state limiting its usefulness. The Checklists

[12] http://www.lib.cam.ac.uk/preservation/incremental/
[13] http://sudamih.oucs.ox.ac.uk/
[14] http://www.dcc.ac.uk/sites/default/files/documents/RDMF/RDMF2/coreSkillsDiagram.gif
[15] http://www.dcc.ac.uk/training/damssi
[16] Research data management training materials (RDMTrain) is a DCC-led initiative to train researchers in the management of their research data.
[17] http://www.dcc.ac.uk/training/damssi-abc

have the potential to provide practitioners and others with effective metrics to assess skills.

C. *DigCCurr (Carolina Digital Curation Curriculum Project)*

DigCCurr consisted of two projects, DigCCurr I (2006-9) and DigCCurr II (2009-12), which aimed at developing a curriculum framework, course modules and experiential components for graduate and doctoral education[18]. Although it expanded its ambit in the second phase, the primary focus of DigCCurr is on formal academic education, in line with traditionally accredited master's and doctoral degrees. The project team for DigCCurr is based at the University of North Carolina-Chapel Hill School of Information and Library Science (SILS), but experts from Canada, the United States, New Zealand, Australia and Europe were represented on the advisory board, ensuring the project had an international perspective.

Of the products generated by DigCCurr I, the two most relevant here are the Matrix of Digital Curation Knowledge and Competencies[19] and the High Level Categories of Digital Curation Functions[20]. The DigCCurr matrix is a tool for identifying content for inclusion in curricula and structuring it for use. It contains six dimensions that provide space for both high-level concepts and the detailed specifics of curation actions. This allows individual skills and tasks to be linked to larger principles and functions. Situating technical and experiential components of education in the framework of an inclusive holistic perspective on curation bridges the gap created by teaching each in completely separate workshops. The matrix also benefits from linking skills to functions and from a less linear understanding of the information lifecycle. The high-level categories of digital curation functions document builds on the functions and skills component of the matrix. It consists of 24 functions and 4 meta-level functions that apply horizontally to the functions. Each function is defined and associated with particular curation activities. These categories are mapped to OAIS, which in turn connects the skills and knowledge in the curriculum to a defined terminology and a model widely used in the preservation community.

The second DigCCurr project shifted the focus slightly to curriculum development for doctoral programs and the continuing education of working professionals. Building on the work of the first project, a series of professional institutes were organized. These training courses target digital curators and are taught by leaders in the field. Unlike most vocational training, they are structured around week-long initial sessions that include theoretical and technical components, followed by a two-day workshop after six months [8]. This format provides more content than typical one-day or half-day workshops, while the follow-up sessions support the review of how the attendees apply the content within their organisation. Despite the efforts to broaden the initial objective to include ongoing vocational training, DigCCurr has not developed a modified framework for this new mode of education. Regardless of any limitations in adapting DigCCurr to vocational training, together these projects have made a significant contribution to curation education and the development of curricula.

The project has spawned a number of other initiatives under the DigCCurr banner; these include professional institutes, fellowships, conferences, symposia, and a number of other smaller collaborative projects. Three of these projects most relevant to curriculum development are profiled below.

D. *Closing the Digital Curation Gap (CDCG)*

Closing the Digital Curation Gap is a collaboration by SILS and the Institute for Museum and Library Services (IMLS), the DCC and JISC in the UK attempting to build consensus around a baseline of knowledge and best practices for core digital curation activities[21]. These activities cover a range of tasks from the management of intellectual property to monitoring storage environments and metadata creation. CDCG ran from October 2009 to March 2013 and, like DigCurV, was focused on continuing professional education within the cultural heritage sector.

The major output of this project is a series of Getting Started Guides[22]. These guides divide curation into six high-level functions modeled on stages in the information lifecycle and take an inclusive approach to the range of high-level and task-oriented activities within these functions. In doing so, they aim for flexibility and comprehensiveness in their use and designed to meet the educational needs of information professionals with only cursory knowledge of digital curation. As such, they include foundational concepts and principles, as well as the application of these in specific activities. The outputs of this project are available through Digital Curation Exchange.

