Personal Digital Archiving as a Bridge to Research Data Management: Theoretical and Practical Approaches to Teaching Research Data Management Skills for Undergraduates

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Introduction

Data literacy is quickly gaining importance for undergraduate students who are preparing to enter the workforce. This chapter brings together three key concepts to address undergraduate data literacy: research data, research data management, and personal digital archiving (PDA).

- *Research data* is the material that is collected, observed, or created, for purposes of analysis to produce original research results.
- *Research data management* is the practice of organizing, preserving, and providing access to research data.
- *PDA* the practice of organizing, maintaining, using, and sharing personal digital information in daily life.

Working directly with research data can be an ideal way for students to develop their data literacy. However, most undergraduates do not collect or manage research data regularly. In this chapter, we draw upon the principles of constructivist learning theory to suggest that PDA can be used as an instructional bridge to teach research data management to undergraduates. PDA closely parallels research data management, with the added benefit of being directly relevant to undergraduate students, most of whom manage complex personal digital content on a daily basis. By teaching PDA, librarians encourage authentic learning experiences that immediately resonate with students' day-to-day activities. Teaching PDA builds a foundation of knowledge that not only helps students manage their personal digital materials, but can be translated into research data management skills that will enhance students' academic and professional careers.

Theoretical Background

The rise of data

Data-driven research is growing both in academia and in the private sector. In 2009, Director John Marburger of the White House Office of Science and Technology Policy asserted that "our Nation's continuing leadership in science relies increasingly on effective and reliable access to digital scientific data."[1] Since then, the perceived power of digital data has only continued to grow—so much so that data scientists have been touted as having "the sexiest job of the 21st

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[1] National Science and Technology Council, Interagency Working Group on Digital Data, "Harnessing the Power of Digital Data for Science and Society" (January 2009), accessed August 27, 2016, https://www.nitrd.gov/About/Harnessing_Power_Web.pdf.

century."[2] Beyond this glamorous reputation, data science and data management skills are increasingly valued by employers looking to take advantage of the insights that big data can provide.[3] In fact, in 2016, Data Scientist topped several "best jobs" lists—as measured by factors like number of job openings, salary, and outlook.[4]

Research data management in academic libraries

Research data management has also grown in importance in academia as federal agencies,[5] private funders,[6] and academic journals[7] increasingly require data management plans and research data archiving. Across professions, there is a growing perception that data is a valuable commodity that can help us understand the world in new ways, which places increasing relevance on research data management skills. Anyone planning to enter data-driven professions—including students at the undergraduate level—will benefit from opportunities to develop research data management skills. Shorish[8] calls research data management a "critical competency" for undergraduate students en route to the workforce, and she maps out a plan for promoting that competency within universities. She suggests that discipline-specific faculty can provide students with training in data comprehension and data analysis, while librarians—with their expertise in teaching information literacy—are well-positioned to provide expertise in research data management and preservation. Indeed, working with data has been viewed as an important element of information literacy for some time. A 1998 progress report from the American Library Association Presidential Committee on Information Literacy emphasized the importance of data literacy in a global marketplace,[9] and the ACRL Information Literacy

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[2] Davenport, Thomas H., and D. J. Patil, "Data Scientist: The Sexiest Job of the 21st Century," *Harvard Business Review,* October 2012, accessed August 27, 2016, https://hbr.org/2012/10/data-scientist-the-sexiest-job-of-the-21st-century.

[3] Harris, Daniel, "So You Want to be a Data Scientist (Again)?," *NatureJobs Blog*, edited by Jack Leeming (May 23, 2016), accessed August 27, 2016, http://blogs.nature.com/naturejobs/2016/05/23/so-you-want-to-be-a-data-scientist-again.

[4] Glassdoor, "50 Best Jobs in America" (2016), accessed August 26, 2016, https://www.glassdoor.com/List/Best-Jobs-in-America-2016-LST_KQ0,25.htm; Careercast, "The Best Jobs of 2016," (2016), accessed August 26, 2016, http://www.careercast.com/jobs-rated/best-jobs-2016.

