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Planning Data Management Education Initiatives: Process, Feedback, and Future Directions

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Abstract

Educating researchers in sound data management skills is a hot topic in today's data intensive research world. Librarians across the country and the world are taking the lead in offering this training to their campus research communities. In Fall, 2013, the Data Curation Librarian at the University of Tennessee, Knoxville, held a one-day "Data Management Basics" Workshop geared towards graduate students in engineering and science disciplines based on the New England Collaborative Data Management Curric-

ulum. Students were asked to complete a pre-workshop survey and a series of seven post-module surveys throughout the day. This article discusses the results of the survey feedback, the planning process, and elaborates on important variables in planning data management training initiatives, such as disciplinary adjustments and time constraints. The article concludes with a discussion of the author's future plans for providing training initiatives based on the feedback he received.

Introduction

Librarians have long recognized a need for formal scientific data management instruction, and they have taken the lead in developing training on the best practices needed to make research data generated in one project useful in another. Preserving and sharing research data supports research scrutiny and reproducibility, but for that to happen, researchers must steward data carefully. While it is the researcher's responsibility to effectively and responsibly manage data for its long term reuse (Corti et al. 2014), surveys of researchers have found that they often employ inconsistent data management practices (Ward et al, 2010). In response to this need, the Data Curation Librarian at the University of Tennessee, Knoxville, offered a

data management workshop for graduate students in fall 2013. This article describes the planning process and an analysis of student feedback received from the workshop that piloted the New England Collaborative Data Management Curriculum (NECDMC) and the plans for future initiatives that will build on it.

Background

Data management skills, practices, and education of student and faculty researchers have been common themes in this and other library publications over the last several years (Adamick, Reznik-Zellen, and Sheridan 2012; Akers and Doty 2013; Piorun et al. 2012; Tenopir et al. 2011). As the raw materials of research, one researcher's data

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can be recycled to become the raw materials of someone else's research. Those data, however, must be managed (or stewarded) in such a way that keeps reuse in mind, so that they will be in a much better condition for preservation, access, and reuse. While preparing data for future reuse is critical, it is often not the first thing on researchers' minds. Busy researchers are typically more focused on getting the research project finished, the data analyzed, and the articles published than making sure the data are described and preserved for later reuse (Eaker et al. 2014).

During the fall semester of 2013, the University of Tennessee, Knoxville (UTK), Libraries offered a Data Management Basics Workshop for graduate students from science and engineering disciplines to begin introducing students to the practices necessary to prepare data for reuse. The workshop, led by the author, was an early pilot of the New England Collaborative Data Management Curriculum (NECDMC), developed by the Lamar Soutter Library at the University of Massachusetts Medical School in collaboration with several other institutions. The NECDMC is based on the *Frameworks for a Data Management Curriculum*, which was also developed by the Lamar Soutter Library, among other institutions. The NECDMC comprises seven modules.¹ Its modular format allows the curriculum to work within a wide range of delivery methods, such as a short 60- to 90-minute session using just Module 1, as a day-long workshop using all seven modules, or as a semester-long course. The author piloted the NECDMC curriculum as a one-day course in an interactive workshop format using a mixture of lectures, collaborative activities, and individual work. This article discusses planning the workshop and feedback received. In addition, it discusses future plans to offer addi-

tional workshops and considerations for others planning data management workshops at their institutions.

Planning & Execution

Planning for the Data Management Basics Workshop began early in August, 2013. The author evaluated three data management curricula, including MANTRA, developed by the University of Edinburgh; the DataONE Data Management Education Modules; and the *Frameworks for a Data Management Curriculum*. Each was evaluated in terms of content, delivery method, and format. The author concluded that based on the desired format and audience, the *Frameworks* would work best for his needs, as it offered a modular format that was highly customizable to the needs of any discipline. The author discussed his plan for using NECDMC with the NECDMC Project Coordinators who offered him an updated version of the curriculum to pilot at his workshop.²

Students for the UTK workshop were recruited by recommendation and invitation. The author contacted professors with whom he had a relationship through introductions with other subject librarians in the Libraries. The professors recommended graduate students that they preferred to attend the workshop. The author then reached out to the students and extended an invitation to them, noting that they had been recommended by their professor. This recommendation/invitation method worked well; all 16 students who were recommended and invited registered for the workshop. Twelve of those 16 students attended the workshop. Disciplines represented are shown in Table 1.

