Outside the R1: Equitable data management at the undergraduate level

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Abstract

Universities within the California State University System are given the mandate to teach the students of the state, as is the case with many regional, public universities. This mandate places teaching first; however, research and scholarship are still required activities for faculty seeking to achieve retention, tenure, and promotion, as well as important skills for students to practice. Data management instruction for both faculty and undergraduates is often omitted at these institutions, which fall outside of the R1 designation, the Carnegie Classification for "very high research activity." This happens for a variety of reasons, including personnel and resource limitations. Such limitations disproportionately burden students from underrepresented populations, who are more heavily represented at these institutions. These students have pathways to graduate school and the digital economy, like their counterparts at R1s; thus, they are also in need of research data management skills. This paper describes and provides a scalable, low-resource model for data management instruction from the university library and integrated into a department's capstone or final project curriculum. In the case study, students and their instructors participated in workshops and submitted data management plans as a requirement of their final project. The case study will analyze the results of the project and focus on the broader implications of integrating research data management into undergraduate curriculum at public, regional universities. By working with faculty to integrate data management practices into their curricula, librarians reach both students and faculty members with best practices for research data management. This work also contributes to a more equitable and sustainable research landscape.

Keywords

Research data management, academic libraries, undergraduates, equity, Hispanic-serving institutions

Introduction

The past several years have brought about a much needed diversity, equity, and inclusion (DEI) reckoning in many libraries (Gibson *et al*, 2020, pp 75). 2020 was no different. Many institutions face a call to analyze, audit, and improve their DEI initiatives or consciously create them if they do not yet exist. As academic libraries attempt to improve equity in all service areas, Research Data Management (RDM) should not be overlooked. As with all areas of society, this service area is not free of structural inequality and equity concerns. This paper will document a course-integrated data management workshop for undergraduate students, but the primary focus will be to highlight equity challenges in data management instruction for universities that are not research-focused and do not meet the Carnegie Classification of "Research 1" or "Research 2", as well as methods to combat those challenges.

RDM has had a home in academic libraries for more than a decade, making a regular and significant appearance in the literature in 2008 (Delserone, 2008, pp. 203-206; Henty, 2008, pp. 2-3). By 2014, it became commonplace to associate this service with academic libraries in the United States. This date was not arbitrary as the U.S. Federal Government stated its intentions for accessing publicly funded

data just a year prior (Holdren, 2013, p. 3). As Bethany Latham astutely highlighted in her column for the Journal of Academic Librarianship, money, primarily that associated with federal grants, was the primary driver for RDM's quick rise to fame (Latham, 2017, p. 1). Over the past decade, scholars have contributed to significant literature on developing successful RDM programs, providing the best practices for these services to users, and standardizing these best practices. This literature has provided the building blocks for smaller libraries to implement successful programs. However, the literature has been nearly silent on the equity challenges that face RDM stakeholders at institutions that fall outside of the Carnegie Classification of 'very high research activity (R1)' or 'high research activity (R2).' [2]

According to this classification, there were one-hundred-and-thirty-one R1 institutions and one-hundred-and-thirty-five R2 institutions in the United States in 2018 (*Carnegie Classification of Higher Education*, 2017,).[3] Nearly four-thousand-three-hundred postsecondary institutions granted degrees in the 2018 academic year, most of which fall outside of these research classifications (Moody, 2019). R1 and R2 institutions represent only six percent of all degree granting institutions. Thus, how do libraries serve the RDM needs of the faculty, students, and researchers at the other ninety-four percent of universities, especially those that serve marginalized communities? This is not to claim that all R1 and R2 institutions provide adequate RDM services to their faculty and students. Much research states that this not is the case (Radecki and Spring, 2020, pp. 4). This is also not to claim that R1 and R2 universities do not serve diverse populations. In 2020, ten R1 universities were designated as Hispanic Serving Institutions (HSIs), like the campus described in this paper (Excelencia in Education, 2020, pp. 1-15). However, there is *no* research documenting RDM at institutions that fall outside of these classifications. Additionally, it is well documented that regional institutions serve more diverse populations than their R1 and R2 counterparts (U.S. News & World Report, 2019). This paper documents a case study of the provision of RDM services at an institution that falls outside of the R1 and R2 classifications and outside the current landscape of study for RDM. Below, the author will describe strategies for 1) creating partnerships with faculty members who face structural challenges in providing RDM instruction for students, 2) recognizing and adjusting for the technical deficits facing students, and 3) implementing practical solutions. These strategies can be implemented to serve all universities, including R1 and R2.

