INSTITUTE of Museum and Library SERVICES

Open Digital Preservation Training and Professional Development Opportunities

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OPEN DIGITAL PRESERVATION TRAINING AND PROFESSIONAL DEVELOPMENT OPPORTUNITIES
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Introduction

Interest in digital preservation training and professional development opportunities is extensive, however, a common understanding of the open materials – ones that are freely available for use online – and how they might be used most effectively is still limited. The digital preservation community, those who shepherd digital collections through the lifecycle for a variety of organizations, would benefit from a common understanding of freely available open training materials. Digital preservation continuing education is valuable to a number of organization types, from small to large, as well as a wide range of practitioners at various points in their careers. Museums, libraries, and archives of all sizes benefit greatly from freely available continuing educational materials on digital preservation topics, as do many other organizations with an interest in preserving digital content for future use. Frequently, learners new to the profession are uncertain as to where to acquire specific digital preservation knowledge, issues, and skills. Similarly, working professionals may need to expand their roles or desire to broaden their knowledge and skillset. Training to meet these needs necessarily occurs outside of formal educational settings, relying on the learner's ability to locate resources that are relevant to their goals.

It is the purpose of this report to begin establishing a common understanding of the types of open digital preservation training materials available, to identify topics around which additional materials should be developed, and recommend ways to increase the effectiveness, use, and reuse of open training materials.

While digital preservation training and professional development is offered in a variety of manners, the focus of this report is on open materials, specifically free, on-demand, self-directed materials that are available online. The development of digital preservation training materials to support the acquisition of skills for those managing and providing access to digital content has been supported by both private and federal grants. These materials have benefited the learners, but have not always been open materials, and even the open materials have not always been made freely available online for additional use by others. As funding agencies look to support new training and professional development opportunities, emphasizing the importance of creating resources that are open and freely available should be a priority. Supporting the creation of resources that are accessible to everyone and have clear licenses that allow for reuse, adaptation, and distribution means funders can see a greater return on their initial investment. Investments in creating freely available resources can have the potential for broader impact than for pay-walled or in-person only access.

Freely available training helps practitioners orient themselves in a constantly changing landscape. Digital preservation work requires that practitioners keep up-to-date with changing formats, storage, software, standards, and more. It is a profession that demands constant learning. Freely available materials help learners familiarize themselves with topics, gain confidence, and develop the skills they need to start working with their digital collections. In addition, freely available materials support a common practice and common vocabulary that strengthen the digital preservation community.

Significant support for crafting in-person workshops and tutorials has been given, however, those materials are out of scope for this report if they do not also exist as a freely available, stand-alone, online offering. Likewise, there are excellent digital preservation texts and articles; however, if they are not freely available online they have not been included.

A sampling of influential, freely available works has been collated and annotated. This sample was initially constructed by the author and then reviewed and refined by various experts in

digital preservation and digital preservation online learning. In this way, this sampling of works is intended to represent materials that have permeated the digital preservation community. These lists in the appendices of the report are models of the kinds of freely available, self-directed, online training and professional development opportunities. The lists are not exhaustive but serve to illustrate the kinds of materials readily available for training use. The items in the lists are grouped and organized in three categories: overview materials, topical resources, and source and technical materials. The categories were developed to provide a logical way to discuss the landscape of resources.

Online learning opportunities are useful for digital preservation training and professional development because they offer needs-based training with a global reach. There are high-quality existing continuing education programs, such as Digital Archives Specialist (DAS), that provide on-demand training. Many of these programs are costly. The expense of buying an online tutorial or webinar can be prohibitive to learners – especially those looking to orient themselves in the digital preservation landscape and learn what they don't know. While these kinds of continuing education courses can offer certification and other indicators of successful completion, open materials can address learners' needs to understand what they need to learn, develop confidence in new knowledge and skills, connect to existing communities of practice, and encourage and foster adoption of new practices in established professional work.

There are also a number of excellent existing in-person training opportunities. Support for the development of freely available online training and professional development materials does not have to preclude supporting the development of in-person training. In-person training workshops are a vital component of professional development for librarians and archivists, but the costs of registration and travel can limit many professionals' ability to participate. Finding ways to support both modes of training is not only possible, but also optimal. For example, once developed, online training resources could be used by trainers as the building blocks for in-person workshops in which more detailed discussion and additional case studies could further enrich the learner. Materials can also flow in the other direction: online training opportunities can be developed out of the content developed for in-person training, bringing the excellent in-person training programs that have been developed and are under development a new life for practitioners beyond the classroom. Offering the prepared training materials to users online to use themselves in asynchronous, self-directed training or in a blended training environment that harnesses the benefits of in-person training with those of online materials increases the return on the investment of developing the resources. Ideally, these materials should be developed into resources for topical instruction that helps the learner orient him or herself in the topic, gain confidence, and connect with ongoing work.

Online training is neutrally regarded by learners, according to the Digital Preservation Training Programme survey.[1] This may reflect the relative lack of structured digital preservation training available. While there are syllabi and recorded web series available, most digital preservation training requires a great deal of individual direction and effort on the part of the learner. The learner currently needs to determine what they don't know, find appropriate materials, evaluate the relevance of those materials, learn the topic, and judge when they have successfully covered enough of the subject to have sufficiently "mastered" the topic. In order to develop confidence in the material, the learner needs to cover even more ground, as there is no direction about what is critical and what is supplemental information. Should open, topical resources be developed and made available online or in a hybrid online/in person setting, the desire for online training could be expected to increase. Increased usefulness and usability of available online learning opportunities around digital preservation skills and strategy would drive increased preference for the medium. Learners have reported that they are looking for resources that help them master

[1] "2015 Digital Preservation Training Needs Survey: What We Learned so Far…." DART Blog. DPTP, 10 Feb. 2016. Web. 12 June 2017. http://dart.blogs.ulcc.ac.uk/2016/02/10/2015-digital-preservation-training-needs-survey-what-we-learned-so-far/+ .

the skills they need for specific professional projects as well as developing confidence in their knowledge and ability regarding digital preservation activities. Training resources that specifically address these needs would be perceived of as more useful to the learner.

