

Dynamic Research Support for Academic Libraries

Edited by
Starr Hoffman

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Preface

Rationale for this book

There are many books on reference services, how to support research and learning, and related initiatives such as data services, digital humanities support and data management. However, there are few, if any, that provide illustrative examples of these varied services in one volume, viewing them as correlated, emerging models of research support.

Higher education and academic libraries are in a period of rapid evolution. Technology, pedagogical shifts and programmatic changes in education mean that libraries must continually evaluate and adjust their services to meet new needs. Research and learning across institutions is becoming more team-based, crossing disciplines and dependent on increasingly sophisticated and varied data. To provide valuable services in this shifting, diverse environment, libraries must think about new ways to support research on their campuses, including collaborating across library and departmental boundaries.

This book is intended to enrich and expand your vision of research support in academic libraries by:

- inspiring you to think creatively about new services
- sparking ideas of potential collaborations within and outside the library, increasing awareness of functional areas that are potential key partners
- providing specific examples of new services, as well as the decision-making and implementation process
- providing a broad array of examples across different kinds of institutions
- shifting from a mindset of research and instruction services, metadata creation, data services, etc., as separate initiatives, toward a broad view of 'research support.'

This volume is not intended as a checklist of ‘must-haves’ for every academic library. Each institution, and each library, serves a different group of students, faculty, and staff, and varies by mission, size, academic focus and more. Thus, there is no ‘one size fits all’ service model. Instead, these projects and support models are presented to inspire initiatives that fit your specific institution’s needs and mission.

‘Research support’ as defined in this book

As implied above, the phrase ‘research support’ in this book encompasses more than the traditional academic library definition of ‘reference’ or ‘research and instructional services.’

‘Research support’ isn’t something limited to large research libraries. Academic libraries of all sizes, missions and locations – including liberal arts institutions, community colleges and others that are teaching-focused – are shifting to broader forms of research support. After all, ‘research’ is merely the pursuit or creation of new knowledge. This quote from Zora Neale Hurston (1942) speaks to a simple passion for this activity, ‘Research is formalized curiosity. It is poking and prying with a purpose.’ This curiosity takes place on every campus, regardless of its mission or size.

Nor is ‘research support’ exclusive to the sciences, social sciences, or other disciplines that use quantitative data. The term ‘research’ is used in this book to describe a wide variety of scholarship across the disciplines. The term ‘data’ in the following chapters includes not only quantitative data, but also qualitative data, images, literary texts, or anything else that may be an object of study.

Audience

The intended audience for this book includes academic librarians, other LIS professionals, and library or higher education administrators. The book is also relevant as a text for instructors and students in library and information science programs. It will introduce them to the increasingly collaborative and fluid nature of research services in academic libraries, and provide specific case studies that may be discussed in class. As described above, the book is appropriate for a variety of institutions, regardless of location, size or mission.

A global context

Academic libraries do not operate in a geographic vacuum. In this global environment, our students and faculty come from many different countries. Based on their varied backgrounds, our users have different

expectations and assumptions about library practices. Therefore, this book was designed with an international audience in mind. Its authors come from several different countries, in an effort to represent a variety of experiences across different institutions and locations.

Overview of contents

This book is divided into three parts. Each part begins with an introduction laying out the theme or theory of that section, paving the way for the chapters that follow. The individual chapters illustrate specific examples of new models of research support. Each chapter describes the model in question, and includes practical information such as decision-making processes, development and implementation.

The introduction, 'A vision for supporting research,' discusses how an exploratory, collaborative library culture contributes to the development of dynamic research services.

Part 1 is titled 'Training and Infrastructure,' and in the introduction I describe the role of staff development and library spaces in research support. Chapter 1, 'Constructing a model for Mexican libraries in the 21st century' by Alberto Santiago Martinez, describes a library renovation and expansion project designed to better support digital scholarship at El Colegio de México (Mexico). Chapter 2, 'Researching illustrated books in art history: a brief history of the Biblioteca Digital Ovidiana project' by Fátima Díez-Platas at the University of Santiago de Compostela (Spain), describes how digitizing a collection of illustrated books has enhanced art history scholarship across Europe. Chapter 3, 'The "Developing Librarian" digital scholarship pilot training project' by Richard Freeman, describes how librarians at the University of Florida (USA) learned digital scholarship skills in order to support their institution's growing research in the digital humanities.

Part 2, titled 'Data services and data literacy,' opens with an introduction by Jackie Carter, University of Manchester on the importance of data support in academic research. Chapter 4, 'Training researchers to manage data for better results, re-use and long-term access' by Heather Coates, provides an example of a data literacy program developed at Indiana University-Purdue University Indianapolis (USA). Chapter 5, 'Data services for the research lifecycle: the Digital Social Science Center' by Ashley Jester, describes a combined research and data services model implemented at Columbia University in the city of New York (USA). In Chapter 6, 'Mapping unusual research needs: supporting GIS across non-traditional disciplines,' Karen Munro details support for architecture and journalism students using geographic information systems (GIS) at the University of Oregon (USA).

In the introduction to Part 3, titled 'Research as a conversation,' I discuss

academic library initiatives to support the dissemination, discovery and critical analysis of research. Chapter 7, 'Implementing open access across a large university: a case study,' by Dominic Tate, describes implementing open access for research outputs at the University of Edinburgh (UK). Chapter 8, 'Bridging the gap: easing the transition to higher education with an information literacy MOOC,' by Mariann Løkse, Helene N. Andreassen, Torstein Låg and Mark Stenersen of UiT, The Arctic University of Norway (Norway), describes the development of an online information literacy course. Chapter 9, 'Metadata enhancement through name authority in the UNT Digital Library' by Hannah Tarver and Mark Phillips, describes the importance of descriptive, rich metadata to making research findable at the University of North Texas (USA).