[5] National Institutes of Health, "NIH Data Sharing Policy and Implementation Guidance" (2003), accessed January 25, 2016, http://grants.nih.gov/grants/policy/data_sharing/data_sharing_guidance.htm; National Science Foundation, "Dissemination and Sharing of Research Results" (2011), accessed January 25, 2017, http://www.nsf.gov/bfa/dias/policy/dmp.jsp.

[6] Gordon and Betty Moore Foundataion, "Data Sharing Philosophy" (2008), accessed January 25, 2017, https://www.moore.org/docs/default-source/Grantee-Resources/data-sharing-philosophy.pdf; Bill & Melinda Gates Foundataion, "Bill & Melissa Gates Foundation Open Access Policy" (2015), accessed January 25, 2017, http://www.gatesfoundation.org/How-We-Work/General-Information/Open-Access-Policy; Wellcome Trust, "Policy on Data Management and Sharing" (n.d.), accessed January 25, 2017, https://wellcome.ac.uk/funding/managing-grant/policy-data-management-and-sharing.

[7] Dryad Digital Repository, "Joint Data Archiving Policy" (2011), accessed January 25, 2017, http://datadryad.org/pages/jdap; PLOS, "Data Availability" (2014), accessed January 25, 2017, http://journals.plos.org/plosone/s/data-availability.

[8] Shorish, Yasmeen, "Data Information Literacy and Undergraduates: A Critical Competency," *College & Undergraduate Libraries* 22, no. 1 (2015): 97-106. http://doi.org/10.1080/10691316.2015.1001246.

[9] Breivik, Patricia Senn, Vicki Hancock, and J. A. Senn, "A Progress Report on Information Literacy: An Update on the American Library Association Presidential Committee on Information Literacy: Final

guidelines (including the 2016 Framework for Information Literacy for Higher Education[10] and its predecessor, the 2000 Information Literacy Competency Standards for Higher Education[11]) include data literacy as a component of information literacy. Building from this foundation, academic libraries have identified a need for library services relating to research data management and preservation.[12]

Academic libraries are beginning to incorporate research data management into their instructional programs, teaching best practices like data management planning; metadata and documentation; organization; storage, backup, and preservation practices; and data publication and sharing.[13] Research data management instruction programs often focus on faculty and graduate students, who commonly work with research data and can therefore find immediate utility in improving their data management strategies.[14] When working with undergraduates, many of whom do not encounter research data on a regular basis, librarians are challenged to find ways to communicate the relevance of research data management.

Report" (March 1998), accessed August 27, 2016, http://www.ala.org/acrl/publications/whitepapers/progressreport.

[10] Association of College and Research Libraries, "Framework for Information Literacy for Higher Education" (2016), accessed August 27, 2016, http://www.ala.org/acrl/standards/ilframework.

[11] Association of College and Research Libraries, "Information Literacy Competency Standards for Higher Education" (2000), accessed August 27, 2016, http://www.ala.org/acrl/standards/informationliteracycompetency.

[12] Ogburn, Joyce L, "The Imperative for Data Curation," *portal: Libraries and the Academy* 10, no. 2 (2010): 241-246. http://doi.org/10.1353/pla.0.0100; Lyon, Liz, "The Informatics Transform: Re-Engineering Libraries for the Data Decade," *International Journal of Digital Curation* 7, no. 1 (2012): 126-138. http://doi.org/10.2218/ijdc.v7i1.220; Cox, Andrew M., and Stephen Pinfield, "Research Data Management and Libraries: Current Activities and Future Priorities," *Journal of Librarianship and Information Science* 46, no. 4 (2014): 299-316. http://doi.org/10.1177/0961000613492542.