Background of the case study

The subject of this paper is best understood with a clear grasp of the system and institution that it took place within. The California State University (CSU) System is the largest public university system in the United States. The CSU has an enrollment of nearly five-hundred thousand students across twenty-three campuses. The system is known for teaching practices, which are often prioritized over research activities in contrast to the heavily funded University of California System. None of the twenty-three campuses fall into the R1 or R2 classification, with most serving regional populations. This study took place at CSU Channel Islands (CSUCI), the newest university within the CSU system, established in 2002. CSUCI is located in Camarillo, CA, between Santa Barbara and Los Angeles, and serves the tri-county area (Ventura, Santa Barbara, and Los Angeles counties). As of fall 2020, CSUCI had a total enrollment of just over seven-thousand students. More than sixty percent are first generation college students or students who are the first in their families to attend a four-year academic institution. Fifty-five percent of the total enrollment are from historically underrepresented

groups and CSUCI is recognized as an Hispanic Serving Institution (HSI) and receives federal funding to support that designation.

Despite its mandate for teaching, research occurs across the CSU system. At CSUCI, this research is almost universally supported by undergraduate students as there is little focus or funding for graduate programs and graduate research assistance. Utilizing undergraduate students as research assistants creates significant demands on faculty and results in general needs for undergraduate RDM training and instruction, both to support faculty research and as a means to prepare students for careers in the digital economy or graduate school. Despite the clear need and plethora of literature on the topic, there is no guidebook or best practice for doing this work with a community that is majority marginalized and faces severely limited resources. This work requires adjustments, sensitivity, and a substantial time investment (for both librarians and discipline faculty) in order to make an effective impact that meets undergraduate students on their level.

Brief review of the literature

The following review of the literature focused on two specific areas: a survey of the RDM work that academic libraries are performing with undergraduates and a survey of where the literature stands on the equitable provision of this work. The research in this review was limited specifically to American institutions due to this paper's focus on the Carnegie Classification as a tool for measuring resources. Additionally, the author chose to focus on American institutions due to the specific diversity, equity, and inclusion (DEI) conversations that are currently on-going in institutions of higher education.

Current work with undergraduates

As mentioned in the previous section, faculty at CSUCI demonstrated the need for undergraduate education around RDM. This experience was validated across much of the literature; though such work has been practiced in a variety of ways. Some practitioners found it challenging to reach undergraduates through course-integrated instruction and sought extra-curricular approaches to RDM education (Carlson *et al,* 2015, pp. 16-17; Clement *et al*, 2017, pp. 8-9; Cook *et al*, 2020, p. 3). This approach often required funding for food to attract students to events and workshops or for other programming. Others found pathways for course integration through both discipline faculty and library-specific courses (Ball and Medeiros, 2012, p. 182; Mooney *et al*, 2014, pp. 376-379; Reisner, Vaughan, and Shorish, 2014, p. 1943; Zhang and Gall, 2017, p. 2). Course integration models for RDM instruction rely heavily on relationships with discipline faculty, but prove to be more equitable for those practitioners working on "shoestring" budgets, allowing practitioners to "take advantage of existing resources and tools," and capitalize on need (Henderson *et al*., 2014, p. 17).