E. *Digital Curation Exchange (DCE)*

Conceived as an online “town center”, the Digital Curation Exchange (DCE) is an IMLS-funded project that grew out of DigCCurr II and CDCG. It functions as an extension of the objectives of these two projects fostering collaboration, networking and the dissemination of resources. As a web portal, DCE consists of an online discussion forum that contains news, events, job postings and teaching resources. The website further facilitates communication by providing both open and closed group spaces for members of active projects to collaborate. DCE does not generate original research. Its role in curriculum development is enabling communication between experts in a centralized area and providing a platform for projects to disseminate their results. A

[18] http://www.ils.unc.edu/digccurr/
[19] http://www.ils.unc.edu/digccurr/digccurr-matrix.html
[20] http://www.ils.unc.edu/digccurr/digccurr-funct-categories.pdf
[21] http://digitalcurationexchange.org/cdcg/
[22] http://digitalcurationexchange.org/cdcg/?q=node/31

central hub like this helps to further the discussions that build the consensus necessary for a baseline of curation skills. In the future, as its user base grows and the website becomes more established, it could function as a repository for course materials. In this capacity, it could help a vocational training curriculum to crystalize.

F. International Digital Curation Education Action (IDEA) Working Group

The IDEA Working Group was created as a forum for experts and educators to discuss issues of education and training. Initiated by the HATII (Humanities Advanced Technology Information Institute at the University of Glasgow), DCC, IMLS, SILS at UNC, and DigitalPreservationEurope (DPE), this group held a series workshops and meetings to investigate opportunities for collaboration and consensus building. The first of these workshops in May 2008 sought to identify training opportunities, investigate collaborative approaches, identify roles and skills within curation, and discuss required curriculum elements [9]. Subsequent meetings built on these foundations with an emphasis on exploring collaboration and building consensus. These events have helped to foster dialogue and exchange about current training practices amongst a wide range of participants. In addition to the founding group involvement in the IDEA Working Group has included representatives from the University of Illinois at Urbana-Champaign Graduate School of Library and Information Science, the UK's National e-Science Centre (NeSC), the UK Data Archive, University of London Computer Centre and nestor amongst others.

G. Digital Preservation Coalition (DPC)

The Digital Preservation Coalition (DPC), a non-profit consortium and member of the DigCurV project, has workforce development as one of its core objectives. Among their efforts in this direction the DPC have initiated a series of Digital Preservation Roadshows that have toured the UK with presentations on issues, tools and organizations involved in digital curation. These have focused on practical solutions and raising awareness amongst information professionals. A second initiative, the DPC Leadership Programme, has provided grants for the staff of member organizations to attend continuing education courses. These efforts are primarily intended to support on-going vocational training and to build the necessary skill set in the workforce of their organizational members.

In July 2013, DPC are hosting the first Digital Preservation Advanced Practitioner Training course, which is organized by the Alliance for Permanent Access to the Records of Science in Europe Network (APARSEN) and involves collaboration with a number of other European curation projects. Unlike other training initiatives, this week-long event aims to build on existing skills and assumes a core of experience-based curation knowledge on the part of attendees. The focus will be on more advanced topics and the exploration of curation processes in greater detail. The organizers anticipate this event will develop iteratively and become an annual offering[23]. An addition to the training landscape, this programme holds the potential to address the specific needs of more skilled curators, while simultaneously acting as a conduit for new developments for digital curation professionals working on the front-line.

Together with the Fondazione Rinascimento Digitale (FRD), and as a part of APARSEN, the DPC published a report evaluating the needs and provisions for vocational curation training in Europe. The study focused on short courses intended for working information professionals with curation responsibilities. In their observations they noted a distinct lack of correlation between the topic of the course and the audience to which it was presented [10]. This indicates a lack of directed development and coherence in the range of course offerings as well as a failure of training providers to coordinate their activities. The study also recommended that curriculum be based on the latest research outputs as a means of remaining current and up to date with community expertise.