[13] EDINA and Data Library, University of Edinburgh, "Research Data MANTRA," *EDINA* (2011), accessed August 27, 2016, http://datalib.edina.ac.uk/mantra; Henkel, Heather, Viv Hutchison, Carly Strasser, Stacy Rebich Hespanha, Kristin Vanderbilt, Lynda Wayne, Stephanie Hampton, Amber Budden, Yiwei Wang, David Bloom, Amy Hodge, Gail Steinhart, Stephanie Wright, and Matt Mayernik. DataONE Education Modules" (Albuquerque: DataONE, 2012), accessed August 27, 2016, https://www.dataone.org/education-modules; Kafel, Donna, Andrew T. Creamer, and Elaine R. Martin, "Building the New England Collaborative Data Management Curriculum," *Journal of eScience Librarianship* 3, no. 1 (2014): e1066. http://dx.doi.org/10.7191/jeslib.2014.1066; Erway, Ricky, Laurence Horton, Amy Nurnberger, Reid Otsuji, and Amy Rushing, *Building Blocks: Laying the Foundation for a Research Data Management Program* (Dublin, Ohio: OCLC Research, 2015), accessed August 27, 2016, http://www.oclc.org/content/dam/research/publications/2016/oclcresearch-data-management-building-blocks-2016.pdf.

[14] Carlson, Jake, Lisa Johnston, Brian Westra, and Mason Nichols, "Developing an Approach for Data Management Education: A Report from the Data Information Literacy Project," *International Journal of Digital Curation* 8, no. 1 (2013): 204-217. http://doi.org/10.2218/ijdc.v8i1.254; Muilenburg, Jennifer, Mahria Lebow, and Joanne Rich, "Lessons Learned From a Research Data Management Pilot Course at an Academic Library," *Journal of eScience Librarianship* 3, no. 1 (2014): e1058. http://dx.doi.org/10.7191/jeslib.2014.1058; Whitmire, Amanda L, "Implementing a Graduate-Level Research Data Management Course: Approach, Outcomes, and Lessons Learned," *Journal of Librarianship and Scholarly Communication* 3, no. 2 (2015): eP1246. http://doi.org/10.7710/2162-3309.1246.

Applying constructivist learning theory to research data management instruction
To make research data management relevant to undergraduates, librarians can look to constructivist learning theory for strategies that create meaningful learning experiences. Constructivist learning theory encompasses several principles, but in this chapter the authors focus on its principles of active, student-focused discovery. As articulated by Good and Brophy,[15] two core tenets of constructivist learning theory specify that

- *New learning builds on prior knowledge.* By tapping into students' past experiences, educators can create a learning sequence that extends from prior knowledge to the current lesson to a lifelong pattern of curiosity and learning.
- *Meaningful learning develops through "authentic" tasks.* According to Cooperstein and Kocevar-Weidinger, activities conducted in class should "simulate those that will be encountered in real life or in an assignment."[16] This strategy ensures that the skills students learn in the classroom have direct relevance to their lives outside of the classroom.

Applying these tenets to research data management instruction for undergraduates provides some guidance for librarians. Given that *new learning builds on prior knowledge,* librarians should aim to understand undergraduates' prior knowledge regarding data, tap into students' past learning experiences, and then build upon that knowledge in the classroom. Given that *meaningful learning develops through "authentic" tasks*, librarians should teach concrete, relatable skills that can be practiced during instruction and afterwards. Librarians need to position research data management skills in the context of students' current lives, rather than promising a theoretical applicability to an abstract future career. One promising way to contextualize research data management skills to students' lives is through the lens of personal digital archiving.

Personal Digital Archiving as a Bridge to Research Data Management
Personal digital archiving (PDA) is a subject of study that investigates how people organize, maintain, use and share personal digital information in their daily lives, with a particular focus on preservation and access.[17] PDA has key similarities to research data management. Both PDA and research data management address the information literacy needs of users in their role as information producers[18]; both address how users manage and preserve their digital materials,[19] and both focus on digital stewardship, storage, long-term access, and value of digital materials by providing practical strategies for management, description, and preservation for future use.[20]

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[15] Good, Thomas L., and Jere E. Brophy, *Looking in Classrooms* (Boston: Pearson, 2008).

[16] Cooperstein, Susan E., and Elizabeth Kocevar-Weidinger, "Beyond Active Learning: A Constructivist Approach to Learning," *Reference Services Review* 32, no. 2 (2004): 141-148. http://doi.org/10.1108/00907320410537658.

[17] Marshall, Catherine, "How People Manage Information over a Lifetime," in *Personal Information Management*, edited by William P. Jones and Jaime Teevan (Seattle: University of Washington Press, 2007), 57-75.