To evaluate the effectiveness of the workshop, the author applied for Institutional Review Board approval to administer a series

¹ Module 1: Overview of Research Data Management; Module 2: Types, Formats, and Stages of Data; Module 3: Contextual Details Needed to Make Data Meaningful to Others; Module 4: Data Storage, Backup, and Security; Module 5: Legal and Ethical Considerations for Research Data; Module 6: Data Sharing & Re-Use Policies; Module 7: Plan for Archiving and Preservation of Data

² At this point, NECDMC had not yet been published. It was published and publicized in early November 2013.

Table 1: Disciplines represented.

Discipline	No. of Students
Civil & environmental engineering	4
Geography	2
Materials science & engineering	2
Chemical & biomolecular engineering	1
Earth & planetary sciences	1
Comparative & experimental medicine	1
Information science	1

of surveys before and during the workshop. With exception of the pre-workshop survey, the NECDMC Project Coordinators provided the surveys and the author used them verbatim. The pre-workshop survey asked the students what they hoped to learn from this workshop. Students responded that they hoped to learn how to organize data, how to backup and secure data, and how to manage large amounts of data, which are topics the NECDMC covers.

During the planning, it became clear that minor adjustments to the curriculum were necessary for the heterogeneous audience that this workshop would serve. First, the NECDMC makes use of case studies that illustrate data management concepts and practices in the context of actual research in specific settings. Students can read the curriculum's case studies to better understand the relevance of good data management practices and data management issues that researchers encounter in the course of their work. For this workshop, however, the author did not use the case studies as those available at that time were based mostly on medical science -- a discipline that was not heavily represented in this class. Additionally, the time allotted for the workshop would not be sufficient for case-study activities in addition to lectures and hands-on activities. Lastly, the author added institution-specific information, resources, and contacts where appropriate throughout the day.

The workshop began at 8:30 am with Module 1: Introduction to Research Data Management. Each module was covered in approximately one hour and followed by a survey that evaluated how well the preceding module covered certain topics. Modules 1 through 3 were covered before lunch; Modules 4 – 7, after lunch. The class ended at approximately 4 pm.

The author requested that the students bring a dataset with which to work on in class exercises. Throughout the day, students used their own data sets during hands-on activities to demonstrate the topics covered, such as creating a Dublin Core metadata record for their data set and creating a data backup and security plan.

The author also used videos throughout the day to illustrate key concepts. To demonstrate the importance of data management practices, the author played a video called "Data Sharing and Management Snafu in 3 Short Acts" (Hanson, Surkis, and Yacobucci 2012). To demonstrate the importance of having a regular backup plan, the author used a video called "How Toy Story 2 Almost Got Deleted" (2012). Students remarked that these videos effectively emphasized the importance of data file organization, description with adequate metadata, and the importance of regular backups. In reference to the Hanson et al. video, one student said, "The video was an excellent way to

Table 2: Module 1 survey results³

	Q1	Q2	Q3	Q4	Q5	Q6	Q7 ⁴	Q8 ⁵
5	6	8	7	3	7	8	6	6
4	4	4	2	6	3	4	6	4
3	2	0	2	1	0	0	0	2
2	0	0	1	2	2	0	0	0
1	0	0	0	0	0	0	0	0

n = 12

demonstrate the importance of properly managing data.”

Survey Results by Module

A pre-workshop survey was administered concurrently with registration to gauge students’ overall confidence in their ability to manage data. This survey posed the question, “How confident are you in your ability to manage data well during a research project?” The scale for responses to this question was 1 to 5 with 1 being “Not confident” and 5 being “Very confident.” Responses ranged from 2 to 4, with a mean of 3.2 (n = 12).

Feedback on each workshop module was accomplished through a series of seven surveys – one administered after each module – which asked specific questions about material covered in the preceding session. The following sections present the individual questions’ results from each module, though not all responses are discussed. All scales are 5-point scales with 1 being “Not at all well” and 5 being “Very well,” unless otherwise indicated.

Module 1: Overview of Research Data Management

In Module 1, students were introduced to what research data is, and 10 of 12 students believed this module accomplished this very well (6) or well (4). Module 1 was also most successful in explaining the need for managing and sharing research data relative to relevant public policies⁶ and identifying the value and importance of data management to the success of a research project. All of the students felt the module explained those areas very well (8) or well (4).