How to use this book

It is our hope that the selective examples provided in this book inspire you to develop new services, to think creatively about your interactions with faculty and students and to reach across library and institutional boundaries to form dynamic collaborations. Think of the following chapters not as strict guidelines, but as jumping-off points from which to build rich services that serve your specific institution best.

Starr Hoffman

Reference

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Introduction: a vision for supporting research

Starr Hoffman

What is 'research support?'

The traditional model of a public services librarian sitting at a desk, answering student questions, no longer adequately captures the experience of many academic librarians. Some still sit at reference desks, but those desks have changed, often incorporating a variety of services such as circulation and technological support. Librarians themselves may be on call nearby while students or paraprofessionals sit at the desk, answering directional and transactional questions. Librarians may find that reference questions swiftly transform into impromptu sessions on information literacy, or tutorials on interpreting quantitative statistics, or methods of sharing research.

In addition to these reference-desk-adjacent inquiries, librarian support for student and faculty work is expanding to include areas such as the digital humanities and data management, which have traditionally been performed by specialists in areas outside the reference and instruction realm. Academic libraries are realizing the power of existing liaison or subject librarian relationships with faculty, and many are mining those relationships to offer discipline-specific support for open access publishing, data use and management, and other services.

Research support isn't something limited to large-scale research libraries. Academic libraries of all sizes, missions and locations – including small liberal arts and community colleges – are shifting to broader forms of research support. After all, 'research' is not something specific to one discipline; it is the pursuit or creation of new knowledge. This idea can also be expressed as 'inquiry,' research as an exploration and process of asking questions (Pagowsky, 2014). Guided inquiry is a learning technique in which students are taught to ask themselves questions such as: 'What do I want to learn?', 'How do I learn it?', 'What did I learn?' and 'How will I use what I learned?' (Kuhlthau, Maniotes and Caspari, 2007).

Likewise, Kenneth Burke's (1974) metaphor of 'research as a conversation' is one that can be applied equally to all disciplines. Burke (1974) describes the research process as being like walking into a room where a conversation has been going on for a while. After listening to the conversation for a while, you join in with your own point of view. Some people agree with you and provide further evidence, while others counter your argument. Nicole Pagowsky (2014) describes this process as 'examining the connections and ongoing narratives between different scholarly pieces'. Instead of merely being consumers of information, this model encourages students to become active critics, engaging with existing scholarly work and in turn themselves creating new knowledge to contribute to the conversation.

Inquiry and research as a conversation are tied intimately to the 'critlib' movement in information literacy, engaging students in critical thinking and questioning traditional notions of authority (Accardi, Drabinski and Kumbier, 2010). Using these 'critlib' methods in information literacy can expand the research conversation to become more diverse and inclusive, as well as challenge students to not merely memorize the indicators of a peer-reviewed scholarly journal, but to create their own criteria for evaluating meaningful and robust scholarship.

As we expand our traditional print-focused mode of information literacy to include media literacy or transliteracy, we must also consider related concepts such as data literacy. Students are faced with an increasing amount and variety of information and upon graduation will be expected to navigate it all with fluency. We must expand our instruction to prepare students to explore and evaluate any kind of information. Thus, through critlib and teaching new forms of literacy, information literacy is also an important part of research support.

Research in our institutions is becoming increasingly team-driven and interdisciplinary. Thus, our users have increasingly sophisticated needs for methodological and analytical support, data management, and research dissemination. Our role as academic librarians is to partner with our students and faculty during this process and provide a holistic suite of research and instructional services. In this context, 'research support' can refer to anything that a library does that supports the activity of scholarship and research at its parent institution. As we develop these services, we should create a library culture that encompasses three themes: exploration, learning and collaboration.

An exploratory culture

Just as research is an iterative process, so should be our exploration and improvement of services. Instead of being static, we should evolve with our

institution and respond to our users' needs by continuously improving our services.

We can accomplish this iterative change through several methods. First, we must encourage a culture of exploration. As librarians, it's important that we feel free to play, to experiment with new technologies and new ideas. In order for our constituents to see research libraries as dynamic spaces where research happens, we must cultivate our own interests and explore new things.

It is important to create an environment where risk is seen as positive. In this environment, a new library service that draws only a few users or has an otherwise disappointing outcome should not be labelled a failure. Rather, such an outcome should be viewed as a data point from which we learn, adjust and try something new. That's what research is, trying something with an uncertain outcome – whether the results are positive or negative, they deserve to be discussed and utilized. Nothing can be learned without making some mistakes.

This idea of exploration segues into the concept of responsiveness. Higher education is in a period of immense change. As libraries, we're constantly affected by new technologies and evolving methods of information dissemination. We must be observant of these changing student and faculty needs, and be ready to respond quickly. Just as we use feedback in reference interviews to respond and adapt on the fly to patron needs, we should draw on that skill to adapt our services as needed.

This continual exploratory process of response and risk must be tied to assessment. Assessment is also iterative; as we observe our constituents' changing needs and respond with new services, we continually assess their outcomes by collecting evidence. In turn we use that data to improve the service, thus continually evolving – assessment should not be a circle, but rather a spiral. We assess in order to use that evidence to act upon and create something new the next time around.

Everyone in the library should be a partner in this process. Just because the term 'assessment' is assigned to a specific position or department doesn't mean that this activity is relegated to only that person or that area. Assessment is a process in which we are all collaboratively involved, because it affects how we move forward. Even those who aren't directly involved in assessment planning or the data collection process should be invested in the assessment results, using them to inform what is done and how it is accomplished. Assessment makes our initial exploration relevant and meaningful, and helps us to continuously evolve and move forward.