The workshop curriculum described later in this paper relied heavily on the work of other practitioners, especially those who have developed frameworks for teaching RDM (Sapp Nelson, 2017, pp. 4-7; Piorun, 2012, pp. 48-49). Specifically, Megan Sapp Nelson's work to develop an RDM competency matrix was extremely helpful in creating a tangible assignment attached to the workshop curriculum. Her use of matrix domains for teaching "personal information management," "team data management," and "research enterprise management," translated well to department faculty and capstone students. While outside the context of academic libraries, Richard Ball and Norm Medeiros' work on instruction related to the values and skills of documentation and READMEs also offered a foundation for the graded assignment (Ball and Medeiros, 2012, p. 182). Additionally, most authors

relied in some form on the DataONE modules and curriculum for teaching and tools, demonstrating this resource's sustained value to the RDM community (Shorrish, 2015, p. 10; Cook *et al*, 2020, p. 3; Mooney *et al*, 2014, p. 375; Sapp Nelson, 2017, p. 7; Kafel, Creamer, and Martin, 2014, p. 61; Reisner, Vaughan, and Shorish, 2014, p. 1945).

The later described workshop activities were developed specifically for this capstone course, but relied heavily on examples from the literature. The Data Curation activity was modeled after the undergraduate RDM curriculum developed for the Chemistry Department at James Madison University, with it's instructions and description left "intentionally minimal" (Reisner, Vaughan, and Shorish, 2014, p. 1944). Additionally, the Data Management Plan Activity and corresponding assignment relied on the DMPTool, a resource designed for institutions with limited resources (Henderson *et al*, 2014, pp. 14-16).

Equitable provision of RDM

While performing this review of the literature, the author also reviewed the types of institutions that dominate the conversation around RDM in academic libraries. Of the articles surveyed and mentioned in this paper that specifically refer to undergraduate work, the research came from sixteen R1 and R2 institutions and eight private liberal arts colleges (most of which were supported by consortia that included R1s or R2s). The only outlier in this survey was the work of Yasmeen Shorish and her colleagues at James Madison University, a public, masters-comprehensive university that falls outside of the Carnegie designations. Her work spoke specifically to the challenges that many academic libraries face in providing RDM services at smaller institutions (Shorrish, 2012, pp. 265-270). However, even this outlier does not adequately represent the situation of many regional public institutions (like those in the CSU system), which have limited master's students and serve primarily underrepresented populations. Additionally, in a dedicated search of all the literature reviewed for this article, not one author discussed RDM in terms of equity or in the provision of this work for students from marginalized backgrounds.

Research Data Management course integration

While faculty across CSUCI's campus voiced calls for RDM training through a variety of localities (especially administrative offices supporting grants), it was up to the librarians to provide outreach around RDM to ensure that relevant faculty were aware of the service. This outreach primarily consisted of unsolicited emails directed to faculty members and requests for time on the agendas of departmental faculty meetings. It was a fifteen-minute presentation at such a faculty meeting that inspired the described partnership with the Department of Environmental Science and Resource Management (ESRM) at CSUCI. What began as a departmental RDM training to refresh faculty members with best practices ultimately became a partnership between the library and the department's required Capstone Project Curriculum. The ESRM Capstone Project is a two-semester, research-based course where students work in groups to answer a scientific research question through data collection and analysis. Librarians were asked to partner with discipline faculty in the development of an assignment that would support RDM instruction. In the assignment, students were asked to submit a graded data management plan during the first semester of the course following a librarian-led RDM workshop. This plan would become a core component of the final submission in the second semester of the course. The integration of the graded assignment greatly increased student engagement and was a core component of the workshop.

Workshop description

A librarian delivered the workshop to three separate sections of the Capstone Course, reaching a total of 71 students and three faculty members. The workshop filled a fast-paced hour, but could have utilized more time. The workshop took place in a computer lab classroom to ensure that every student had access to a computer and would be able to fully participate in the activities. Students participated in the workshop as pre-existing groups, already assigned for their Capstone projects. Prior to the workshop, the instructing librarian hosted the documentation and data on a stable library webpage to ensure that students could access the material both during and after the class session. The outline and description of the workshop are summarized below:

Introduction to Research Data Management for undergrads

1. *What data should we manage?*
    a. To begin the workshop, students were asked to define "data" and compile a list of the types of data that they would be collecting in their Capstone Projects. These data types were collected and written on a dry erase board in the classroom.
    b. Once the list was compiled on the board, students were asked to add any software or hardware needed to collect or process their data.