Landscape of Open Digital Preservation Educational Materials

For the purposes of this report, it is useful to consider the landscape of open digital preservation training and professional development materials available online as a pyramid (Figure 1) given the relative size of each group. There are extensive source and technical materials, 17 influential examples have been selected for the appendix in this category; a relatively small number of well-established overview materials at the point, 4 have been selected for the appendix in this category; and in the middle a group of a topical resources that can be used for instructional purposes, the appendix for this category includes 9 examples of excellent topical resources. This middle group is the main focus of discussion, as it presents the greatest opportunity for impact in high-priority skill areas. This landscape of resources could benefit from further research into usage and adoption of resources to help determine which are the most useful/used and might best serve as models for the development of new materials.

Overview Materials

There are a small number of established, well-regarded materials that thoroughly cover the basic concepts and act as introductions to digital preservation. Several such resources are listed in Appendix I, including MIT Libraries' Digital Preservation Management workshop and the suite of resources offered by the Digital Preservation Coalition.[2] These are influential, widely cited and referenced by the digital preservation community, and offer the benefit of providing a shared understanding to a wide variety of practitioners, for example web archivists, audio/visual preservationists, and others, of the basic concepts and structure of digital preservation issues. There is little need for new overviews or introductions to the topic as these materials are currently widely and freely available.

Indeed, the stability of the existing materials is a virtue as it creates a common vocabulary and understanding among practitioners who have used these materials as introductions. While it is typical for learners to express interest in "where to begin" or "digital preservation basics," there is not a significant need to create additional instructional materials for overviews and introductions to digital preservation as the existing ones thoroughly address the topic.[3] Developing new introductions is not a high priority. Going forward, projects focused on digital preservation education and training should focus on using, refining, or enhancing these materials, not recreating them. If new introductory materials are desired, creators should work to ensure that new introductory materials provide similar vocabulary and general concepts to the learner as established content.

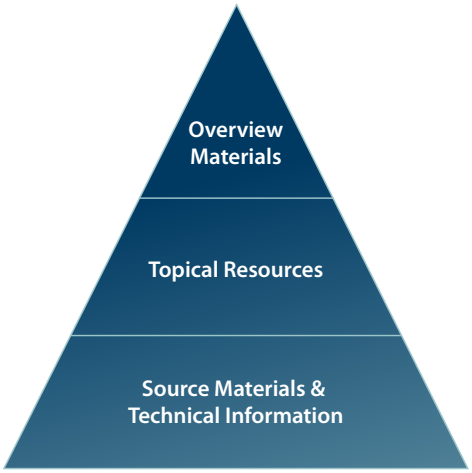

Figure 1. Landscape of freely available, online digital preservation training materials

[2] See Appendix I. Annotated List of Overview Materials.

[3] "2015 Digital Preservation Training Needs Survey: What We Learned so Far…." DART Blog. DPTP, 10 Feb. 2016. Web. 12 June 2017. http://dart.blogs.ulcc.ac.uk/2016/02/10/2015-digital-preservation-training-needs-survey-what-we-learned-so-far/+ . "Knowing where to start" ranked as the most important of possible topics relating to digital preservation.

Topical Resources

In the middle of the pyramid, there are resources focused on specific topics that can be used as instructional materials. For example, the PERICLES Modular Training Package features self-instructive, stand-alone modules including A Brief Introduction to Archiving and Preservation, Contextualizing Semantics, New Perspectives on Appraisal, and others. The Sustainable Heritage Network offers online tutorials, workshops, and web resources focused on preservation and conservation issues including digital stewardship and care of physical objects. [4]

The objective of these thematically organized instructional materials is not to give a practitioner an overview of digital preservation concepts so much as it is to help the practitioner be confident that they developed the necessary skills to do required work in that thematic area. At the very least, having worked through topical resources should leave the learner with a clear understanding of the skills or concepts they need to master and an ability to further their acquisition of those skills or concepts using the vast source and technical materials available online.

There is relatively little currently existing in this category that would be considered a formal online learning opportunity with learning objectives, assessments, learner activities and support, in addition to the online instructional materials. There are benefits to formal learning including:

- Standardized instruction and training at the end of which learners have a common understanding and common skill set
- Clear metrics regarding completion of training allowing for evaluation of the relative success of training opportunities.
- Clearly defined core competencies the saturation of which could be measured within the community.

Utilizing existing materials can speed development of formal online learning opportunities. Not all topical resources for instructional purposes need to be formal online learning opportunities. When qualifications are not necessary, informal learning of a more experiential nature can benefit the user. Informal learning is less time-consuming and less expensive to produce. As one develops training materials, one should evaluate the goals and intentions for the resources and decide accordingly. There are some excellent informal training such as webinars, tutorials, and slides from workshops that exist and address particular digital preservation subjects.[5] There are some truly excellent materials covering key topics in digital preservation including:

- Introductions to fixity and file authentication (what it is and why it is important). For example, AVPreserve Resources has a webinar by Amy Rudersdorf introducing the concepts of fixity. This webinar specifically instructs how to use the AVPreserve tool, but it also includes an excellent overview of the concepts and importance of fixity. Also, the North Carolina Department of Cultural Resources' Digital Preservation Education has a web page going over the basics of what fixity is and why it is important.
- Descriptive metadata standards. For example, DPLA has a webinar as part of its digitization curriculum that discusses how to plan for, create, and proof descriptive metadata for digital files. This is a part of the DPLA digitization curriculum listed in Appendix II.
- Email management practices. For example, the North Carolina Department of Cultural Resources' Digital Preservation Education has a tutorial with a certificate of completion on managing email as a public record available. Also, the CoSA Pertts portal has a pdf of a

[4] See Appendix II. Annotated List of Topical Resources.