A culture of learning

This culture of exploration is intimately connected to the concept of lifelong, continual learning. As a library, we should foster a learning culture not only among students and faculty, but also among ourselves as librarians. By encouraging growth in each other, we are poised to reskill ourselves to meet new research needs and thus become more effective partners in our institutions.

Community is an important aspect of fostering a learning culture. As a profession, librarianship is good at the individual level of professional development. However, we should also harness the power of community, viewing our colleagues as learning partners. For many, it is easier to learn in an environment in which others are also learning. A learning community, whether formal or informal, provides encouragement, companionship and guidance. Community members can help each other through difficult concepts or technologies, as well as keep one another accountable for their learning.

There are multiple ways to create learning communities. Groups can be formed within functional library divisions, or across the libraries. These groups may be formed to explore a specific skill or technology, may be broadly exploratory (without a specific skill in mind), or may be designed to produce a specific research output. Such groups are most effective when driven by their members, created out of their own shared desire to learn, rather than dictated by management. The community's learning goal may be influenced by institutional needs, but ultimately will be driven and shaped by its members' interests and passions.

An example of such a group is the 'Developing Librarian' project undertaken by Columbia University Libraries' Humanities and History Team (2013). This group of librarians decided to undertake a digital humanities project in order to reskill themselves to support similar scholarly work. As an added benefit, the digital humanities outcome itself, a digital history of the Morningside Heights neighbourhood that surrounds Columbia's campus, is itself a valuable research output that provides value back to the community. This project has capitalized on existing librarian subject expertise and local collections, while also training librarians in software (like Omeka) and various skills (such as manipulating and cleaning digital assets). This kind of reskilling, particularly for liaison or subject expert librarians, provides nearly unlimited opportunities for libraries to support research (Aukland, 2012; Jaguszewski and Williams, 2013; Schonfeld and Rutner, 2012).

Collaboration and engagement

As the role of liaison librarians evolves, we must collaborate and engage with

the university as true partners. If we look for examples, we will find a variety of partnering models. A classic example is formal physical embedding, a librarian who has an assigned location and office hours in an academic department. Such collocation of librarians, students and faculty enables embedded librarians to be effective, visible partners in department activities. It also facilitates librarian familiarity with a discipline's research processes and unique needs. However, informal engagement can be just as significant. This might be regularly engaging with faculty and students in their academic space, for instance, by attending events and meetings. It's possible to be a part of that academic culture without the structure of set hours or location. An alternative model of informal embedding might be setting up office hours in the public area of an academic department, similar to the office hours that faculty provide for their students. The end goal of these activities is to make the library's research support more visible, and to find new opportunities in which to engage as research partners.

Alternatively, engagement can be expanded to partner with support departments like centres for instruction, academic support centres and student affairs offices. Libraries share common goals with many of these areas, particularly in supporting student learning and faculty research; partnering on events and services could be powerful. In particular, co-hosting workshops and other events could increase the reach of both the library and the participating department, while incurring only half the cost and/or staff involvement that each department would typically sustain. Libraries could work with these support departments to potentially develop new, collaborative services that are highly flexible.

Such collaborations might extend to offices for sponsored research, partnering to share information and services on locating grants, writing proposals, and data management. In institutions where institutional repositories or data management are handled by external, non-library departments, libraries could consider partnering with them to create seamless research support structures for faculty. Even the simple act of sharing information with external departments – telling them about library services and asking about what they offer – can increase referrals and help both the library and external departments reach a broader audience.

True collaboration lies in librarians paralleling faculty as researchers. The future of the reference librarian lies in becoming an integral partner in the research process of students and faculty. Librarians are highly skilled in organizing, synthesizing and disseminating information, all of which are key research skills. Many academic librarians have additional expertise in subject areas, making them ideal research partners. This partnership might take formal shape as a librarian becoming co-investigator on a grant-funded research project, or may be as simple as a series of conversations about methodology.

This idea of research partners builds on the recent evolution of the liaison or subject librarian as a partner with other library functional areas, such as data management and scholarly communication. Liaison librarians must partner with library specialists in these areas to provide dynamic, comprehensive research services. Liaisons may partner with specialists by helping draft data management plans, consulting on copyright and helping disseminate research in institutional repositories and open access journals. As cited earlier, recent reports on liaison librarian roles from the Association of Research Libraries (Jaguszewski and Williams, 2013) and Research Libraries UK (Aukland, 2012) document examples of collaborative reskilling of subject specialists in these areas, thus broadening the types of academic library research support.

To further emphasize the central role of the library in the research process, many institutions are sharing research outputs in library space, by hosting researcher lectures and sharing research images or posters in library spaces. Other approaches could include sharing research results from a variety of disciplines in an interdisciplinary lightning round or pecha kucha session (brief presentations of 20 slides shown for 20 seconds each).

Librarians can also partner with faculty on instruction. Many institutions have already begun this by embedding information literacy into their undergraduate curriculum. As librarians form deeper relationships with faculty, they can seek additional opportunities to engage with their courses. Research methods courses are natural places to insert information literacy, to either engage with a class several times or to co-teach it with a faculty member. Incorporating the library into these foundational research courses ensures that students understand not only where to find information, but more importantly how to evaluate and process it. Additionally, as subject experts, librarians may seek opportunities to guest-lecture for courses, to share and expand on their specific subject expertise.

These are merely some of the broad spectrum of ways in which libraries can engage and collaborate as research partners with students and faculty, and across the institution.