2. *Why should we manage this data?*
    a. The instructing librarian then addressed the importance of research data management, focusing specifically on 1) reproducibility, 2) transparency, and 3) integrity.
    b. Students were then presented with several examples of recent data management and preservation debacles in the news and in research (Hern, 2020; Vine *et al*, 2014).

3. *Data curation activity*
    a. After this introduction students were asked to perform a data curation activity to demonstrate the importance of these principles. Students were asked to download a zipped folder that contained all of the files from a completed research study that originated in an open access repository. The folder contained more than 1800 unorganized files that did not follow any particular file name structure. The folder also contained multiple README files. Students were given "intentionally minimal" instructions and asked to explore the files and try to answer the following questions in groups:
        i. How many files did this study produce?
        ii. What is the topic of this study?
        iii. What type of data did the researchers collect?
        iv. How would you open these files?
        v. What information would need to replicate this study?
    b. The students responded very well to this activity, vocalizing the file types that they recognized and expressing their frustration at the complexity of the files. The instructing librarian walked around the room, provided assistance when asked, and often suggested students search for a README within the files.
    c. After about ten minutes of exploration, most students were able to identify the rough subject of the study, a few data types, and several software tools that might be helpful

for opening files. The instructing librarian then revealed the title and documentation for the unorganized folder by sharing the link to the open access repository record.

  d. Students were then asked to discuss their thoughts on the activity based on the earlier content.

4. *Data management plans*

  a. As a response to the somewhat frustrating data curation activity, the instructing librarian then introduced Data Management Plans (DMPs) by 1) defining DMPs, 2) demonstrating their purpose, especially in the context of the previous activity and previously mentioned examples, and 3) describing their components.

5. *Data management plan activity*

  a. Building on the content, students were asked to set up accounts using the DMPTool (dmptool.org). The instructing librarian offered assistance as students signed up.

  b. Once the students had access to their accounts, each group was assigned a section of the plan to familiarize themselves with and then report out to the rest of the class. The sections included: data collection, documentation and metadata, ethics and legal compliance, storage and backup, selection and preservation, data sharing, and responsibilities and resources. Each section provided guiding questions and resources for students to explore within the DMPTool.

  c. Students were given fifteen minutes to discuss this within their groups. During the sharing portion of the activity, the instructing librarian asked guiding questions that related to each section and provided instruction on the best practice for each area.

  d. This section of the workshop provided a majority of the Research Data Management instruction, but was led by the students.

  e. The discipline instructor also introduced the graded Data Management Plan assignment.

6. *File name and digital stewardship best practices*

  a. To demonstrate a necessary component of their DMP assignment, the instructing librarian also gave a brief overview of file naming best practices. This included examples of 1) creating unique file names, 2) creating consistent file naming structures, and 3) avoiding special characters and spaces within file names.

7. *Careers in data management*

  a. Lastly, the instructing librarian described several career paths for students who found themselves interested in the topic of data management and provided a list of job titles and education requirements for interested students to investigate.

Equity evaluation

It was necessary to dedicate significant time and sensitivity to equity considerations in preparation of the workshop. Having trained in Research Data Management at only R1 institutions, the workshop designer needed to critically evaluate any assumptions made in the workshop, especially regarding students' available resources and personal technology. As demonstrated through the aforementioned analysis, the literature and best practices for RDM often make many assumptions with regards to

these aspects, as the majority of this work is done at well-funded research universities. Adjustments were needed to ensure that the workshop was equitable for both CSUCI students and faculty with limited resources.