[5] See Appendix II. Annotated List of Topical Resources.

slide deck on email preservation that is a useful overview of the major steps of processing email for preservation and making it accessible online. The presentation itself is not available for this resource, so the user is limited to the content on the slides. Contextual information is not available.

- Management of electronic theses and dissertations. For example, the ETD+ Toolkit's modules on copyright, data organization, storage, version control, etc. are available on the Educopia website.
- Media migration practices. For example, UIUC University Library offers a clear write up on Best Practices for Media Selection and Migration.
- Digitization planning and instruction. See the DPLA digitization curriculum in Appendix II.

Materials in this category expand on key themes or concepts in digital preservation work. They give the learner insight into what a specific digital preservation activity or concept is and why it is important. In some cases and around some topics, these topical resources are highly developed and instructive. If anyone were interested in developing structured, online learning courses around digital preservation issues, these materials could serve as the basis for such courses.

While some of the materials in this section are highly instructive, there are nevertheless a number of topics that would benefit from additional and/or more detailed coverage. These areas will be discussed in depth in the Opportunities section.

Technical Information and Source Material

There is a plethora of materials in this category. From UIUC University Library's clear write up on Best Practices for Media Selection and Migration to the California Digital Library's Information Gateway for Information for Technologists to the Federal Digitization Guidelines Initiative (FADGI), and many others, there are extensive source materials and technical information available.[6] The motivated and educated professional can educate themselves using the blog posts, syllabi, background reading, tool and software documentation, and other available materials. While rich in detail and thought provoking, these source materials and technical information do not guide the reader or offer clear mastery of subjects or skills. The necessary information can be gleaned, but without an existing understanding of the offerings available, the learner frequently finds him or herself adrift – uncertain if he or she has covered enough on a given topic to confidently make decisions around a specific issue or to develop enough skills to perform necessary tasks. Furthermore, while technical documentation and training videos exist, learners may not know where to look for them. There is a need to help learners find and engage with the materials being produced. It would be highly valuable for new topical material that is produced to have a secondary objective to support learners in teaching themselves how to navigate these resources.

These technical information and source materials document the work of communities of practice. Groups form around the use and development of open source tools and services as well as around the development of standards, guidelines, and best practices. These groups produce wikis, blog posts, documentation, and other products. The materials these groups produce are the front lines of developing practice in digital preservation. As such, these materials provide a window into new skills and expertise that are becoming important to digital preservation practice. Monitoring developments in this category will help surface topics that warrant investment in, and creation of, more structured, topical resources. The technical information and source materials category can be thought of as a resource to the learner as well as to those developing topical resources. It would be valuable if those developing topical resources could offer the learner a guided dive into the depths of specific digital preservation topics.

[6] See Appendix III. Annotated List of Source Materials and Technical Information.

Articulated Needs

It is important to consider open digital preservation training materials as they align to the needs for training as expressed by practitioners, managers, and executives. There have been a number of influential surveys in which digital preservation and digital curation are identified as important training and continuing education topics along side more general skills such as outreach, advocacy, leadership, collaboration, analytical skills, and communication skills.[7] These surveys are used in this report as evidence of the self-reported needs, preferences, and foci of learners seeking digital preservation continuing education. Additional work, such as user research, could be a useful way to help strengthen the claims that the surveys discuss. For example, in the NDSA Staffing Survey Report:

"A passion and motivation for digital preservation and knowledge of digital preservation standards, best practices and tools were considered the most sought after skills, followed by general communication and analytical skills. Respondents were less concerned with the specific degrees or certificates people held."

Skills in communication, leadership, project management and other such topics are critical to the success of digital preservation practitioners. There are not currently established opportunities for developing these skills as they specifically relate to digital preservation. However, these skills are broadly required ones that span many communities and industries. There are existing training and professional development opportunities in these general areas, they are not areas that require immediate attention to support ongoing digital preservation work. The digital preservation community would do well to leverage these existing resources and spend time and money on the digital preservation specific resources that are needed. .

There is high demand for digital preservation specific skills.[8] The National Digital Stewardship Residents (NDSR), post-graduates performing residencies at organizations with significant digital content, have repeatedly expressed that they feel under-equipped in regard to technical skills as they enter the digital preservation workforce.[9] This survey is particularly valuable because the NDSR residents represent technically savvy recent graduates who nevertheless feel ill equipped to manage digital content. Digital preservation training and professional development are not just of interest to new practitioners entering the workplace. It is useful to note that as of 2013, 75% of organizations that responded to the National Digital Stewardship Alliance's (NDSA) Staffing survey reported that they are retraining existing staff to perform digital preservation stewardship responsibilities.[10] For learners just beginning their careers, or refocusing their professional lives

[7] Clareson, Tom. "Supply Analysis Project Report." (n.d.): n. pag. Coalition to Advance Learning in Archives, Libraries and Museums, 4 Oct. 2016. Web. 12 June 2017. http://www.coalitiontoadvancelearning.org/wp-content/uploads/2016/10/Coalition-Supply-Project-Report_Oct2016.pdf. This report expresses the importance of outreach, project management, communication, etc.
Atkins, Winston, et al. "STAFFING FOR EFFECTIVE DIGITAL PRESERVATION." (2013): Dec. 2013. Web. 12 June 2017. http://ndsa.org/documents/NDSA-Staffing-Survey-Report-Final122013.pdf. This report also emphasizes the importance of traditional skills as they specifically relate to digital preservation activities.
Blumenthal, Karl-Rainer, et al. "What Makes A Digital Steward:A Competency Profile Based On The National Digital Stewardship Residencies." IPRES, 3 Oct. 2016. Web. 12 June 2017. https://osf.io/jxqna/. This is another report that lists skills in communication, leadership, project management, and more as important to digital preservation work.