Do less, but deeper

For far too long, the mantra in many libraries has been ‘do more with less,’ the idea that we should somehow solve shrinking budgets by creating more projects and services despite time and budget constraints. This inevitably results in a slew of half-finished projects and frazzled librarians. While the desire to do more is creditable and speaks to passion for librarianship, all too often implementing ‘more with less’ results in a lack of buy-in, creates a perception that administration doesn’t understand the realities of staff

workloads and ultimately can lead to staff burnout. Our librarians and staff deserve more respect and care than this model allows.

Aside from considerations of limited time, staff, and money, there is good reason to limit what is accomplished in libraries. Each academic library resides in a specific situation with a unique collection, has specific strengths, and serves a parent institution of a certain size, funding control, student body and mission. Institutions are best served by focus – by limiting library services to what institutions need most and what libraries do best. ‘What institutions need most’ means focusing on the parent institution’s programmatic priorities and strengths as well as its users’ most frequent needs. ‘What libraries do best’ means assessing staff talents, collection strengths and the realistic possibilities of physical spaces to provide services in which librarians and library spaces shine. We shouldn’t try to recreate what every other library is doing – instead, we should look for what our specific institution needs, and what we already do best, and tailor our approach accordingly. Relevant self-assessment questions include:

- What is the one thing that is most important for our library users?
- What activity takes up the most time in our library – is it related to that most important user need?
- If not, how can we reduce the time spent on this activity?

By limiting the services provided and the projects created, libraries can enable their staff to spend more time and care on each. This results in services that are well thought-out and planned, regularly assessed and fluidly responsive to changing user needs. Further, it enables staff to maintain passion and enthusiasm for the work they do, ensuring that they are able to do it at a higher quality than if their attention and energy are split between a myriad activities. Prioritization and restraint are valuable tools for academic libraries. Libraries can prioritize by asking questions such as:

- Does this service support the mission and vision of the library? Of our parent institution?
- Is it meaningful?
- What may we have to cut or reduce to accomplish this?
- How can we best utilize our existing resources, staff expertise and talents, collection strengths, facility advantages?
- What is the measurable gain for our constituents?

The ideas presented in the following chapters are presented as case studies, examples from which each may pull what is most relevant for their situation.

They are not intended as a list of required activities, but as a menu from which to select what fits best. Adapt these ideas as needed, and apply the ‘small apartment’ mantra – for every new thing, one old thing must go. This idea is as relevant for library initiatives as it is for shoes!

Conclusion

Our role as academic librarians is to explore, to learn, to collaborate as true partners in the university. There is no single magical answer or essential service, nor can any academic library implement all of the ideas in this volume. Each institution, and each library, serves a different constituency. Our institutions vary by mission, size, funding control, academic focus, curricular strength, student body, region and more. There is no ‘one size fits all’ for academic libraries: they are as varied as the parent institutions that they serve. By investigating academic library trends and casting them in the environment of our institutions, we can determine which services work best in our specific context.

We must be ready to learn, evolve, and to change as our institution changes. As librarians, we are uniquely suited for this. We are trained to seek out, to learn, and we are passionate about this work. We must channel these talents and create strong relationships in order to support a thriving learning and research culture at our institutions.

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Training researchers to manage data for better results, re-use and long-term access

Heather Coates

Introduction

The existing academic research workforce is ill-equipped to manage research data using the increasingly complex computing technologies available to them. Despite the availability of ever more powerful desktops and mobile technologies, and of high-performance cloud computing and storage, universities are failing to provide graduate students with adequate data management skills for research in academia or industry. The challenge for mid- and late-career faculty is even greater, because of the difficulty in changing established research practices for ongoing studies. This skills gap places at risk billions of research dollars, the integrity of vast quantities of research data, and the quality of life for millions of people.

Providing this workforce with the skills they need to collect, manage and share their data effectively is a challenge many academic libraries are taking on. Though libraries may provide some technological solutions, our most valuable contributions lie in expertise and trust. We have the resources to fill this skills gap by using our information management expertise, teaching ability, ability to facilitate conversation across departmental and disciplinary boundaries, and a uniquely holistic understanding of the scholarly record. At Indiana University Purdue University Indianapolis (IUPUI), education and advocacy is the foundation of our data services. This choice is shaped by the recognition that many graduate programmes are not sufficiently preparing students to manage digital research data. Before we can expect academic researchers to share, preserve and curate their data, they must understand the value and importance of data management.

This chapter will describe IUPUI's initial foray into data information literacy instruction, and the lessons learned, and look forward to the future of such programmes. We drew upon best practices in instructional design and information literacy, the scientific lab experience (Coates, 2014), and

interdisciplinary data management expertise to develop the programme. The focus is on practical techniques for responsible data management and relies heavily on the data management plan (DMP) as a tool for teaching and research. Our initial trainings have reached a diverse audience, many of whom were not identified as stakeholders when developing the curriculum. This chapter will describe the development of our instructional programme, assessment results, and modifications to portray an emerging data literacy programme at a high-research-activity university.

As data has become increasingly important in academic research, confusion over terminology abounds. Bringing together researchers from diverse environments introduces uncertainty when similar terms encode different meanings for different communities. The community of library data specialists includes professionals with diverse backgrounds, and so it is useful to clarify the terms we use to discuss data skills. I use data literacy to encapsulate the skills related to finding, collecting, managing, processing, analysing, visualizing, disseminating and re-using data within the context of a research project. Data information literacy describes the skills needed for data creators, data managers and data consumers to do their work. This could include activities that take place outside the research process. When I teach, I present these skills as research data management skills. Lisa Johnston, Research Data Management/Curation Lead and Co-Director of the University Digital Conservancy at the University of Minnesota articulates this distinction very well:

For me, data management (or RDM if you prefer) is a set of skills or best practices that can be discussed, taught, and put into practice. Other examples might be digital preservation or data visualization. These (and others) are key competencies that can be included in the overarching concept of data information literacy. But I don't tell the students that. Data information literacy is simply the binding concept that brings all of these skills and ideas into one frame of reference that I can use to define my own research in this area.