The financial burden of RDM was the primary equity issue facing students in the course. It touched many aspects of the workshop, but was most evident through students' lack of access to dedicated computers. Across the three sections of the course, several students did not possess their own computers. These students relied on some combination of cell phones, tablets, loaner laptops from the library (which have significant download and permissions restriction), desktop computers located in the library reading room, desktop machines available within specific campus department labs, or shared computers between family members at home. This created a variety of challenges at several points throughout the workshop. These challenges are outlined below:

1. *Storage*

Workshop designers and discipline faculty knew that it was out of the question to suggest that students spend additional funds on materials for RDM in their capstone course, specifically because the course was a graduation requirement, not an elective. In addition, the campus did not provide dedicated server space for student projects in the Environmental Science and Resource Management department. These factors, along with the lack of personal computers, forced most students to access and manage their data almost universally in low-cost or free cloud storage. Nearly all of the student groups stored their data in campus-provided Google Drive accounts, either because they, themselves did not have consistent access to a computer or an external storage device or because even one member of the project group did not have consistent access to a computer or external storage. This made cloud storage the primary (and typically only) form of storage. Most student groups had no feasible option for traditional backups. This was not a problem reserved only for the students. Faculty members in the department faced similar storage issues. Apart from business-level Dropbox accounts provided by the university, faculty members had no department or campus servers, making it difficult for them to store their own research, let alone provide assistance or impart best practice to their students.

Workshop designers needed to respectfully mitigate these issues, while still providing instruction on the best practice. Rather than briefly explaining the need for multiple backups, this workshop required more time, explicit instruction, and discussion about what a good backup procedure might look like in their situation. The instructing librarian specifically explained the importance of multiple backups and asked students to discuss how they would manage two to three backups within their group, either in different platforms of cloud backups, external storage, or on personal computers. Although it was not ideal and it was an additional burden on the student groups, most groups were able to negotiate a workflow for data storage and backups. The students were also able to document the workflow in real time using the DMPTool, immediately demonstrating the value of a data management plan. Asking students to solve this problem, led them to conversations about how the students would communicate with one another and schedule backups and syncs with any non-networked storage options.

2. File naming

File renaming presented another major disruption. Students who created or collected data that uploaded directly to Google Drive or Dropbox (often from an external tool like a drone or water probe) faced significant issues with file naming or renaming due to the proprietary nature and usability of the cloud interfaces. There is no easy or granular way to rename files in bulk in these systems. Even though several plugins and extensions exist for batch file renaming within Google Drive, they are less reliable than their client-based counterparts. File naming best practices are typically a major component of basic data management instruction and thus the instructing librarian dedicated more workshop time to this topic so that students could plan for work arounds in their data management plans.

To combat this challenge, the instructing librarian asked students to think through their data collection workflows and document how digital data files would be created. Students using external tools recognized that they would need to create file naming schemas prior to the data collection process and set up their tools to produce files with names to match their schemas. Some students found that they needed to locate and consult with user manuals for the tools that they would be using. This was a time-consuming component of the workshop. The instructing librarian offered additional options for later consultation for student groups who were not able to finish this within the time allotted or those who were not yet prepared for their data collection process.

3. Time

RDM practitioners are keenly aware that this work is time consuming at its best and painstaking at its worst. To combat this, researchers at well-funded institutions often rely on automation and syncing tools to make tasks less burdensome. Researchers with access to these tools spend more time analyzing data and less time moving and processing it. This was not a luxury afforded to students in this course. It was important for workshop designers to be realistic about time costs with students as many have a variety of other demands that require their time. CSUCI is often referred to as a "commuter school," with many students coming from the far reaching edges of the county for their courses, while also balancing child care, elder care, and jobs. Only a small number of students live on campus with regular and consistent access to labs for processing and analyzing data. Additionally, the campus library is not open on a twenty-four-hour schedule, as is the case at many larger institutions, limiting the hours for students to access library computers and software.