[8] Blumenthal, Karl-Rainer, et al. "What Makes A Digital Steward:A Competency Profile Based On The National Digital Stewardship Residencies." IPRES, 3 Oct. 2016. Web. 12 June 2017. https://osf.io/jxqna/. This paper includes specific responses from National Digital Stewardship Residents about the technical and general skills they found most critical to digital preservation work.
"2015 Digital Preservation Training Needs Survey: What We Learned so Far…." DART Blog. DPTP, 10 Feb. 2016. Web. 12 June 2017. http://dart.blogs.ulcc.ac.uk/2016/02/10/2015-digital-preservation-training-needs-survey-what-we-learned-so-far/+. This report covers some of the specific skills that respondents of the survey felt ill equipped to perform.

[9] Blumenthal, Karl-Rainer, et al. "What Makes A Digital Steward:A Competency Profile Based On The National Digital Stewardship Residencies." IPRES, 3 Oct. 2016. Web. 12 June 2017. https://osf.io/jxqna/.

[10] Atkins, Winston, et al. "STAFFING FOR EFFECTIVE DIGITAL PRESERVATION." (2013): Dec. 2013. Web. 12 June 2017. http://ndsa.org/documents/NDSA-Staffing-Survey-Report-Final122013.pdf.

in a digital direction, digital preservation training and continuing education opportunities are a critical method of closing the knowledge and skills gaps.

Learners are looking for digital preservation training and professional development opportunities to give them confidence that they have the right information and skills to make and execute decisions.[11] While surveys frequently report that learners are looking for direction on where to begin with digital preservation, this is not, in fact, a desire for introductory courses or concepts of digital preservation. This is rather an expression of looking for more strategy and skills based training in a landscape in which the learner is uncertain where to find materials. Supporting the development of topical resources that fit into the mid-level of the pyramid discussed earlier would help address these needs.

It is useful to take a look at two surveys that are the most specific about digital preservation skills that learners would like to acquire in relation to the preservation activities as they were reported in the NDSA Staffing Survey and in Digital Archivists in Practice: A Preliminary Survey.[12] The table below attempts to line up a subset of the desired skills reported in the surveys with what have been reported as preservation activities in which practitioners engage. The focus here is to find skills that align with those reported in the other sources.

These comparisons help highlight a list of potential areas for development of training materials that could prove central to successful digital preservation practice which are addressed in detail in the opportunities section. While the surveys themselves cover more categories, the categories in the table were chosen because they emphasize the skills that are currently in demand for digital preservation professionals.

Category	Practitioner Desired Skills: DPTP survey	Practitioner Desired Skills: NDSR survey	Job descriptions: NDSA Staffing Survey	Job descriptions: Digital Archivists in Practice
Digital collection management	Complex Objects	Digital Asset Management	Selection for preservation	Collection transfer and development, Collection management
File management and processing	File Format Migration	Coding/scripting	File format identification and validation, Normalization of files, Fixity checks	Processing
Preservation planning and strategy	Strategy and planning		Preservation planning, Preservation policies and strategies	Program development and management, Preservation
Metadata and description		Metadata creation and standards	Metadata creation and extraction	
Storage system management	Purchasing a system	Hardware implementation	Secure storage management, Content replication	
Expertise in specific content types	Web Archiving	Web Archiving, AV preservation		Electronic recordkeeping
Software tools	Tools	Software implementation, Workflow enhancement		Tool exploration and evaluation
Providing access			Creation of access copies	Access, Use
Outreach and education			Preservation education, training, and outreach	

Table 1. Cross-comparison of desired and actively used digital preservation skills

[11] DART blog "2015 Digital Preservation Training Needs Survey: What we learned so far..."

[12] Zhang, Jane, and Dayne Mauney. "Digital Archivists in Practice: A Preliminary Survey." 1 Feb. 2013. Web. 12 June 2017. http://lis.cua.edu/res/docs/DigitalArchivistsSurvey-2013.pdf.

Opportunities

General Needs

Existing, open, online digital preservation training and professional development materials have been independently developed by organizations and groups to fit specific needs. As such, there is no governing structure or organizing principal. While a highly structured environment is not necessary or even desirable, the digital preservation community would benefit from some consistent support around opportunities that could provide wide and lasting benefit. As funders look to support training and professional development for digital preservation, and as experienced practitioners and organizations seek to create resources, it would be beneficial for those resources to be created to have these characteristics, which are addressed in detail below:

- Consensus about core competencies
- Open licenses
- Connect learners to communities of practice
- Focus on structured learning opportunities

When the development of new resources is supported, those resources should attempt to address these general issues.

Consensus About Core Competencies

While difficult to achieve, developing a general consensus around what core competencies are required for effective digital preservation work would be highly beneficial. It would help the community to incorporate training for those competencies into existing degree and certification programs, provide a clear focus for those developing professional development materials, and offer direction to the self-motivated learner. A clear, common understanding of digital preservation strategy, planning, and implementation would benefit the learner. It would help define parameters of topics and skills necessary to master in order to effectively engage in digital preservation work. Core competencies would also help learners develop the confidence that was reported as so critical in the DPTP survey. Clarity around the subjects and skills that can be considered core competencies could provide direction for development of new topical materials that help the learner master key concepts and develop abilities.

Open Licenses

New resources for training and continuing education n digital preservation should be produced with open licenses and made freely available for reuse. It would also be useful to support putting existing instructional materials from workshops or in-person sessions online under open licenses. This could enhance the reputations of the groups providing the instruction and also provide learners with a recognizable entity to look to for direction on how to navigate complex materials. In addition, openly licensed work can be adapted, built upon, and even updated over time by interested parties. This recommendation reflects current trends. Funders are increasingly looking to support open materials. Since the 2013 Executive Order -- Making Open and Machine Readable the New Default for Government Information, federal funders in particular have been interested in funding resources that will be open and freely available. [13]

[13] "Executive Order -- Making Open and Machine Readable the New Default for Government Information." National Archives and Records Administration, 9 May 2013. Web. 19 July 2017. https://obamawhitehouse.archives.gov/the-press-office/2013/05/09/executive-order-making-open-and-machine-readable-new-default-government-.