Personal communication, 31 March 2015

Research is a process of discovery demanding motivation, perseverance and the ability to learn independently. Being an effective researcher requires a strong foundation of disciplinary knowledge, as well as intellectual curiosity, intrinsic motivation and metacognitive skills needed to cope with frequent obstacles encountered in the discovery process. The core of our data literacy programme includes teaching strategies for managing information and metacognitive skills that enable researchers to overcome difficulties, course correct, and ultimately persevere in the face of repeated failures. Much traditional library expertise can be translated and applied to research data

management, given some knowledge and experience of the research process (Lyon, 2012; Pryor and Donnelly, 2009; Swan and Brown, 2008; Tenopir, Birch and Allard, 2012).

An informal environmental scan of our campus conducted in 2012 revealed that very few programmes offered courses in managing research data. The few that existed were very discipline-specific. Although our first step in providing data services was offering support for faculty developing NSF data management plans, conversations during workshops and consultations reinforced the need for training in digital data management. And while faculty are often targeted as high-impact stakeholders, the potential impact of training early-career researchers in more effective data management practices is higher over the long term. These practices are typically passed down from advisor to mentee and staff. Unfortunately, they are often idiosyncratic and based on outdated technologies available during the mentor's training. The significant role of mentorship in graduate training can result in passing on outmoded research practices that compromise data integrity and reproducibility. Our programme was designed to teach generalizable strategies for data management throughout the lifecycle that can be applied to current and future research technologies.

Data management lab

Background

This programme began as an informal lab pilot, but has since taken the form of a workshop series, standalone workshops and tutorials. The scope and format were informed by a scan of available courses on campus, discussions with graduate programme directors, and a review of data management curricula available at the time (DataOne, 2012; EDINA and University of Edinburgh Data Library, 2014; Cox and Verbaan, 2013). Throughout the design process, input from the Data Management group at the Indiana Clinical and Translational Sciences Institute (CTSI) provided useful guidance and targets. Tolerance for innovation within IUPUI University Library is high; we are encouraged to experiment with new services. Thus, this programme began as a grassroots effort.

While the Center for Digital Scholarship was recently established (2014), our staff have been creating digital collections of cultural heritage materials, electronic theses and dissertations, and open journals for nearly 15 years. Over the past four years, three librarians were added to expand open access initiatives and to develop support for research data and digital humanities. Current staff members include an Associate Dean of Digital Scholarship, five librarians, three full-time staff and several part-time student employees. These services and systems are supported by an internal IT team (6 FTE), who also

provide support for the library website, archives, and special instructional initiatives not maintained by other institutional or campus services.

The Data Services Program, established in 2012, has been shaped strongly by the context and strategic priorities of University Library, the campus and the institution. The library's Strategic Directions include two items relevant to data: enhance the ability of IUPUI students and faculty to make their scholarly output widely accessible, and ensure its preservation (Lewis, 2015). The IUPUI Strategic Plan for Research (Indiana University – Purdue University Indianapolis, 2014) incorporates several priorities suggested by University Library: encourage wider access to findings and applications from research at IUPUI. More specific action items include the following:

- 5.2. Facilitate and increase dissemination of research and scholarship;
- 5.3. Support new metrics to assess research impact at all levels;
- 5.4. Facilitate data management re-use and archiving.

Indiana University – Purdue University Indianapolis, 2014

These statements emphasize data as a valid scholarly output and highlight the parallels between public access to publications and data-sharing issues. Within this context, data management is viewed as a cluster of skills crucial for the production of high-quality data, the responsible conduct of research, and long-term access to the products of academic research. The Center's mission supports the dissemination, re-use and evaluation of data as a valuable scholarly product alongside our support for publications.

Approach and audience

The ultimate goal of this programme is to provide researchers with the skills to manage their data responsibly to produce better results. Five broad priorities were identified:

- 1 Building awareness of research data management issues
- 2 Introducing methods to facilitate data integrity and address common data management issues
- 3 Introducing institutional resources supporting effective data management
- 4 Building strategic skills that enable researchers to solve new data management problems
- 5 Building proficiency in applying these data management methods.

These priorities emphasize the importance of data management within the research process and its role in the integrity of the scholarly record. Framing

the content in this way demonstrates the relevance of data management strategies to the products of their research, which is an important motivational tool for encouraging researchers to implement these strategies.

The programme was designed to be learner-centred by using outcome-based planning and incorporating active learning strategies. Initially, the intended audiences were faculty, graduate students, and research staff. Unexpectedly, several staff from administrative units such as the Office of Research Compliance (ORC) and clinical production labs like the Indiana University Vector Performance Facility attended the fall 2014 workshops. This connection with the ORC has led to the creation of a working group established to develop institution-wide guidelines for research data management that will inform policy development and adoption.

Structure and content

Content for the data management lab was gathered from literature spanning multiple disciplines. Selected resources ranged from practice manuals such as *Good Clinical Data Management Practices* (Society for Clinical Data Management, 2013) to data-processing texts such as *Best Practices in Data Cleaning* (Osborne, 2013) to guidelines from the Office of Research Integrity (Steneck, 2004), as well as articles from computer science, library and information science, ecology and statistics. Other key resources included reports from the National Academy of Sciences (Committee on Science, Engineering and Public Policy, 2009), the UK Data Archive *Guide to Managing and Sharing Data* (Corti et al., 2014) and the ICPSR *Guide to Social Science Data Preparation and Archiving* (ICPSR, 2012). It took nearly a year to conduct the literature review and develop the curriculum and instructional plan.