[18] Carlson, Jacob, Michael Fosmire, C. C. Miller, and Megan Sapp Nelson, "Determining data information literacy needs: A study of students and research faculty," *portal: Libraries and the Academy* 11, no. 2 (2011): 629-657. http://doi.org/10.1353/pla.2011.0022.

[19] Fear, Kathleen, "'You made it, you take care of it': Data Management as Personal Information Management," *International Journal of Digital Curation* 6, no. 2 (2011): 53-77. http://doi.org/10.2218/ijdc.v6i2.190.

[20] Cushing, Amber L, "Highlighting the Archives Perspective in the Personal Digital Archiving Discussion," *Library Hi Tech* 28, no. 2 (2010): 301-312. http://doi.org/10.1108/07378831011047695;

Where PDA differs from research data management is in its broad applicability—PDA strategies focus on all personal digital materials, not just research data. The universal relevance of PDA suggests that librarians can teach PDA strategies as a bridge to research data management.

Following the principles of constructivist learning theory can inspire creative connection points between research data management and PDA. PDA taps into undergraduates' prior knowledge and is immediately relevant to students' daily lives. Students have likely worked with personal digital materials for most of their lives. By learning to manage their digital documents, photographs, music files, and other digital materials, students can build on their prior knowledge of handling these materials. PDA also has immediate relevance to undergraduate students, and facilitates learning through authentic tasks. By applying PDA techniques to their digital possessions, students see the clear, concrete benefit that research data management practices have on the organization of their digital lives.

Learning to manage digital assets like personal digital information and research data is an important skill for a thriving digital life and, as discussed, is becoming a core competency in many emerging professions. Now that the theoretical background has been established, this chapter will transition to a discussion of practical instructional methods based on the authors' experience teaching undergraduates at Montana State University. This section aims to guide instructors in creating lesson plans and learning materials that connect the immediate benefits of PDA practices with the potential future benefits of research data management. By building a bridge from PDA to research data management, instructors can enhance learning and foster digital stewardship skills that can be broadly applied to students' futures—both personal and professional.

Practical Instruction Strategies

Aiming to introduce undergraduate students to research data management at Montana State University, the authors put constructivist concepts into practice by developing lessons that activated prior knowledge and engaged students in authentic learning tasks. At the beginning of instruction we *set the stage* for learning by activating students' prior knowledge related to working with personal digital files, such as photos, word processing documents, music files, and other media files. In particular, we asked students to provide examples of problems they had encountered when managing their personal digital files. Acknowledging these problems not only activated students' prior knowledge, but it also established the need and relevance of the lesson. Once students' prior knowledge was activated, we presented the *basics of PDA* as a set of useful strategies to avoiding common file management problems, particularly the problems students had identified. After the basics of PDA were presented, we engaged students in authentic tasks that gave the opportunity to *apply learning with activities*. For these activities students apply PDA principles to their own digital files. Finally, through discussion, students *debrief to connect PDA to research data management*. Students predicted the relevance and applicability of PDA principles to their potential future work with both their own personal data and research data in their future studies and professions. During this discussion section, instructors and students

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Briney, Kristin, *Data Management for Researchers: Organize, Maintain and Share Your Data for Research Success* (Exeter: Pelagic Publishing Ltd, 2015).

highlighted parallels between the principles and strategies of PDA and those of research data management.

This section on practical instruction strategies details the highlights from these lessons. These lessons have been used with both face-to-face and online classes and, as such, the components of these lessons can be adapted to either context with only slight adjustments.The lesson highlights in this section can be combined in different configurations depending on the context, audience and their needs. The instruction and outreach strategies in this section are designed primarily for undergraduate audiences, but can be adapted to graduate and professional audiences with minimal adjustment.

The lessons presented here are organized into four key sections:

- **Set the Stage**
- **Basics of PDA**
- **Apply Learning with Activities**
- **Debrief to Connect PDA to Research Data Management**

Each section is recommended to be completed in the order as presented because the sections build on each other and culminate in a complete lesson. That said, instructors can develop novel ways to deliver the sections in this suggested sequence. For example, for blended classes, the instructor may wish to do the first two sections online and use the face-to-face class time to complete the activity and debrief. Regardless of how the instructor redesigns and customizes these sections, we hope that the highlights from these sections will provide instructors with a solid, road-tested starting point for developing useful, engaging lesson that develops PDA and research data management skills for learners.