H. Digital Preservation Training Programme (DPTP)

The DPC was also instrumental in the initial launch of the award-winning Digital Preservation Training Programme (DPTP)[24], run by the University of London Computer Centre (ULCC). Designed for vocational training, this programme is structured around modular units that are taught in three-day workshops by recognized experts. The audience for these workshops can range from technical staff to traditionally trained archivists. With a broad audience, the programme introduces substantial amounts of foundation knowledge in its curriculum. Timetables from previous DPTP courses indicate a consistent pattern in which general knowledge is introduced and then followed by more in depth examinations of such issues as metadata, tools, and management issues. For workshop attendees with prior knowledge of curation or exposure to the topics being presented, many of these components of the curriculum may be redundant. In these cases, space within these courses could be better used for instruction on additional tools or more in-depth discussion.

The ULCC staff also offer courses that are specifically tailored to the needs of the client organization. These provide an opportunity to place emphasis where it is most needed and to provide instruction at the level that best suits the audience. The tools, methods and models that can be directly applied in daily practice can be situated at the core of the curriculum. Such a scenario will address immediate needs more effectively, but is unlikely to be a sustainable solution. Vocational training implies the on-going development of knowledge, skills and competencies. This is particularly important in a rapidly evolving field like digital curation. While the course packages

[23] http://dpconline.org/events/details/62-APARSEN-Training-APJul13?xref=68
[24] DPTP: http://www.dptp.org/

offered by DPTP have many strengths, the inclusive overview approach they take to curriculum means that the space available for new developments is limited and whatever new content can be included will be relatively small in comparison to material previously presented. This dissuades working professionals from taking courses on a topic more than once and undermines the sustainability of the programme.

I. Digital Preservation Outreach and Education (DPOE)

An initiative launched by the Library of Congress, Digital Preservation Outreach and Education (DPOE) is a program to foster vocational training nationally through networks of qualified trainers and course offerings. Based on a needs assessment and curricula review in 2010, the staff of the Library of Congress developed a curriculum specifically targeted at working professionals[25]. The program is delivered through an evolving series of workshops, conferences, and web seminars taught by experts in regions across the country. These experts comprise a National Trainer Network that provides geographic coverage and extends the reach of the program. The scope of the program is further aided by a "train the trainer" approach that sees professionals from different regions trained as instructors by Library of Congress staff to then conduct seminars and workshops at their institution. This decentralized mode of dissemination is guided by the DPOE's core training principles, which address the audience, content, instructors, and events of this network[26].

The heart of this initiative is the DPOE Baseline Digital Preservation Curriculum, which consists of six areas closely mapped to the core archival functions: identify, select, store, protect, manage, provide. The curriculum displays a heavily archival perspective. It situates the tools, concepts and models of digital curation inside the professional framework of archives. By doing so, it implies a *post hoc* approach to preservation, rather than pre-emptive curatorial involvement that addresses the full lifecycle in its approach to digital objects. In this sense, the program reflects a narrow view of *digital preservation*, rather than a holistic *digital curation* orientation. This subtle shift is in keeping with the Library of Congress' role as a national cultural repository and its archival orientation.

An additional product of the 2010 Training Needs Assessment Survey was the DPOE Pyramid[27]. The survey results indicated that there was benefit in parsing the training audience into three broad professional groups: executive, managerial, and practical. This visualization illustrates these groups along with likely roles and potentially effective training methods. This identification of audience groups and the recognition that each has unique training needs based on their different roles in digital curation programmes formed the basis for the distinct lenses in the DigCurV curriculum framework [1].

J. Digital Archives Specialist (DAS) Curriculum and Certification

The Digital Archives Specialist (DAS) Curriculum and Certification is a program, offered by the Society of American Archivists (SAA), for the continued vocational training of archivists who work with electronic records. The program uses a tiered curriculum that incorporates content hierarchically structured at four levels; foundational, tactical and strategic, tools and services, and transformational[28]. The different levels are mapped to three primary audience groups; practitioners, managers and administrators, that correspond loosely with the categories of practitioners, managers and executives used by DigCurV. Specific courses are targeted at one or more of these groups, with each tier predominately geared to one or two audience groups.