Identified strategies were reviewed for curriculum inclusion based on feasibility, value and relevance to as many research methods and contexts as possible. The tentative curriculum was compared to curricula available at the time, such as Research Data MANTRA, RDMRose, and the DataONE Educational Modules. This comparison was helpful for identifying gaps in the evidence base as well as the curriculum and in balancing the needs of diverse research methods and tools. Unsurprisingly, the curriculum developed for IUPUI is very similar to those developed by other academic libraries (Coates, Muilenburg and Whitmire, 2015; Johnston and Jeffryes, 2014; Kafel, Creamer and Martin, 2014). This convergence reflects significant consensus across the community about the data management skills researchers need to succeed.

The assembled practices and strategies were organized around the DataONE data lifecycle to relate them to the research process as experienced by study personnel. This approach was selected to reflect the needs and

expertise of researchers who are engaged in ongoing studies. The programme includes a broad introduction to the research data management and scholarly communication issues with the recognition that people learn what they regard as relevant. This introduction explicitly describes the connections between data literacy skills and the quality of research products, their professional reputation and the importance of quality evidence for scientific progress.

Key programme take-aways emphasize the importance of thorough planning before embarking upon data collection. Specific planning events should include (Society for Clinical Data Management, 2013):

- defining expected outcomes and quality standards for generated data
- identifying legal and ethical obligations as they affect data management, protection, security and ensuring confidentiality/privacy
- selection of tools, formats and standards
- a sound storage and back-up plan, including the use of data locks or master files
- developing an index of project and data documentation to support efficient and accurate reporting
- identifying relevant best practices for data collection, entry and coding
- identifying key expertise needed at the institutional and research community levels for informed decision-making.

These considerations and decisions are documented in the data management plan and updated as the project progresses.

Evidence-based instructional design

The format of data management and literacy training has typically consisted of one-shot workshops and standalone courses. At IUPUI, we are currently limited to providing non-credit-bearing workshops. In order to move quickly into the gap in data management education, we chose to start by offering a variety of workshops, both standalone and series. The January 2014 pilot was offered as a one-day, eight-hour workshop. Since then, the programme format varies depending on the specific audience and content that is targeted each semester. In the spring of 2014, it was offered as a four-week workshop series of weekly two-hour workshops. We scheduled evening sessions because our target audience, graduate students in the health and social sciences, often work. This proved to be less popular than expected, so subsequent events have been scheduled earlier in the day. Three key topics from the curriculum were selected for the fall 2014 line-up. Standalone workshops were offered on three topics: practical data management planning, preventing data loss and ensuring data quality. Other formats for the curriculum are planned. First,

activities that are relatively straightforward and procedural will be adapted into tutorials and flipped classroom sessions. Additionally, we are exploring the feasibility of offering a for-credit course as well as embedded instruction tailored to the needs of particular departments or research centres. A long-term goal for the programme is to offer tiered and progressive instruction across the curriculum, similar to integrated information literacy programmes.

Learning outcomes for each topic were developed from best practices and recommended strategies when available. While there are gaps in the literature, the challenge in this phase was to prioritize the long list of learning outcomes into a cohesive and feasible programme. Once a reasonable list was developed, the next steps were to identify instructional design and assessment strategies. The guiding approach for this phase was to minimize lecture as much as possible in order to provide sufficient time for application through active learning exercises. This was a fairly complex process, so structure was imposed through the use of an instructional design spreadsheet (see Table 4.1). The primary form tracked modules, topics, learning outcomes, activities, assessment products, and use of case studies and examples. More specific sheets contained details about

Table 4.1 *A subset of the instructional planning spreadsheet developed for the IUPUI Data Services Program*

Module	Topic	Learning outcomes
Documentation & Metadata	Project & data documentation	Outline planned project and data documentation in a data management plan
		Identify metadata to describe the data set
		Explain the role of metadata and standards
	Organizing data & files	Develop a consistent and coherent file organization and naming convention scheme for all project files
		Select appropriate non-proprietary hardware and software formats for storing data
		Create protected copies of files at crucial points in your study
Data Quality	Quality assurance & control	Develop procedures for quality assurance and quality control activities
	Data collection	Describe key considerations for selecting data collection tools
	Data coding	Use best practices for coding
	Data entry	Use best practices for data entry
	Data screening & cleaning	Develop a screening and cleaning protocol and/or checklist
	Automating tasks for better provenance	Explain why automation provides better provenance than manual processes
Identify effective tools for automating data processing and analysis		

instructional timelines, assessment, and instructional materials.

We used outcome-based planning to create a learner-centred classroom that engages students with active learning techniques. In selecting recommended instructional design strategies (Clark, 2010; Nilson, 2003), four areas of focus emerged: lecture, discussion, examples and exercises. Keeping these in mind, specific activities were created to address motivation, procedural skills, strategic skills and metacognitive skills. Strategic and metacognitive skills in particular are crucial for researchers to be successful in the uncertain world of research. But teaching these skills will be ineffective if students are not motivated to learn the material. We can help motivate them by making the material relevant to their day-to-day experiences, future careers or real-world problems. The primary method we used was explaining the connection between learning outcomes to the ultimate goal of ensuring research integrity. Similar to information literacy instructional programmes, our data literacy curriculum attempts to develop strategic skills for solving new data management challenges and enable researchers to become self-regulated and self-directed learners.