The survey also included free response questions which asked students which content they liked best and least in the module. Four of the 12 students felt the discussion of file naming best practices to be the most helpful, illustrated by the comment, “This is currently a major issue for me.” Three students felt that discussions of best practices were most useful, while two students felt that the introduction to the data life cycle was most useful. One student stated that he or she never thought of research as a life cycle, but as a linear process, and that this discussion helped him or her conceptualize research differently. When asked about their

³ Survey questions are included in the appendix.

⁴ Scale: 1 = Did not meet my needs/expectations; 5 = Entirely met needs

⁵ Scale: 1 = Materials not at all useful/relevant; 5 = Materials very useful

⁶ e.g. National Science Foundation’s data management plan and National Institutes of Health’s data sharing plan

Table 3: Module 2 survey results⁷

	Q1	Q2	Q3	Q4	Q5	Q6	Q7 ⁸	Q8 ⁹
5	5	7	7	2	3	5	3	3
4	4	1	4	6	3	3	6	6
3	3	3	1	1	3	3	3	3
2	0	1	0	2	2	0	0	0
1	0	0	0	1	1	1	0	0

n = 12

Table 4: Module 3 survey results¹⁰

	Q1	Q2	Q3	Q4	Q5	Q6 ¹¹	Q7 ¹²
5	3	4	4	4	4	1	2
4	6	7	7	3	3	4	5
3	2	0	1	4	5	4	3
2	1	1	0	1	0	3	2
1	0	0	0	0	0	0	0

n = 12

least favorite topic, students' responses were mixed; one student stated "it is boring to read [funder policies] all during the module," while another stated, "just wait to introduce [metadata] later."

Module 2: Types, Formats and Stages of Data

In Module 2, students were introduced to data types, formats, and stages. Nine of 12

students indicated that this module explained the range of data types very well (5) or well (4). Eleven of 12 students found this module explained non-proprietary data formats that will be accessible in the future very well (7) or well (4). Students felt this module was least successful in helping them identify methods of recording research data that are discipline-specific (very well [3] well [3], not well [2], not at all well [1], neutral [3]).

⁷ Survey questions are included in the appendix.

⁸ Scale: 1 = Did not meet my needs/expectations; 5 = Entirely met needs

⁹ Scale: 1 = Materials not at all useful/relevant; 5 = Materials very useful

¹⁰ Survey questions are included in the appendix.

¹¹ Scale: 1 = Did not meet my needs/expectations; 5 = Entirely met needs

¹² Scale: 1 = Materials not at all useful/relevant; 5 = Materials very useful

Table 5: Module 4 survey results¹³

	Q1	Q2.a	Q2.b	Q2.c	Q3.a	Q3.b	Q3.c	Q3.d	Q4	Q5 ¹⁴	Q6 ¹⁵
5	7	7	7	6	5	6	4	5	6	4	5
4	4	3	3	4	6	4	4	6	3	5	5
3	1	2	2	0	1	2	2	1	3	3	2
2	0	0	0	2	0	0	2	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0

n = 12

Free response questions indicated that eight of the 12 students felt the discussion about preferred file formats was most useful. Students wrote comments such as “I didn’t know there were preferred formats [of data] and “I’m using a range of specialty software that frequently produces compatibility issues.” Four of the 12 students felt the discussion of stages of data was most useful. One student said, “It helps me target my progress in data management.” Two students mentioned they would like to have spent more time discussing file types and formats.

Module 3: Contextual Details Needed to Make Data Meaningful to Others

Module 3 discussed metadata in more detail after it was introduced in Module 1. Nine of the 12 students felt this module explained the concept of metadata very well (3) or well (6), while one student said it did not explain it well, and two were neutral. Nonetheless, students overwhelmingly felt the module helped them understand why metadata is important, saying it explained it very well (4) or well (7). Seven thought the module was successful in helping them identify an approach to creating metadata, while five were neutral.

Free response questions indicated that eight of the 12 students felt the discussion of the importance of metadata was the most useful part of this module, but the exercise in which they created a Dublin Core metadata record for their data sets was not as helpful as it could have been; eight of the 12 students were still confused about what metadata is and how to create a metadata record. Several students commented that they were “Still confused about how to create [metadata],” that there was “not enough guidance on what to include,” and they are “still confused about metadata standards.”

Module 4: Data Storage, Backup, and Security

In Module 4, students were introduced to the importance of secure data storage, data security, and a regular backup plan. Eleven of the 12 students felt that this module helped them understand why data storage, backup, and security of research data are important (very well [7] and well [4]). Nine of the 12 students felt this module helped them identify an approach to creating a data storage, backup, and security plan (very well [6] and well [3]), while three were neutral. Eight of the 12 students felt the module helped them

¹³ Survey questions are included in the appendix.