Set the Stage
Students describe the use, importance, and challenges of data within their discipline or other personally relevant contexts.

We have found it useful to set the stage for instruction by providing readings and videos for learners to review prior to the session. Based on our experience we recommend selecting readings and viewings that have a relevant connection to the course discipline and are intended for a fairly general, popular audience. For example, when we worked with a Health and Human Development course, we selected article from a popular magazine that discussed complexities of health data from patient, family member and caregiver perspectives.

At the beginning of the session engage the class in a discussion about the readings and viewings. Having this discussion allows the instructor to demonstrate how the readings will relate to the day's lesson, build a rapport with the students, refresh the students' memory of the preparatory material, and clear up any confusion or misconceptions. Hearing students' reactions and thoughts can also reveal new insights into what they find interesting and their life experiences. Later in the session the instructor can use these insights as the basis of examples to illustrate a point.

Connecting to the next section on the basics of PDA, the instructor can ask for student examples of how they name and organize their coursework-related files. For in-person courses, these examples could be shared orally; for online courses, they can be shared in writing on discussion boards or via other online tools. For more in-depth exploration of student examples, the instructor can devise a short activity where students diagram, share, then discuss their current file organization and naming structure of a set of their own files. With either approach, students should be given enough time to have detailed reflection on their current practices. It is important that several different student examples are shared with the class so that variations and differences can be brought to light. This activity should lead students to consider the benefits and drawbacks of various approaches to organizing common files, like coursework files.

The Basics of PDA
Students discover basic PDA strategies and principles that are also used to manage research data.

The PDA basics that we have found to be most relevant to undergraduates are naming conventions, folder structure, metadata/description, and backup, which are also fundamental for research data management. The students will explicitly explore the connections and similarities between PDA and research data management during the debrief section at the end of the lesson, so this section can focus solely on the basic PDA practices. For each of these concepts, instructors can use an interactive presentation technique that first lays out the general concept and rationale, then asks for student-provided examples, and finally provides additional examples. Depending on time, instructor style, and the capabilities of the instructional space the instructor may wish to use presentation slides for this section. Example slides can be found on Project Cora[21] When students provide examples instructors can ask them to share verbally, write examples on whiteboards, or write on live collaborative slides. Online instruction will likely need to provide more details in slides or accompanying audio, but will still benefit from engaging students in providing their own examples of each PDA concept. Online discussion boards are one readily available option in major course management systems for collecting and distributing student examples. Beyond the course management system, there is a constantly evolving set of online tools that enable groups to collaborate and share ideas in a way that is complementary to the aim of this section. To facilitate student-generated examples online, beyond the content management system, we recommend searching for current tools for brainstorming, discussions, polling or mind-mapping.

Apply Learning with Activities
Students apply PDA strategies and principles to organize and document their own files and data.

In this section of instruction students will get hands-on experience applying the PDA strategies discussed to their own data and files. Even if students do not have their own computers or access to their own files, the instructor will ask them to work with a set of files that they know they store on their computer or in the cloud. To focus the students, the instructor should suggest they work with a set of their files rather than all files on their computer. For students who have

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[21] Mannheimer, Sara and Ryer Banta, "Everyday Data Management," *Project Cora*, (2016). http://www.projectcora.org/assignment/everyday-data-management.

difficulty selecting a viable set of their own files, they should consider the files for their school work. These students can be reminded of the variety of files they may have from their school work, such as various versions of papers they wrote, instructor-supplied readings, their own presentations and associated media, and presentations provided by the instructor. Students may need some additional structure to focus on the various PDA strategies and principles. To provide this structure, we recommend initially asking students to devise a folder structure at least three levels deep with folders that conform to naming conventions. Following this, students can then be asked to focus on developing naming conventions that account for similar types of files, various versions of files and preservation of dates.

The following are some questions to ask students at the completion of this activity:
- What naming conventions did you use and why?
- What were some challenges of the activity?
- What questions were raised by the activity?
- Which of the strategies you learned today do you think will be most useful to you and why?