The content is delivered through short workshops and online seminars. Audience members have the option of enrolling in single courses or completing a defined number of courses from each tier, after which they can apply to take a comprehensive examination and be awarded a certificate. The certificate itself is issued by the SAA and is valid for five years. A renewal procedure is being developed that will see certified professionals continue to take non-foundational courses as they are offered to retained their certification. The certificate is intended to reflect seven core competencies. These cut across audience groups, professional roles and repository functions.

Like DPOE, this program has a digital archives orientation, despite the shared content with more definitively curation-oriented programmes. This reflects the SAA's role as a professional organization and the development of the programme to address needs of its members. Unfortunately, the perspective in the programme is narrower than other training alternatives as a result, for example a narrower range of digital objects are addressed. Repositories in the cultural heritage or scientific sectors manage a much wider range of objects than the electronic records that are the focus for DAS.

K. nestor

Nestor (Network of Expertise in long-term STOrage of digital Resources in Germany) is a competence network and co-operative association for digital preservation in German-speaking countries. Amongst their concerns are the development and accessibility of training in digital curation. Current nestor training activities follow five streams: occasional seminars taught by experts, nestor schools modeled on early work by ERPANET, DPE and DELOS Preservation

[25] http://www.digitalpreservation.gov/education/

[26] http://www.digitalpreservation.gov/education/coreprinciples.html

[27] http://www.digitalpreservation.gov/education/educationneeds.html#__utma=37760702.2113400002.1340813252.1340813252.1340813252.1&__utmb=37760702.5.9.1340813321399&__utmc=37760702&__utmx=&__utmz=37760702.1340813252.1.1.utmcsr=digitalpreservation.gov|utmccn=%28referral%29|utmcmd=referral|utmcct=/education/&__utmv=-&__utmk=195900526

[28] http://www2.archivists.org/prof-education/das

Cluster, the continuously evolving nestor handbook, the development of a co-operative curriculum, and the development of e-learning modules[29]. The scope of these activities is broader than most vocational education and incorporates universities involved in undergraduate and graduate level programs in related fields. This reflects the co-operative orientation of nestor and its objective of facilitating the development of a digital curation curriculum by members, rather than controlling its own branded content [11].

The membership of nestor recognized as early as 2006 that there was a need for a systematic approach to training and that it could benefit from differentiating target groups. Like the DPOE pyramid, nestor separated practitioners and managers at different levels. In addition to working professionals, nestor added two groups of students in university programs. The final five target groups are upper management, middle management, staff (working professionals or practitioners), graduate-level students and undergraduate-level students. nestor also acknowledged that the scope and breadth of the field were too great for full coverage to be handled in any depth by any one organization[11]. The co-operative nature of nestor enables the co-ordination of contributions to a large comprehensive curriculum and the dissemination of that content through a range of means. The curriculum developed by members is reflected in the different training activities. This content is also captured in the nestor handbook, which has been published and maintained since March, 2007. Designed to be a cumulative and comprehensive reference, it is developed iteratively to reflect the latest knowledge in the field.

III. DigCurV Curriculum Framework

This brief survey of curriculum initiatives has demonstrated a number of features that limit the effectiveness of current training approaches. Most of the programmes covered by this survey follow a similarly structured curriculum that contains four components: introductory principles; concepts and models; tool and metadata; and management issues such as privacy, intellectual property and risk management. Regardless of the particular instantiation, the material is presented in a similar order, with each section building on and referencing the previous components. Together these topics form a strong curriculum that assumes a generic approach to digital curation and resembles a comprehensive introductory course.

The justification for this approach is understandable. Major surveys of curation training needs conducted by DigCurV [5] and DPOE[30] are consistent in indicating that a high priority is placed on virtually all aspects of digital curation. Unfortunately, while this approach does consider the areas of need and is productive as introductory instruction, it is not an effective model for the on-going vocational training necessary to meet the changing needs of working professionals. By including content in all of these areas, curricula are limited in the depth at which they can examine any particular topic. Curators often have widely varying roles within their institutions and, while very few of them will need more than introductory instruction in all areas, most will need more in-depth training in some specific aspects of curation directly related to their daily activities. Placed in the categories of the DigCurV curriculum framework, current training methods are serving the needs of managers and executives more effectively than practitioners.