¹⁴ Scale: 1 = Did not meet my needs/expectations; 5 = Entirely met needs

¹⁵ Scale: 1 = Materials not at all useful/relevant; 5 = Materials very useful

Table 6: Module 5 survey results¹⁶

	Q1	Q2.a	Q2.b	Q2.c	Q2.d	Q3	Q4	Q5	Q6	Q7	Q8 ¹⁷	Q9 ¹⁸
5	7	7	7	6	6	6	4	6	6	8	5	5
4	2	3	4	4	1	3	7	3	3	3	5	4
3	2	1	0	1	2	2	0	2	2	0	1	2
2	0	0	0	0	1	0	0	0	0	0	0	0
1	0	0	0	0	1	0	0	0	0	0	0	0

n = 11

understand the importance of migration to newer storage media (very well [4] and well [4]), while 2 did not feel it did a good job, and 2 were neutral.

Overall, the students most liked the discussion of backing up data regularly. Six students listed this discussion as the one they like most. In reference to backup services provided by the University, one student stated, “I would like to use them in my research projects.” Another stated he or she “did not know the different types of backup (full vs. incremental).” Two students said data security was the most useful part of Module 4, stating, “I can think of several ways to improve our data security based on this.” Two students also felt the exercise in which the students created a Back and Security Plan using the “Data Backup and Security Checklist” to be very helpful saying it was “useful” and “a helpful tool for my research group.”

Module 5: Legal and Ethical Considerations for Research Data

In Module 5, students were introduced to the legal and ethical considerations related to

data sharing, such as ownership and copyright of research data. Nine of the 11 students¹⁹ felt this module explained very well (7) or well (2) the ownership considerations related to data sharing. All students stated that they were better prepared to explain and evaluate copyright issues related to data (the module explained it very well [7] and well [4]). Ten of 11 students stated the module explained intellectual property issues very well (7) or well (3), while one student was neutral. All students said Module 5 prepared them very well (4) or well (7) to understand privacy levels for research data.

Four students found the discussion on citation of data sets to be the most useful. Two students found each of the following discussions to be the most useful: ownership of data (“I had never seen this!”), copyright, and licenses. In reference to the discussion of Creative Commons licenses, one student stated, “I was unaware of the ability to grant varying degrees of permission of creation use” to a data set. One student stated that the discussion on HIPAA regulations was not useful as it was not relevant to him or her. Three students found the case study related

¹⁶ Survey questions are included in the appendix.

¹⁷ Scale: 1 = Did not meet my needs/expectations; 5 = Entirely met needs

¹⁸ Scale: 1 = Materials not at all useful/relevant; 5 = Materials very useful

¹⁹ Attendance dropped to 11 students at this point.

Table 7: Module 6 survey results²¹

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9 ²²	Q10 ²³
5	6	6	4	4	5	3	3	3	2	5
4	3	1	4	3	2	3	3	2	5	3
3	1	3	1	1	3	2	2	2	1	1
2	0	0	1	2	0	2	2	2	2	1
1	0	0	0	0	0	0	0	1	0	0

n = 10

to ownership of research data very enlightening; one student went further to say it was “helpful to put everything in context.”²⁰

Module 6: Data Sharing and Re-Use Policies

In Module 6, students were introduced to data sharing. Students felt the module prepared them well for explaining the benefits of data sharing, with nine of 10²⁴ saying it prepared them very well (6) or well (3). The module explained Open Access, Open Science, and Open Data, and most (7 of 10) students felt this module prepared them very well (4) or well (3) to understand the differences among the three concepts, while two students felt it did not prepare them well. Six students of 10 felt they were prepared very well (3) or well (3) to identify different options and types of repositories for sharing data.

Open Access and Open Science were concepts three of the 10 students found most helpful in Module 6. One student commented, “Open science was something I had not heard of before.” Five students found the discussion of sharing data within one’s research group the most beneficial, with one

calling it a “good consideration to keep in mind moving forward and preparing data.”

Module 7: Plan for Archiving and Storing Data

In Module 7, students were introduced to concepts and methods for archiving and storing data sets. Students understood certain topics in this module better than others. For example, on the one hand, nine of 10 students felt that the discussion on the different options for long-term sustainable preservation of data prepared them very well (5) or well (4). On the other hand, less than half of the students felt the discussion on costs for data storage and services helped them understand it very well (3) or well (1); three felt it did not prepare them well at all, and 3 were neutral.