Lecture

Used appropriately, lecture is a valuable component of almost any instructional programme. However, the weight of evidence for recall and application favours active learning strategies such as those that are inquiry-guided, problem-focused and collaborative (Nilson, 2003). Since it was not possible to eliminate lecture completely, the amount of time spent on lecture was minimized by focusing only on content that was strictly necessary. In general, this was realized by following established best practices based in neuropsychology. Each lecture component was brief, limited to 20 minutes (Nilson, 2003). This ensured that content was kept concise, focused only on the information needed to accomplish the learning outcomes (Clark, 2010). Each lecture began with a statement of learning outcomes and ended with a review to reinforce the connection between the content and how attendees could implement it. Presentation slides utilized a combination of text and graphics and incorporated examples whenever possible (Clark, 2010).

Discussion

Discussion, the second core component of the instructional plan, is most effective when it is activity-based, encourages reflection, and provides for formative assessment. It provides an opportunity for learners to practise self-regulation of their learning through application of metacognitive strategies. Nilson (2003) clarifies situations in which discussion is particularly effective. Those relevant to data literacy instruction include examining and changing

attitudes, beliefs, values and behaviours; problem-solving; exploring unfamiliar ideas open-mindedly; and transferring knowledge to new situations. Discussion often requires more up-front planning than expected. Students need to be primed for discussion. One goal is to have them engage with each other, rather than talking through the instructor (Nilson, 2003). Specific strategies to facilitate productive discussion include waiting for responses, starting with a common experience, brainstorming what students already know about a topic, using good questioning techniques and concluding with a wrap-up (Nilson, 2003). The wrap-up ensures some closure and provides a summary; it is most effective when led by students (Nilson, 2003). We used discussions to share diverse perspectives and research experiences, build rapport and community and address complex topics such as ethical and legal obligations and choosing what data to retain for preservation.

Examples

Examples were used to make lectures and exercises more engaging and to provide concrete examples of how broad data management concepts are applied across disciplinary boundaries. Effective examples enable learners to integrate new information into a coherent structure, such as their mental model. They are especially effective when worked and partially worked examples are provided and discussed (Clark, 2010). These can facilitate procedural learning by modelling the process, which provides support for learners through each step (Clark, 2010). This can present challenges for a mixed audience of novice and experienced researchers, and so it is important to remember that while novices learn better with examples, experts do not. They benefit more greatly from time to practise (Clark, 2010). Our programme embedded examples into the lecture content and used them to support the exercises, described next.

Exercises

People learn through elaborative rehearsal and by connecting new knowledge to what they already know and believe (Nilson, 2003). In the classroom setting, exercises provide opportunities for this rehearsal. We designed exercises to be relevant, meaningful, contextualized and targeted to a particular skill. Each activity provided an opportunity to practise the strategies introduced during the lecture. Activities in the spring workshops were designed with the graduate student thesis or dissertation project in mind, to make them meaningful and contextualized. This approach met the need to provide exercises requiring application rather than recall (Clark,

2010). One effective practice we were unable to implement is distributed practice of skills over time to promote retention (Clark, 2010). Including exercises that meet all of these criteria is challenging, but implementation has improved with each iteration of the programme. Specific improvements will be discussed later, along with challenges and next steps.

The data management plan

The content and meaning of a data management plan (DMP) varies widely. For funding agencies, a DMP serves as a data collection tool to identify common practices. Researchers use the DMP as a planning tool, a part of the project start-up process, a communication mechanism throughout the project, and a resource for writing results. It is effective for both planning and implementation. However, a DMP is just one piece of good study documentation. Data management plans are functional, living documents that reflect both planning and study conduct, encompassing information that can be used in articles, reports and subsequent proposals. A DMP should reference existing standards and norms for the field. Several professional and research communities have established standards for data management and interoperability (CDISC, 2010; CDISC, 2013; Federal Geographic Data Committee, 1998; Knowledge Network for Biocomplexity, 2011). One such group is the Society for Clinical Data Management, which produces a guide to *Good Clinical Data Management Practice* (2013) that is updated biannually. It is both comprehensive and focused, covering all aspects of project management for clinical research.

The DMP is extremely valuable in the instructional context. It is a real-world product that enables authentic assessment of learning outcomes; it is an effective instructional tool because it relies on strategic skills (i.e., performance of tasks that are not routine and require problem-solving to adapt to the unique circumstances of the situation). The DMP provides an excellent opportunity for engaging learners with relevant examples and exercises. The challenges lie in developing rich cases or scenarios from which detailed DMPs can be developed if learners are not at a point in their own research to develop one. These characteristics make the DMP a uniquely powerful activity and product for assessment.

Its value as an actionable document for planning, start-up, active project phases and project completion make it worth the time needed to explain how a DMP can be used. A functional plan articulates outcomes that can be measured to identify successes and failures; it also helps researchers to anticipate problems and prevent them, gathers information needed for team communication and reporting, and enables extension, secondary use or re-use, and reproducibility of results. Perhaps most importantly, the planning process

helps researchers to clearly link data quality standards to study processes, thereby producing higher quality research outputs. This is perhaps most clear in the highly regulated clinical research environment. Although the current emphasis is on its use in planning, an effective DMP, like all study documentation, should be viewed as a living document that is used frequently and updated periodically (Society for Clinical Data Management, 2013).

Strengths

Overall, evaluations for both the pilot and spring workshop series were positive. Responses to the examples were strongly positive, in session and in the evaluations. Time for discussion was appreciated and many asked for more time to continue them. Learners also appreciated the resources provided, particularly institutional services and resources, and links to further information. When asked what topics were most valuable, responses varied. Topics identified include data management plans and planning, file organization and naming, storage and back-up, master files and versioning, documentation and data citation. The evaluations also provided constructive criticism that was used to improve later offerings. During the pilot, even the experienced staff stated that a full eight-hour day was too much; they felt overwhelmed. In the spring, content was separated into four workshops of two hours each. This format provided sufficient time to engage students with exercises, while alleviating the weight of providing all the content at once. It also provided students time to reflect between sessions, which enhanced discussion because they were better able to make connections between the topics.

