

Building as They Come:

Comparative Case Studies of Co-constructing Data Visualization Services with Academic Communities

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With the inundation of data in all areas of the academy and industries, the applications of data visualization continue to grow. Data visualizations, defined as the visual representation of information by any means, are a powerful method to understand large amounts of data. They are also effective tools to communicate data and tell memorable stories with their visual elements.

It is thus important for higher education to build skills within data visualization, both the literacy ability to assess data visualizations to interpret meaning, patterns, and trends and to create data visualizations either for analysis or communication purposes.¹ To the former, promoting data visualization literacy is of importance to academic libraries due to their commitment to supporting information literacy and promoting critical information skills, whether the format may be text, data, or visualizations.

Academic libraries are well-situated to be strong supporters of democratizing and building knowledge and expertise in the use of data and data visualization as they cut

across all of academia, regardless of discipline or department. Within the past decade, many academic libraries across North America have added data visualization services to their offerings. This has been done in several ways, from existing librarians with related portfolios like GIS or research data learning new skills to libraries creating new positions with the focus on the portfolio on data visualization.

This chapter presents and compares two case studies of building data visualization services at York University Libraries and McMaster University Library. We do so with the hope of sharing practical and relevant knowledge with our readers.

Literature Review

In an expanding body of literature, many researchers attest to the increasing role of data visualization within academic libraries. These roles are twofold: data visualization as a practice within libraries can aid data-driven decision-making, internal assessments, and external communications; and data visualizations as a service complement other offerings such as data and digital scholarship services. While both serve important functions, the data visualization services are the topic of interest for this chapter.

Several data visualization researcher-practitioners within libraries have shared case studies of their services. In a relatively early case, Hayes, Yi, and Villaveces share how the Health Sciences Library at the University of North Carolina at Chapel Hill and the Renaissance Computing Institute built a centre in 2005 with a visualization wall and provided technical instruction or developed custom applications for specialized visualization projects.² Federer and Joubert share their experiences using and teaching Tableau at the National Institutes of Health.³ Catalano, Vaughn, and Been write about their library sessions to teach health science students to use Tableau to create dashboards and maps for improved data-driven decision-making.⁴ All of these cases report on the popularity and effectiveness of data visualization as an instructional or research support service.

Further, there is a small amount of research surveying data visualization services within libraries. In the 2021 article, “Data Visualization as a Research Support Service in Academic Libraries: An Investigation of World-Class Universities,” Zakaria reports that out of seventy highly ranked English-speaking universities, 43 percent of their libraries mentioned data visualization and 36 percent of them offered data visualization services.⁵ LaPolla shares that a review of 155 US or Canadian libraries within the Association of Academic Health Sciences found that 6 percent of them offered data visualization workshops focusing on Excel.⁶ According to a survey by Zoss, while data visualization services have been offered at some libraries in North America, either officially or unofficially, the vast majority of official services have only been offered since the early 2010s. Further, two-thirds of survey respondents did not have “data visualization” in their job title but did have data visualization responsibilities.⁷

There is also a significant body of literature focused on surveying a wider suite of services that are inclusive of data visualization, such as research data services, data science, and digital scholarship. Research data services are now broadly defined as a suite of services that assist researchers across various areas including data management planning, digital curation, data documentation, data analysis, and data visualization.^{8,9} Interestingly, when first defined in 2013, it was defined without the inclusion of data analysis and data visualization.¹⁰ Data librarianship is defined similarly to now include data analysis, data visualization, data literacy, linked data, and more.¹¹ Several of these studies find that out of the offerings included in research data services, data visualization is one of the least commonly offered services, due to a lack of expertise within the libraries as well as the need for more support from leadership to facilitate such a change.^{12,13}