It was necessary for the instructing librarian to make these time costs abundantly clear to students early in the process, so students could plan realistically and accordingly. For example, students were instructed to prepare for the time costs involved in moving large amounts of data, both from lab computers to cloud storage and back; to prepare for the amount of time they would need to reserve for machine and equipment access, if using loaned equipment; and to prepare for the amount of communication needed across the group when data syncing could not be assumed across all group members.

Assessment

Although formal data was collected during the first iteration of the workshop through pre and post survey, and interviews with both faculty and students, the author was unable to utilize the data for this case study due to time constraints and workload issues related to the campus institutional review board during the COVID-19 pandemic. This leaves much opportunity to revisit the study and continue

formalized, quantitative assessment on future iterations of the workshop in the post-pandemic environment.

Without data collection, assessment of the workshop came from on-going conversations and collaboration with the discipline faculty. It was clear early in the discussion with discipline faculty that the workshop's biggest weakness was the hour-long time constraint. This did not provide enough time for students to gain depth of knowledge on any aspect. Discipline faculty agreed to test the next iteration of the workshop in a ninety-minute class period. Apart from the time constraints, faculty course instructors were immediately pleased with the result of the workshop and saw improvement of the capstone assignments over the course of the year. They also requested that the instructing librarian visit the course again during the second semester to check-in with students on their Data Management Plans, answer lingering questions prior to submission, and provide on-going mentorship. Based on the first year's success, the discipline faculty elected to continue the partnership and make both the workshop and assignment a permanent part of the course.

In addition, the workshop proved to be easily scalable for remote instruction. During the spring semester of 2020 and the entirety of the 2020-2021 school year, all twenty-three campuses of the CSU system remained closed due to the COVID-19 pandemic. The workshop ran smoothly in this environment and also worked well as recorded asynchronous instruction. It should be noted that the instructing librarian saw more requests for separate group consultations for RDM during the pandemic, most likely caused by students feeling less inclined to speak during online instruction.

On a broader level, the library also saw an increase in faculty requests for assistance and consultation in RDM (data management plans required for grants, specifically) from not only the Environmental Science and Resource Management department, but across the university. This was an unexpected, but welcome surprise. It spoke to the success of the course integration and highlighted potential areas for the library to build more relationships with discipline faculty and reach more students.

Conclusion

For library workers, it should always be a priority to provide equitable access to library services. For Research Data Management there is much work to be done. Equitable service does not have to contend with best practice; however, it must contend with time allotted to provide this service. This time constraint exists in both the planning and execution of services. This case study provides a variety of valuable lessons for providing RDM services outside of the R1.

The first and most important lesson was to establish a strong and communicative partnership with the department and faculty members requesting RDM services. They provide access to students and hold the most direct knowledge of their students' personal equity challenges. This case study was only possible because discipline faculty welcomed and collaborated with the library. The relationship began as a cold email to a department chair and blossomed into a repeated course integration. The inclusion of a data management plan as a graded assignment was an important piece of the capstone project that pushed the workshop beyond a typical information literacy session. It also integrated RDM (and the library) into the rest of the students' research and coursework. Most importantly, it provided the students with valuable experience and skill building that could serve them well beyond their undergraduate careers.

The second lesson was that this level of course integration demanded that the librarian instructor dedicate significant thought to the equity challenges that come with providing RDM services. The author had to think about each step of the teaching workflow and ask herself if it was possible to accomplish without a dedicated personal machine or any financial strain. This process was challenging and time-consuming, but allowed for the space to consider the areas that practitioners can improve equity in this service area. While designing the workshop, the author found it important to remember why we provide this service to an undergraduate population. If RDM practitioners hope to diversify academia (and specifically academic libraries), they must expose more students at diverse institutions to this work.

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Endnotes

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[2] Carnegie Classifications and Definitions are available at https://carnegieclassifications.iu.edu/definitions.php

[3] Carnegie classifications include any institution that conferred at least one degree during the 2016-2017 academic year and were reported to the National Center for Education Statistics IPEDS. This data is intended to be a snapshot of a given time frame and is not updated yearly.