Challenges and next steps

Although the evaluations spoke to the relevance and utility of the programme to their research, there remains substantial room for improvement. In particular, there is much to be done to optimize instructional design and delivery and expand its reach to the research community at IUPUI. Possibly the most significant challenge was not knowing where students are starting from (Nilson, 2003). Within the graduate student population alone, there is a wide range of experience with research. Some are professionals seeking education to advance or change careers, while others have just finished their undergraduate work. Teaching researchers with such a diverse range of experience is difficult; some strategies are more effective for novices than experts, and vice versa, making it difficult to develop learning outcomes, choose exercises and select relevant examples. One option is incorporating topic-specific pre-assessments into the beginning of each session to prime learners and target instruction more effectively. Another is to have learners

complete a broad pre-assessment prior to the programme. Unfortunately, no such assessment currently exists.

Despite positive evaluations, attrition was high throughout the spring series of workshops. While 23 attendees registered, only slightly more than half (12) attended the first session. By the fourth and final session, just four students remained. It may be possible to improve this with better timing, but retention is generally a problem for non-credit bearing workshops on our campus. We are exploring other incentives to promote retention, as well as the possibility for partnering with an academic department to provide a for-credit graduate course.

The third significant adjustment is to provide better support for relating data management skills to existing knowledge and experiences. As Nilson (2003) reminds us, we need to teach students how to learn the material. We hope to accomplish this by explicitly connecting individual learning outcomes with the broader goals and skills they will gain. For each session, we will provide an empty outline of the key points for students to fill in along with a background knowledge probe. We will facilitate attendees relating new ideas to their existing knowledge by providing time for reflection and explicitly discussing the connections between the learning outcomes and the students' area of research. Tools like concept maps are time-consuming to use, but the burden on the instructor could be alleviated by using peer review to provide helpful feedback.

There are many minor adjustments to be made. We have already begun to try workshops that cover fewer topics in order to delve more deeply and provide more opportunities for application. While the design for the spring workshop series attempted to build in plenty of assessment opportunities (Nilson, 2003), execution in the classroom was less than ideal. We will further examine the activities and assessment products to ensure we provide adequate motivation and clearly state the connection to learning outcomes. Specifically, formative assessment of data management plans and documentation will be incorporated primarily through peer review (Whitmire, 2014). Ideally, summative assessment will be added to gather evidence of behaviour change and implementation of learned strategies. We will build in additional time to complete the formative assessments, review them and respond to them. There are also plans to teach more explicitly the metacognitive skills to promote self-regulation of learning within their own research.

Future of data literacy instruction Opportunities

We face several important questions as the demand for these skills within and outside the academy increases. When do we provide data literacy instruction? When is it most relevant and useful for students? Information literacy research has found that support and instruction are most powerful at the

point of need, but there are many such points that arise throughout the research process. How do we reach students during those times? And how do we help students identify when they need support? Further research into these questions is necessary for instruction to proceed beyond a trial and error approach to meeting the needs of our researchers.

I see two immediate opportunities. If we want to better adapt data literacy instruction to students, we need to develop pre-assessments that accurately gauge their knowledge of disciplinary research practices as well as the research process. The most pressing needs for data literacy instruction are authentic, engaging examples and activities. While many participants have pre-existing projects, students who are novice researchers need the support of relevant examples and well structured exercises. Such resources rely on real-world datasets that are curated for instruction purposes, rather than for re-use. Developing scenarios and case studies are time-consuming and can be difficult to tailor to specific fields of research if the instructor is unfamiliar with them. Just as librarians have developed rich resources for information literacy instruction, we need a repository for instructional materials, cases and scenarios to effectively teach data literacy. This should include activities and assignments relevant to disciplinary practices and which provide opportunities for authentic assessment. The data management plan is just one of these activities. Second, we need to identify foundational data management skills and determine the optimal sequence of learning outcomes that enable students to practise responsible data management within their own discipline. This will require the data librarian and specialist community to leverage the expertise of our instructional and liaison colleagues.

Moving forward, the community of instructors teaching data literacy, including faculty and librarians, has several issues to address in order to develop sustainable models for instruction. We should explicitly acknowledge the many roles through which people interact with research data – creator, manager and consumer. In these early days, we can simply build in support for data literacy alongside existing information literacy services such as reference and instruction, content guides, citation tools and training, first-year experience programmes and discipline-based programmes. Rather than creating new models for service, it may be more sustainable to train library staff to deliver data content and instruction in the context of their daily work. For those data specialists or managers tasked with developing or co-ordinating support for researchers, this could take several forms (Tenopir et al., 2013). However, models which simply extend existing services (such as reference, instruction and liaison activities) to include data are less well documented.

The future of data literacy instruction at IUPUI

The future of our programme will include broadening the range of formats by offering targeted materials and activities for use by faculty in discipline-specific courses, a for-credit graduate course, self-paced tutorials, as well as general workshops and on-demand instructional sessions. In particular, we need to develop mechanisms to deliver point-of-need support alongside embedded support within particular academic courses. Of course, the ultimate goal for data literacy instruction is to demonstrate long-term impact and application of these skills in the research happening on our campuses. For that, we can look to the literature on demonstrating the value of academic library for examples and strategies. People learn when they are motivated to do so by the inspiration and enthusiasm of others (Nilson, 2003). Instructors can tap into their own passion and energy by finding the aspects of data literacy that are compelling to them, and can in turn help students connect with their interests by sharing stories of failure and success.

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