Instructors should provide ample time to address these end-of-activity questions. Larger groups typically require more time to address questions than smaller groups. These questions about the activity typically segue naturally into the final section of instruction in which the group debriefs to connect PDA to research data management.

Debrief to Connect PDA to Research Data Management
Students reflect upon the value of the PDA principles and practices for their own personal data and discover the connection and similarities between PDA and research data management.

To get the most out of putting constructivist theory into practice, after providing students with activities based on authentic tasks, students need space to reflect on their learning. One widely used method for student reflection is post-activity debriefing.[22] Post-activity debriefing can take many forms, but the basic aspects to consider are immediate or delayed, and individual or group (see Table 1). Depending on the depth of reflection desired, instructors may wish to use more than one combination of aspects. For example, directly after the activity an instructor could use an immediate, group debrief strategy, like a group discussion reacting to a simple prompt, then later in the week students could write a multi-paragraph reflection that responds to more in-depth prompts. Any combination of these aspects (immediate/delayed, individual/group) can leverage online technologies, like online survey tools or discussion boards, or can use time-tested offline approaches, like writing by hand or having a group discussion.

Table 1. Types of Debrief

	Immediate	**Delayed**
Individual	**Example:** Students complete online survey in class.	**Example:** Short reflection paper **Good For:** Checking individual

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[22] Baker, Ann C., Patricia J. Jensen, and David A. Kolb, *Conversational learning: An experiential approach to knowledge creation* (Westport: Greenwood Publishing Group, 2002).

	Good For: Checking individual understanding. Quickly clearing up misconceptions. Students can learn from their peers if responses are reviewed. **Drawbacks:** Superficial reactions that may miss deeper connections. Although some peer learning can happen if responses are reviewed, students have less opportunity to build on the reflections of their peers than when working in groups.	understanding and providing individual feedback and support. Deep, complex reflection that connects disparate concepts. **Drawbacks:** Students cannot take advantage of collective wisdom or build on the ideas of their peers. Due to the time delay, student may not carefully consider instructor feedback.	
Group	**Example:** Small group discussion in class. **Good For:** Checking collective level of understanding. Quickly clear up misconceptions. Students learn from each other and build on the reflections of each other. **Drawbacks:** Superficial reactions that may miss deeper connections. Difficult to check individual's understanding.	**Example:** Online discussion board **Good For:** Deep, complex reflection that connects disparate ideas. Students can learn from their peers and build on each other's ideas. **Drawbacks:** Difficult to determine that students have engaged with the comments of their peers, unless the prompt specifically requires reaction to a peer comment.	

To create this reflective space instructors can designate some class time to debrief as a group, or provide an online discussion prompt to activate reflection. For this particular lesson instructors need to develop a two-step prompt. The first prompt enables students to connect PDA strategies to their own personal data management and the second prompt connects PDA strategies to workplace, professional and research settings.

At the beginning of the debrief section instructors can ask students to reflect, then describe which PDA strategies they predict will be most useful for their personal use. There are a few options for how to facilitate this kind of activity (see Table 2). The most simple and direct way to do this is to give students a minute to think about which strategies they will use in the future, then ask for volunteers to share their thoughts verbally. In this case, instructors should allow time for several students to voice their predictions and thoughts. Some students may wish to build on the comments of others, or they may offer contrasting opinions. Instructors should avoid voicing judgments on student comments about which strategies they think they will or won't use in the future. Instructors should be aware that student comments from a simple reflect-then-share activity will only surface the PDA strategies that resonate most immediately, and may not reveal deeper motivations for why some resonate and others do not. Instructors who wish to dig deeper into the motivations behind these comments will need to use a more in-depth reflection strategy, such as a two minute writing activity with prompts that aim to uncover motivations and rationale.

Students can then be asked to estimate which of these strategies would be applicable to data used in professional workplace and research settings. If the session is conducted with disciplinary

faculty, the library instructor should encourage the disciplinary faculty to share their experience and perspective.