Providing instructions, guidelines, and incentives for releasing instructional materials under open license would help encourage the creators of instructional materials to do so. The federal government already has the Federal Open Licensing Playbook, a resource developed by the State Department that notes shared practices and considerations that are common to federal open licensing efforts.[14] This resource is an excellent starting point for non-federal organizations looking to release open materials or develop their own guidelines.

Connect Learners to Communities of Practice

Distributed online communities of practice create extensive and rich material including documentation of software and tools, standards development, tool-specific training resources, mentorship opportunities, and much more. This wealth of source material and technical information is foundational to the development of topical resources. But there is also an opportunity to better connect learners to this sphere of work and equip them for participation in this ongoing work. Communities of practice exist in many areas of digital preservation, for example: web archiving, digital forensics, AV preservation, and many others. Connecting learners to these vibrant groups and helping them orient themselves in the process of continually learning and developing new preservation techniques would benefit the learner as well as the communities.

Focus on Structured Learning Opportunities

The middle layer of the pyramid, topical resources, should be the focus for development of new online instructional materials. It would be beneficial for newly developed instructional materials to be created in a way that could be used for both self-paced online learning and for the development of in-person workshops. Creating online learning opportunities with clear sequencing, pacing, materials, objectives, and quizzes or exams, as well as models/kits for individuals to use in workshop and/or online training would help learners systematically acquire new skills and understanding. Creators could organize, group, and produce structured online learning opportunities from the extensive source materials and technical information. Turning existing technical and source materials into thematically organized and structured online learning opportunities would benefit learners. Materials featuring case studies, shared workflows, and other real-world examples of how work gets accomplished would be beneficial. The more these materials include activities for the learner, the more likely the learner would be to develop the confidence that he or she is looking for. Those creating new resources would do well to consider the existing literature and scholarship about adult online learning. Leveraging this existing information about what types of content and scenarios are best fit for self-paced online learning could greatly improve the usefulness of freely available, open-source, online digital preservation continuing education materials.

Specific Content Areas

There are opportunities for developing additional open digital preservation training and professional development resources, particularly in the middle category of topical resources that support learners in developing the skills and confidence they need to execute digital preservation tasks. Projects focused on digital preservation education and training should use, refine, or enhance existing materials rather than recreate materials. This will help create a common understanding of mastery of specific concepts and skills as well as minimize investment in areas

[14] "Federal Open Licensing Playbook." Https://eca.state.gov/files/bureau/open_licensing_playbook_final.pdf. N.p., 19 July 2017. Web.

that have been adequately covered. Digital preservation training materials should ideally have two objectives:

1. Help the learner master the concepts and skills they need to perform the digital preservation tasks relevant to their job and
2. Teach the learner how to navigate the wealth of source materials to continue to refine and support their knowledge and abilities.

Digital preservation requires ongoing effort to learn and stay current with new practices, formats, concerns, and standards. Resources that teach specific skills in such a way as to guide practitioners to become lifelong learners will be most successful and will maintain relevance the longest. Detailed study should be given to what skills can be best imparted online to help individuals become adept at navigating the landscape of information and ensure they become lifelong learners.

The focus on development of instructional and professional development materials should be on the mid-level of the pyramid. Creating topical resources for instructional use in these content areas would improve the offerings currently available for online use. These content areas reflect some of the desired skills that were reported via the surveys, some of the work that is currently being performed, and what seems to be missing from the current landscape of freely available, online digital preservation training and professional development materials that were developed in a thematic way. These include:

- Strategy and planning for preservation
- Storage system management: purchasing, establishing, and running storage systems
- AV content preservation
- Web archiving
- Digital forensics
- Implementing scheduled fixity checks
- Providing Access: emulation and virtualization
- Developing and communicating preservation priorities

Strategy and Planning for Preservation

The Digital Archiving & Preservation Training Needs Survey highlighted a trend toward student interest in strategic planning issues especially: organizational change and advocacy, collaboration, and strategic thinking.[15] While professional training resources exist in these general areas, the field of digital preservation has unique possibilities and challenges that require additional professional context. Materials supporting the development of strategy development and digital preservation planning work are under-represented in the topical resources layer of the pyramid. Creators of these materials would be directly answering an expressed need.

Storage System Management: Purchasing, Establishing, and Running Storage Systems

Related to planning and strategy, digital preservation practitioners have expressed a need for guidance in purchasing, establishing, and running digital storage systems. Materials in this area

[15] "2015 Digital Preservation Training Needs Survey: What We Learned so Far…." DART Blog. DPTP, 10 Feb. 2016. Web. 12 June 2017. http://dart.blogs.ulcc.ac.uk/2016/02/10/2015-digital-preservation-training-needs-survey-what-we-learned-so-far/+.

should not be storage system instructions for particular environments. Rather, resources that support learners in this topic should help the individual walk through long-term cost implications, budgeting, connecting with IT about system requirements, evaluating and comparing storage systems, how to make decisions to keep a system relevant, how to address system update and refresh needs, and so forth.

AV Content Preservation

Preservation of digital AV content is starting to move from being a specialized focus to a core competency. AV content continues to grow and it is becoming increasingly important in more areas of study (including the sciences) as well as a primary mode of documenting daily life. The 2015 National Agenda for Digital Stewardship identified moving image and recorded sound data as one of the five critical content-specific challenges in digital preservation and claimed "there is a significant need to further define and communicate what preservation formats are in this area and what, exactly, workflows should look like for working with and maintaining the authenticity of increasingly complex forms of digital audio and video files.[16] Digital preservation practitioners would benefit from the development of topical resources that introduced them to key issues as well as connected them to the strong, existing communities of practice, such as the Association of Moving Image Archivists (AMIA) and the Coordinating Council of Audiovisual Archives Associations (CCAAA).