When asked about which content the students liked best, there was a wide range of favorites from the discussion about different levels of preservation (e.g., bit stream copying vs. migration vs. emulation) to tips for discovering data in various repositories. One student who liked the repository discussion called it “Very useful!” while another

²⁰ “Who Owns Research Data? A Case Study.” Adapted from “The Jessica Banks Case.” <http://bit.ly/1nkeqce>.

²¹ Survey questions are included in the appendix.

²² Scale: 1 = Did not meet my needs/expectations; 5 = Entirely met needs

²³ Scale: 1 = Materials not at all useful/relevant; 5 = Materials very useful

²⁴ Attendance dropped to 10 students at this point.

Table 8: Module 7 survey results²⁵

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9 ²⁶	Q10 ²⁷
5	5	5	3	4	5	2	4	3	3	4
4	4	2	5	1	3	3	4	1	3	3
3	1	2	2	5	1	2	2	3	4	2
2	0	1	0	0	1	2	0	1	0	1
1	0	0	0	0	0	1	0	2	0	0

n = 10

said it would help him or her with data mining.

Discussion

The surveys showed that the modules were generally effective at explaining the material. Overall, students felt the materials gave them sufficient understanding of the data life cycle and various points to consider when managing data. The workshop introduced important aspects of managing data that many of the students had never considered. One student commented that he had never considered the benefits of data sharing and would keep those benefits in mind during his future research and data management. Nine of 12 students found the discussion on data security and backup to be extremely useful. One student stated, "I can think of several ways to improve our data security based on this [discussion]." Simply exposing the students to these issues and causing them to think about them is a positive outcome from this workshop. Students now understand the basic underlying reasons why data management is important and have some tools to accomplish it.

When taking the responses in aggregate for

each module, weighted average ratings²⁸ declined over the course of the morning, rose again after lunch (between Modules 3 and 4), and then declined again over the course of the afternoon (see Figure 1). One possible explanation for this trend is that students got increasingly tired as the day progressed, thereby finding it more difficult to concentrate. The author also found it difficult to maintain energy towards the end of the day, which might have reduced the effectiveness of his teaching. The following sections discuss adjustments to future workshop delivery formats based on this experience.

Time Constraints

An important consideration when planning for a data management workshop is the length of the class. The NECDMC has been designed modularly so that one has the option to select material that is needed for a specific purpose and omit the rest. The first module is an overview of the entire curriculum and can easily be used as the basis for a 60- to 90-minute overview session that could then be followed up by several other one- to two-hour sessions that would cover topics from other modules. The NECDMC is also well-suited for a longer course. For ex-