Variations on this pattern exist, but tend to result from the particular configuration of delivery such as short, targeted workshops or self-contained units within a longer period. Several of the programmes surveyed also offer more advanced instruction in the form of workshops on individual tools, techniques or methods, but the range of these workshops falls short of the spectrum needed. Likewise, a number of training providers are engaged in offering courses customized to institutional needs. Several benefits are gained from this degree of customization, including a more precise targeting of needs and more appropriate delivery methods. Unfortunately, many of the institutions that require training the most will be unable to exploit this opportunity for financial or other reasons. Those that can are unlikely to see it as a sustainable, or even repeatable, solution to their on-going training needs.

What these observations reveal is that there is a conflict at the heart of curation training between general and specific needs that is manifested on both the individual and organizational levels. At the International Curation Education (ICE) Forum in London, UK in 2011, one of the observations to emerge from the discussion was the existence of an unclear or poorly defined boundary between core curriculum content and specialized or extended content[31]. The unclear scope or range of the content to be included in curricula, pressures instructors to be more inclusive in their course designs, to the detriment of the skills, knowledge and competencies that are unique to each specific role. Unlike formal graduate degrees, vocational training is about providing a continuous update of skills that have relevance within the immediate context of professional employment. Given that context, vocational training programmes have little choice but to address specialized needs directly. The DPOE needs survey provides some evidence to support this. Amongst their survey questions, respondents were asked to rank their training needs. Analysis of the responses indicates that all identified areas from high-level

[29] http://nestor.sub.uni-goettingen.de/education/index.php?lang=en..

[30] http://digitalpreservation.gov/education/documents/DPOE2010Survey_CrossTabs.pdf

[31] Tibbo, Helen R. “Educating the Curator: Digital Curation Education in the United States”. London, UK, 2011.

strategic planning to management and technical skills out rank basic knowledge in importance by a considerable margin.

Within digital curation as a field, a similar question exists on a larger scale. It remains unclear if the features or characteristics that determine practices, task, strategies and programmes are entirely defined by the particulars of a situation or are subject to broader generalizations. At present this tension remains unresolved. The number of variables that need to be given consideration in the development and execution of curation programmes will inevitably vary widely even between similar circumstances. Unfortunately, that underlying tension creates a barrier that needs to be addressed to develop the replicable solutions that the modern digital environment demands.

The vocational training challenge facing the digital curation community is less about disseminating knowledge than it is about balancing competing needs. While there are no definitive solutions to the problem or methods for achieving this balance, the survey of initiatives above has indicated twelve characteristics that programmes should have if they are to achieve a broader set of objectives. The characteristics themselves are interrelated and not mutually exclusive:

- **Sustainability**: the field is in a constant state of development training will need to be a continuous process if professionals are to remain conversant with the latest advances.
- **Consistent Incremental Evolution**; programmes must provide a stream of new knowledge as it emerges as well as instruction in the accepted body of general or foundational knowledge.
- **Systematic:** a structured approach to training is necessary to ensure all relevant topics are included, content is appropriately targeted and redundancy is kept to a minimum. A major step would result from defining a canon of preservation and curation knowledge that professionals require and keeping that canon under review.
- **Tailored:** curricula must fit the needs of the professional community, match the professional roles of participants, and be complimentary to their daily activities.
- **Based on expert consensus:** curricula should be distinguishable from open research questions in order to prevent vocational training becoming little more than a weather vane to academic debates.
- **Operational:** the orientation of the course content should be towards practical results in real world scenarios. The material presented should be readily applicable in curation workflows.
- **Certification:** training programmes should be embedded in a certification structure to provide evidence that professionals have and are maintaining the relevant skill set Means should be in place for the maintenance of the certified status through continued training.
- **Portable:** while the training should be tailored to specific jobs, the skills, knowledge and competencies learned should be applicable beyond the particular instance of employment.
- **Leverage existing knowledge:** the participants in vocational training are assumed to be highly educated information professionals who approach programmes with a well-developed skill set relevant to the curricula. These skills should be harnessed to maximize the effectiveness of the training.
- **Incorporate participant feedback:** a mechanism should be in place to systematically gather and evaluate feedback from the audience at every stage. This can be used to evaluate effectiveness and inform later iterations of the curriculum.
- **Address issues of all relevant digital object forms:** formats or file types that can reasonably be expected to exist within a repository cannot be ignored by training curricula.
- **Utilize appropriate dissemination methods:** vocational training has a much wider range of potential delivery methods than other forms of education. The full spectrum of these methods should be explored in order to provide the audience with learning opportunities that match their needs.