Web Archiving

Topical resources are needed that could help digital preservation practitioners gain insight into the real world problems of crawling and archiving the web. The Harvard Library Web Archiving Environmental Scan identified few freely available online training and professional development opportunities around web archiving. The report also identified training and skills development as a prevalent theme, along with that of communication and collaboration, in which resources are desired. Specifically, training "researchers with skills they need to analyze big data found in web archives" was a significant recommendation.[17] Additional topics for content supporting web archiving could emphasize the importance of monitoring and improving the crawling process and how to scope and adjust crawling activities for collecting the most effective archive. This is a topic that is galvanizing effort. Internet Archive and several partners entitled Community Webs will address the lack of training resources on web archiving for local history collection development by public libraries and expand into community-focused web archiving.[18] The Community Webs project demonstrates an interest in and support for web archiving resources that could be capitalized upon to create additional topical resources. The work currently underway emphasizes the community interest and need for resources around this topic.

Digital Forensics

There are a number of excellent video-casts and web tutorials on how to use specific digital forensics tools, such as those by BitCurator. There are also a number of other digital forensics resources that focus on computer security. There is still a need for a more general overview of digital forensics as it relates to digital preservation, focusing on concepts and best practices rather

[16] Altman, Micah, et al. "2015 NATIONAL AGENDA FOR DIGITAL STEWARDSHIP." NDSA, Sept. 2014. Web. 19 July 2017. http://ndsa.org/documents/2015NationalAgenda.pdf+

[17] Truman, Gail. "Web Archiving Environmental Scan." Harvard Library Report. 2016. Web. 12 June 2017. https://dash.harvard.edu/bitstream/handle/1/25658314/HL_web_archiving_env_scan_2006.pdf.

[18] "Community Webs: Empowering Public Librarians to Create Community History Web Archives." IMLS. Internet Archive. Web. 12 June 2017. https://www.imls.gov/sites/default/files/grants/re-85-17-0060-17/proposals/re-85-17-0060-17-full-proposal-documents.pdf.

than specific tools. Samples of decision trees and cost-benefit analyses that help organizations determine when to use digital forensics tools would be valuable. Resources could provide examples of the circumstances in which an organization might decide to employ digital forensics, questions and decisions that have to be made, and pointers to the already existing instructions on how to use digital forensics tools.

Implementing Scheduled Fixity Checks

It would be useful to have some thematic instruction developed that focused on checking fixity at regular intervals. According to the 2013 NDSA storage survey, memory institutions doing fixity checks were likely to do so upon ingestion and transfer but most were not engaged in checking fixity of their digital content at regular intervals. It would be useful for learners to have access to topical resources that offered instruction on how to make the necessary decisions for organizations to engage in scheduled fixity checking. Ideally, these resources would walk the learner through how to take into account relevant considerations such as how storage media type may be affected by fixity checks, whether it is best for your organization to do collection-wide fixity checking or use a statistical sample of the data, how to handle decisions around checking fixity for redundant copies, whether to build in fixity checking into a storage system for block-level checks or solely perform file-level checks, how to assess the fixity information provided by third party storage providers, and other related issues.

Providing Access: Emulation and Virtualization

Access is a constant digital preservation lifecycle issue. While format and media migration to ensure accessibility is well documented, emulation and virtualization are less widely employed digital preservation strategies. As barriers to using emulation and virtualization are beginning to fall away and effective emulation for user access becomes more relevant, there is a need for digital preservation practitioners to have topical resources providing insight into emulation decisions, system needs, metadata requirements, and other related issues. Organizations and funders have recognized that this is an area that would greatly benefit from additional attention and resources, for example, the Software Preservation Network have recently been awarded an IMLS grant which will produce open curricular resources and a training webinar. Additional efforts around this issue would be valuable as well.

Developing and Communicating Preservation Priorities

Preservation of digital collections is an organizationally complicated task. In many memory institutions, those charged with the responsibility to accession, ingest, create metadata, manage, and provide access to digital content are not the same people who are charged with developing storage architectures, designing systems, providing security, and other traditional IT tasks. It would be highly valuable for digital preservation practitioners to have some online, open, topical resources available that would walk through how to develop and communicate preservation priorities that make preservation preferences and needs clear to IT professionals. Case studies or suggested language would enrich these resources and provide insight into what kinds of communication get a practitioner the answers he or she needs and what kinds of questions lead to information dead ends. In addition, it would be useful to have a parallel resource that highlighted effective ways to communicate preservation needs and priorities to stakeholders.

Some of these underrepresented topics are challenging because they are implementation and workflow focused, requiring hands-on experimentation and experience. Implementation and

workflow are also areas in which it is difficult for online training materials to stay relevant, be universally applicable in face of specific organizational and technical systems, and saturate the learner community enough that learners have a common skill level and vocabulary. Even though these are challenging areas, the benefits to addressing these topics are potentially significant. Support for new resource development should focus on the topical resources. There are struggles for those developing materials that include: getting training content in this category found by learners; having a common, community-wide understanding of the topics covered in this category; and keeping the training content timely and ensuring it is relevant in a variety of organizations. Clearly planning for how to address these challenges will increase the likelihood of open training materials having an impact.

Funders interested in supporting the development of digital preservation training and professional development opportunities would see the greatest return on their investment by supporting projects that:

- Use, refine, or enhance existing materials rather than recreate materials
- Produce thematic, structured instructional material in key gap areas
- Support learners in developing skills and confidence
- Support a common understanding of concepts and skills
- Teach the learner how to navigate source materials to continue to refine and support their knowledge and abilities
- Connect learners with communities of practice
- Create freely available, online materials under open licenses to further encourage use, reuse, enhancement, and adaptation.

By supporting projects that enact these recommendations, funders can effectively address the knowledge and skills gaps digital preservation practitioners face, realize a significant return on their investments, and support on-going engagement with existing and emerging communities of practice.

Appendix I. Annotated List of Overview and Conceptual Materials

These are examples of materials that provide an overview of the concepts of digital preservation.