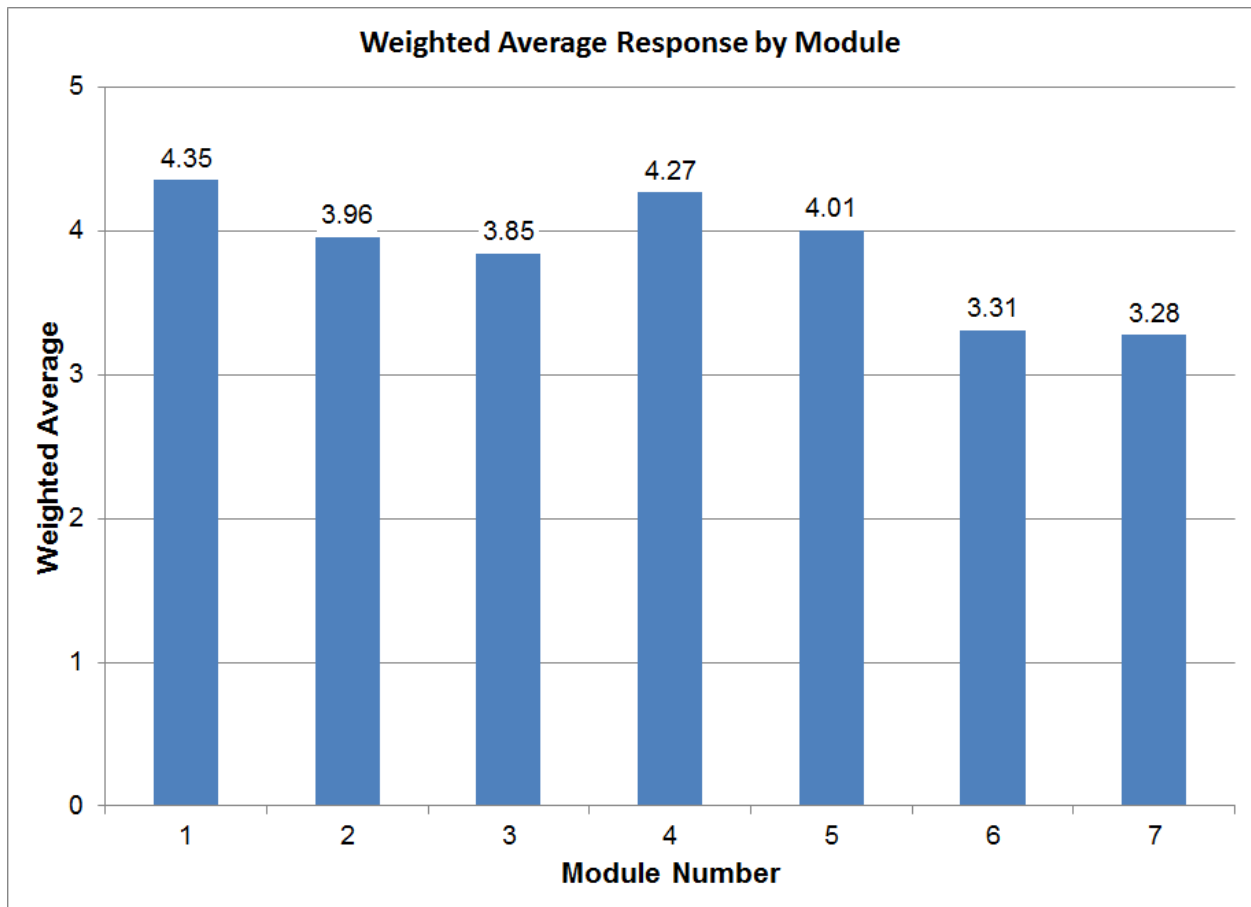
²⁵ Survey questions are included in the appendix.

²⁶ Scale: 1 = Did not meet my needs/expectations; 5 = Entirely met needs

²⁷ Scale: 1 = Materials not at all useful/relevant; 5 = Materials very useful

²⁸ Calculated as the overall average score for all questions with a 5-point scale per module.

Figure 1: Weighted average overall response per module



ample, the course content and activities could be augmented with additional materials, readings, and assignments and be used as the basis for a 15-week long, for-credit course. Librarians who are considering using NECDMC for teaching RDM should assess the support of their institution, the time they will need to prepare for a class or course, and the amount of class time they have allotted. These factors will help determine the best approach for your situation.

Benefits of offering shorter workshops include ease of planning and delivery. Short workshops are also good for overviews of topics and can be repeated multiple times over the course of a term. Benefits of longer workshops include the ability to provide greater depth of material, but they are more difficult to deliver and coordinate. As men-

tioned earlier in the preceding section, longer workshops could increase the chances of participant burnout and dropout (Eaker and Ogier 2014; see Figure 1).

Future Plans

The workshop was an educational experience for the students as they were exposed to information they had never before considered. Preparing for the workshop was also an educational experience for the instructor. One lesson the author learned was that it is important to keep the sessions short, especially for first-time presenters. The author chose to offer the NECDMC as a day-long workshop. Based on his experience and the students' feedback, he will pace the introduction of material in smaller doses and tailor it for different disciplines. For example,

he is designing smaller, target workshops for different disciplines, such as geospatial projects, agricultural projects, and engineering projects. These shorter workshops will be offered at least once during each semester and will provide customized information for that discipline, such as which repositories or metadata schema to use. This format will provide students with customized, actionable concepts rather than generalized information, as well as reduce participant burn-out.

Conclusion

This article discusses the author's process to plan and implement a data management workshop at the University of Tennessee, Knoxville. Additionally, it discusses the students' feedback. Future efforts here will be guided by the feedback received from participants and the instructor's experiences in planning and teaching the workshop. Continuing education in data management practices is crucial to students' success as researchers, but their time is limited. From the author's experience, targeted sessions for specific disciplines provide more value for the students' investment of time. Targeted sessions save students time by eliminating the need to determine how generalized information applies to their discipline and situation. There must be a balance between the efficient use of their time and giving them the skills they need to succeed in a data-driven research world.

Electronic Content

Appendix: Survey Instrument

An online supplement to this article can be found at <http://escholarship.umassmed.edu/jeslib/vol3/iss1/1/> under "Appendix: Survey Instruments".

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