Table 2. Debrief Options

Quick Reflect and Share Method
 	
    Benefits: easy to implement, quick, immediate feedback, can be extended with additional questions
    Drawbacks: more gut reactions, does not reveal deeper motivations
    Example Prompt: Take a minute to think about which of the strategies we talked about today that you will most likely use in the future. After you've thought about it, I'll be looking for some volunteers to share.
    Tips: Let students respond to each other. Avoid voicing judgments. Use additional prompts if you need more diverse responses. Aim for a representative sample of student thoughts.

Two Minute Writing Activity
 	
    Benefits: This is a quick way to get students thinking deeper about the topic so that they are better prepared to discuss.
    Drawbacks: Students can become too focused on quality writing and less focused on exploring the ideas if they don't fully understand the intent of the activity.
    Example Prompt: We're going to do a quick two minute writing activity. This is about gut reactions and your writing doesn't have to be elegant. The writing is just for you, as a way to process your thoughts, and afterwards we can have a productive discussion. I would like you to write about which of the strategies we talked about today that you will most likely use in the future.
    Tips: Before giving the prompt, let students know that they will write for two minutes so that they can explore the idea and then they will be expected to share their thoughts with the class. This does not have to mean that they will read what the wrote.

Outreach Strategies

The practical instruction strategies previously described will go a long way in helping librarians develop lessons that use PDA as a bridge to research data management. However, as librarians most commonly rely on working with students outside their own classes, outreach strategies are necessary to identify collaborators willing to invite outside instructors to their classes. Outreach strategies take different forms on different campuses, and depend greatly on existing relationships, but there are some strategies the authors have used that will be broadly applicable to a variety of higher education settings.

Initially librarians should look to match PDA lessons to the curriculum. Librarians can start by identifying programs and specific courses that require students to work with data and may even have outcomes that explicitly address data literacy in some form. Once courses and programs are identified librarians can set up meetings with instructors and program coordinators, paying special attention to the timing of this lesson within the rest of the course. When reaching out to

instructors about data instruction needs librarians should also leverage existing relationships between instructors and the library. Even if courses with explicit data competencies are not readily apparent, librarians can look for courses in which students work with many digital files, like media production courses, or courses that produce digital projects and portfolios.

Another outreach strategy that we found to be successful was sharing learning materials like slides and lesson plans before meeting with interested instructors. Sharing learning materials can go a long way toward demonstrating the librarian's goals for a session. Concrete examples are powerful tools in convincing instructors of the value of these lessons and will give both parties a tangible starting point for conversations about learning outcomes and how to achieve them.

Key Takeaways and Conclusion

Whether undergraduate students work in the public or the private sector after graduation, they will likely be asked to manage and analyze data at some point in their careers. Teaching PDA as a general introduction to research data management allows students to understand research data management strategies through activities that are tangible and relatable. This chapter suggests that librarians can use the following four steps to build an instructional strategy that works as a bridge from PDA to research data management.

- **Set the Stage.** Students describe the use, importance, and challenges of data within their discipline or other personally relevant contexts. This step helps prepare students to apply the lesson to their own lives.
- **Basics of PDA.** Students discover basic PDA strategies and principles that are also used to manage research data. This step provides a foundation of knowledge that informs in-class activities.
- **Apply Learning with Activities.** Students apply PDA strategies and principles to organize and document their own files and data. This step provides students with hands-on experience with PDA strategies.
- **Debrief to Connect PDA to Research Data Management.** Students reflect upon the value of the PDA principles and practices for their own personal data and discover the connection and similarities between PDA and research data management. This step allows students to process the lesson and consider future applications of the skills they learned.

Students have a tangible need for research data management skills—in their personal lives, academic pursuits, and future careers. Using constructivist learning principles, educators can respond to that need by presenting PDA as a bridge to research data management. PDA lessons build on students' prior knowledge of their digital belongings, and PDA allows students to learn through authentic tasks that have immediate relevance to their daily lives. The basic instructional strategies in this chapter can be applied, remixed, and customized to fit many different learning contexts.

Ultimately, the strategies outlined in this chapter establish a bridge from PDA to research data management. By encouraging undergraduates to think more critically about managing their digital materials—be they personal files or research data—librarians can provide important foundational skills that benefit students during their undergraduate education and in their future careers.

Acknowledgments

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