Digital Preservation Management Workshop
http://www.dpworkshop.org/
The Digital Preservation Management workshop is hosted by MIT Libraries and focuses on "implementing short-term solutions for long-term problems." The online tutorials is available in three languages and was given the 2004 SAA Preservation Publication Award. The online tutorial was developed from the course topics of the in-person Digital Preservation Management Workshops that the group offers for a fee. These materials offer practical and introductory guidance on how to manage digital content.

Digital Preservation Coalition
http://dpconline.org
The Digital Preservation Coalition (DPC) is a UK-based membership organization seeking to universities and others "make our digital memory accessible tomorrow." Their knowledge base and training materials include the Digital Preservation Handbook, a list of digital preservation training opportunities hosted by member organizations, as well as a number of case studies that show how various organizations have tackled a variety of digital preservation issues and topics.

Digital Preservation Video Series
https://www.youtube.com/user/wepreserve - p/u
WePreserve released a series of original videos introducing key issues in digital preservation starting in 2010. The majority of the videos are animations intended to provide memorable presentations of key topics and issues related to preservation and curation of our heritage for future generations.

NEDCC Digital Preservation
https://www.nedcc.org/free-resources/digital-preservation
NEDCC has a handbook, a preservation policy template, and a stewardship questionnaire available as well as a preservation-readiness self-assessment tool and other resources. The materials include tools developed by NEDCC as well as links to organizations that support the research and development of digital preservation tools, standards, and best practices.

Appendix II. Topical Resources

These are examples of free, on-demand, self-directed professional development training materials that have been developed around digital preservation topics.

AVPreserve Resources
https://www.avpreserve.com/avpsresources/papers-and-presentations/
An annotated list of AVPreserve's papers, presentations, and webinars. This list features instructional information on AVPreserve's tools as well as information on general digital preservation topics such as fixity, digital preservation standards, embedded metadata, preservation evaluations of cloud storage service providers and more.

CoSA PERTTS Portal
https://www.statearchivists.org/pertts/
The Council of State Archivists (CoSA) has been working on an NHPRC-supported effort called the State Electronic Records Initiative (SERI) to improve electronic records management and digital preservation in all 56 state and territorial archives since 2011. A part of this work is the group's Program for Electronic Records Training, Tools, and Standards (PERTTS) Portal, which provides education and training materials for preservation of electronic records.

Of particular note are the Self-directed Training Modules—a series of short, how-to manuals and videos. And the CoSA-Preservica Practical Digital Preservation program—a series of webinars providing state archives staff with practical information on how to preserve digital information. A second theme has been launched within the series to help broaden awareness of the importance of electronic records and the need for digital preservation. These webinars are aimed at senior managers, budget officials, CIOs, and others. Registration for these live webinars is required, and recordings are available on the website a few weeks after the live presentation. CoSA also provided training to state archives staff through the development of introductory and advanced electronic records institutes and SERI monthly topical webinars. Curriculum development was funded by IMLS in a Laura Bush 21st Century Librarian grant. Links to recordings and slides from this training is also available on the PERTTS Portal.

Data Archives and Digital Preservation User Guide
http://cessda.net/CESSDA-Training/Data-Archives-and-Digital-Preservation
In addition to offering resources, workshops, and consultancy, the Consortium of European Social Science Data Archives (CESSDA) provides a digital preservation user guide as a series of downloadable PDFs. With topics such as "What is digital preservation," "OAIS," "Access and reuse," and others.

Digital Curation Centre How-to Guides & Checklists
http://www.dcc.ac.uk/resources/how-guides
The How-to Guides provide working-level knowledge of curation topics. They provide background concepts and practical steps aiming to help implement data management capabilities in their organizations. Each checklist aims to address the full scope of challenging curation topics. Also available are PowerPoint presentations from the Digital Curation Centre Workshops on a variety of topics presented at the DCC workshops including: data management, open research, planning for sustainability and other topics.

Digital Preservation Education
http://digitalpreservation.ncdcr.gov/index.html
The North Carolina Department of Cultural Resources's (NCDCR) Digital Preservation Education

site features a number of tutorials, videos, and recorded webinars aimed at librarians, archivists, collection managers, and state agency employees. These include subjects such as:

- Managing and Preserving Digital Images
- Introduction to Cloud Computing
- Storage Media
- Authenticity and your digital files
- Preservation planning and an introduction to PREMIS
- Managing electronic public records: Recognizing perils and avoiding pitfalls
- Managing your inbox: E-mail as a public record
- Saving your Facebook data
- Someday they'll thank you: An introduction to digital preservation

DPLA digitization curriculum
https://dp.la/info/2015/10/07/new-self-guided-curriculum-for-digitization/

The Digital Public Library of America's New Self-Guided Curriculum for Digitization is a self-guided version of the digitization workshops developed by DPLA in conjunction with many digitization experts. The material was developed for cultural heritage organizations. Each of the 6 modules includes a video presentation, slides with notes in Powerpoint, and slides in PDF. These materials are an excellent introduction for cultural heritage organizations looking to embark on digitization projects.

- Planning for Digitization
- Selecting Content for a Digitization Project
- Understanding Copyright
- Using Metadata to Describe Digital Content
- Digital Reformatting and File Management
- Promoting Use of Your Digital Content

ETD+ Toolkit
https://educopia.org/publications/etdplustoolkit

A free, open set of six modules that prepare students and researchers to create, store, and maintain their research outputs on durable devices and in durable formats. More focused on personal action, however, it may be useful for organizations looking to disseminate instructions to content creators.

PERICLES Modular Training Package
http://pericles-project.eu/training-module/

PERICLES has packaged insights in self-instructive, stand-alone modules including A Brief Introduction to Archiving and Preservation, Contextualizing Semantics, New Perspectives on Appraisal and others.

Sustainable Heritage Network
http://www.sustainableheritagenetwork.org/

Offers online tutorials, workshops, and web resources focused on preservation and conservation issues including digital stewardship and care of physical objects. "The SHN is a collaborative project that complements the work of indigenous peoples globally to preserve, share, and manage cultural heritage and knowledge."