None of the programmes in this survey contain all of these characteristics. Each has its strengths and weaknesses. The contribution of the DigCurV curriculum framework to this context is that it is a tool to structure course content and develop comprehensive plans for on-going training. By separating curators into distinct groups, and identifying the skills, knowledge and competencies associated with each role, the framework helps trainers achieve the characteristics above. With this tool emphasis can be placed where it is most useful and the redundancy of current approaches can be corrected. The details provided by each of the lenses can be used to clarify boundaries for curriculum, while defining core and specialized content. It is unlikely that any single solution will ever exist to the problem of vocational training needs. However, what the DigCurV curriculum does do is equip trainers to tackle these challenges and ensure that curricula are as effective as possible.

IV. Recommendations

The DigCurV curriculum framework holds tremendous potential for the future of digital curation. Part of this potential resides in its on-going use and development. This report offers a series of recommendations in order to develop effective training curricula and maximize the impact of the framework on the current training landscape. The first recommendation is to map the curriculum framework to existing models of digital curation and preservation such as OAIS and the DCC Lifecycle Model[32]. Such mapping will promote adoption by

[32] Students in Professor Seamus Ross' Introduction to Digital Preservation at the University of Toronto in the Winter of 2013 experiments with mapping DigCurV Frameworks to

demonstrating the skills, knowledge and competencies necessary to implement the models. It will also provide curators with the opportunity to position themselves in the models that guide curation programmes, and help to connect their daily activities to the larger functions of their institutions.

One of the most significant contributions the curriculum framework can make to digital curation vocational training is that it can be used as a basis to structure a formal certification program. Following the DAS example, internationally agreed certification will help to build consensus in the field by providing a common goal for trainers at different organizations. It can also help to disseminate emerging knowledge by including it in requirements for certification. This in turn will bridge the gap between research and practice, while demonstrating that certified professionals are acquainted with the latest developments in the field. The process of certification itself may benefit from the establishment of a multi-tiered system that distinguishes on-going vocational training from more formal graduate-level degrees or even between the different categories of professional identified by DigCurV or DAS.

The development of a fourth lens is recommended. This idea was discussed at the roundtable meeting in Florence, Italy, where the lens under consideration was targeted at personal record keeping [12]. This would extend the benefits of the framework beyond institutional curation programmes and the immediate purview of cultural heritage repositories. While there are advantages to this suggestion, a recommendation more in keeping with DigCurV's orientation would be for the creation of a lens for data creators. This new lens could focus on knowledge that would assist creators to produce reliable, well-documented and curatable digital objects. A lens of this kind would bridge the gap between DigCurV's focus and that of the DCC, making the curriculum framework of direct use in DCC's researcher training initiatives, while encouraging curation considerations to cover the full information lifecycle. The definition of research data used by the DCC is broad enough to encompass cultural heritage objects, and although focused on the heritage sector, the curriculum framework is versatile enough to be of use in other domains.

The final recommendation is to conduct case studies of the curriculum framework in use to develop, create and execute vocational training programmes. Studies of this kind would demonstrate the framework's effectiveness, identify areas that require further development, provide feedback into the development process and bring to light further use cases. The experience gained from use of the framework can reasonably be expected to lead to more thorough and grounded advice about its implementation. An optional worth exploring, is to use the framework to structure curricula to be taught through MOOC's (massive open online courses). The fragmentation of roles into specific knowledge, skills and competencies by the lenses creates small easily learned and applied units to which MOOC instruction is naturally adept. A case study of digital curation vocational training through MOOC's would explore the viability of this format, potentially extending the range and audience of curricula.

OAIS and the DCC Curation Lifecycle demonstrated the efficacy of this idea.

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