Appendix III. Technical Information and Source Material

These materials are examples of information that could be useful in creating digital preservation instructional materials. They are not professional development materials themselves, but are good examples of the kinds of existing work that could be built upon when creating tutorials or other training guides.

BitCurator Consortium Videos
https://bitcuratorconsortium.org/videos
Videos depicting how to use configure and use BitCurator. These videos include publicly released materials and recordings of training sessions offered to BitCurator Consortium members that are only accessible to members.

CDL Information Gateway for Information for Technologists
http://www.cdlib.org/gateways/technology/
A series of software and services provided by CDL with descriptions. Some offer toolkits and other learning opportunities. In addition there is a best practices and standards section that describes work developed by CDL that has been adopted by the preservation community.

CRADLE Research Data Management & Sharing MOOC
http://cradle.web.unc.edu
Project CRADLE (Curating Research Assets and Data using Lifecycle Education), launched a Coursera MOOC (Massive Open Online Course), entitled Research Data Management and Sharing in 2016. The syllabus for the course is available online.

A Curriculum Framework for Digital Curation by DigCurV
http://www.digcurv.gla.ac.uk/index.html
A framework rooted in working experience of digital curators that takes a look at digital curation from an executive lens with a strategic view, a managerial lens, and a practitioner lens. The framework is built upon the assumption that digital curation is a multi-skilled profession in which both subject-specific skills and generic professional skills need to be cultivated.

Community Owned digital Preservation Tool Registry (COPTR)
http://coptr.digipres.org/Main_Page
COPTR describes tools useful for long-term digital preservation. It acts as a finding and evaluation tool help practitioners find the tools they need to preserve digital data. COPTR collates the knowledge of the digital preservation community by brining together the tools registries of organizations. There are currently 422 different tools described in COPTR.

"Costs: Why Do We Care?" by David Rosenthal
http://blog.dshr.org/2014/11/talk-costs-why-do-we-care.html
A blog post detailing David Rosenthal's keynote talk at Investing in Opportunity: Policy Practice and Planning for a Sustainable Digital Future, a DPC event.
This talk details storage cost trends, library and archive digital content accession trends in relation to digital content production rates, and estimated rates of loss for content. A valuable think piece with well-research links to related documents.

DigCCurr
https://ils.unc.edu/digccurr/products.html
Instructional materials, curriculum frameworks, syllabi, conference papers and presentations, and supporting documentation was developed as part of two different efforts 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.

Digital POWRR
http://digitalpowrr.niu.edu/survived-powrr-wkshp/
Digital POWRR offers in-person workshops intended to help practitioners and organizations move beyond theory to implementation of digital preservation practices. They provide free access to some sample digital preservation policies and partner institution case studies.

Digitization Cost Calculator
http://dashboard.diglib.org/
The Digitization Cost Calculator collects and make freely available a large set of data on the time it takes to perform various tasks involved in the digitization process, in order to assist organizations in digitization project planning and benchmarking.

FADGI
http://www.digitizationguidelines.gov
The Federal Agencies Digitization Guidelines Initiative articulates "common sustainable practices and guidelines for digitized and born digital historical, archival, and cultural content." The group has a detailed and substantive guidelines produced by two working groups, the Audio-Visual Working Group and the Still Image Working Group. Guidelines include:

- Guidelines for Embedding Metadata in DPX Files
- Digitizing Motion Picture Film
- Technical Guidelines for the Still Image Digitization of Cultural Heritage Materials
- Audio Analog-to-Digital Converter Performance
- MXF Application Specification
- File Format Comparisons
- Content Categories & Digitization Objectives
- Digital Imaging Framework
- Digitization Activities – Project Planning
- Minimal Descriptive Embedded Metadata in Digital Still Images
- Embedding Metadata in Broadcast WAVE Files, Version 2
- TIFF Image Metadata

JISC PoWR project
http://opus.bath.ac.uk/12110/
Preservation of Web Resources: The JISC PoWR Project "is developing a handbook on best practices and advice aimed at UK higher and further educational institutions for the preservation of Web sites and Web resources." Topics include: challenges institutions face in preserving the Web, workshops organized by the project to identify best practices, and outlines of needed work.

Library Carpentry: Software skills for library professionals
http://librarycarpentry.github.io
A series of short instructional videos aimed at introducing library professionals to the fundamentals of computing and providing a platform for further self-directed learning. Topics include shell scripts, managing data, SQL, Git and GitHub, and OpenRefine.

NDSA Fixity Guidance Report
http://ndsa.org/documents/NDSA-Fixity-Guidance-Report-final100214.pdf
This report seeks to provide guidance on how to ensure a file/digital object has not changed over time or during transfer processes. It helps the reader think through how, when, and how often to check fixity. It also offers some insights into audi and repair strategies.

NDSA Levels of Digital Preservation
http://ndsa.org/activities/levels-of-digital-preservation/
The National Digital Stewardship Alliance (NDSA) Levels of Digital Preservation is a "tiered set of recommendations for how organizations should begin to build or enhance their digital preservation activities." The tiers move from Level 1 to Level 4, from the basic need to ensure bit preservation towards broader requirements for keeping track of digital content and being able to ensure that it can be made available over longer periods of time. The NDSA levels have been adapted by a number of organizations for their own use.

Sustainability of Digital Formats Planning for Library of Congress Collections
http://www.digitalpreservation.gov/formats/index.shtml
The Digital Formats Web site provides information about digital content formats. It is "devoted to the analysis of the technical aspects of digital formats. This analysis will inevitably have implications for policy matters, most significantly collection policies."

UVA Sustaining Digital Scholarship
http://dcs.library.virginia.edu/sustaining-digital-scholarship/
General guidelines to bringing in digital materials into a library-managed environment. Details levels that can be worked toward along a shifting spectrum of preservation work.

UIUC University Library
http://cms.library.illinois.edu/export/dcc/bestpractices/chapter_18_mediaselectionmigration.html
UIUC University Library offers a clear write up on Best Practices for Media Selection and Migration.