Finally, several research articles share best practices for data visualization services: Kapel and Schmidt note the growing popularity of infographic-creating assignments and the need for guidance for best practices from libraries.¹⁴ Ogier and Stamper offer a consultation framework for data visualization services, where understanding the purpose of the project and details of the research and design process are important to discuss during the consultation.¹⁵ Briney offers a scaffolded process for librarians to gain foundational data visualization skills and then strengthen them by teaching an introductory workshop.¹⁶ Aghassibake, Joque, and Sisk emphasize the need for skilled staff and the types of literacies needed to deliver data visualization services.¹⁷

Altogether, the literature shows that in the past decade, data visualization services within libraries have quickly grown in popularity, although they are not yet as widely offered as other services. At many institutions, data visualization is embedded within other larger service points, such as data services and digital scholarship. It shows that some institutions have invested in hardware like data visualization walls while others focus on building foundational data visualization skills. With a topic as broad in application as data visualization, its service models are equally as varied, and our own two case studies support these distinctions.

The Creation of Data Visualization Services

Introduction to York University Libraries and McMaster Library

Founded in 1959, York University has rapidly become one of Canada's largest schools with over 50,000 enrolled students. York's vision is to provide a high-quality education to students from a wide sociodemographic background and prides itself on its drive for impact, equity, diversity, and inclusion.¹⁸ It was initially focused on the liberal arts, and

while nearly 40 percent of its student body is in the Faculty of Liberal Arts and Professional Studies, York has since added many prominent areas such as its Faculties of Education, Health, Science, Engineering, Law, Fine Arts, and Business. To best support this growth and impact, York University Libraries (YUL) adopted a functional organizational structure in the late 2010s. Shifting away from a branch and subject-specialization model, librarians each adopted a functional area, such as teaching and learning, research data management, and digital engagement.

In contrast, McMaster University, with an enrollment of 36,000 students, is a mid-sized comprehensive university with a majority of students enrolled in the Faculty of Sciences. One of McMaster's core strengths lies in its innovations in pedagogy and research. The inquiry approach—a form of self-directed, problem-based learning—originated at the medical school at McMaster University and is now used in various universities around the world as a model.¹⁹ Like York University Libraries, McMaster University Library uses a functional librarianship model rather than a branch and subject specialization.

New Portfolios Focused on Data Visualization and Data Analysis

In 2021, YUL and McMaster Library respectively hired librarians Alexandra Wong and Subhanya Sivajothy to focus on inaugural portfolios of data analysis and data visualization. Without a dedicated librarian with the time to focus on data visualization, the libraries recognized the gap in services related to data visualization. McMaster Library confirmed this with a review of digital scholarship centres across North American universities; the YUL Digital Scholarship Centre's needs assessment similarly found that data visualization was one of the top interests, often in the capacity of desiring skills training for faculty or workshops within their classes.²⁰

McMaster Library chose to situate its role within the Sherman Centre for Digital Scholarship, which acts as a comprehensive hub for digital scholarship, including consultation and technical services in the areas of bibliometrics, research data management, digital scholarship, spatial information, and data expertise, as well as data visualization and analysis. The role further met the need for services on data visualization for knowledge mobilization. Certain tools like Tableau, Gephi, and Voyant were familiar to others within the Sherman Centre, but more broad expertise, specific methodologies, and theoretical underpinnings related to data visualization were also needed.

In comparison, YUL's position developed from the retirement of a data librarian and thus needed to fulfill many of the same responsibilities of the previous librarian for continuous data services. The new Data Visualization and Analytics librarian would also provide support and instruction on how to edit, analyze, and visualize data using a variety of proprietary and open-source tools. Situated within the Open Scholarship department, the Data Visualization portfolio fits within the Data Services team, amongst

services of finding secondary data, GIS and geospatial data, financial data, and research data management.

Recognizing the need for data visualization support in internal operations in the library, both data visualization portfolios include responsibilities to aid operations, such as with visual reporting on library assessment activities.

Building Services

Establishing a Baseline

Building the data visualization services from the ground up, we first needed to outline what we could offer and how to promote those services. Through discussion with our departments, we laid the groundwork for what we could cover. Although we had a vague understanding of our communities' needs, we knew we wanted to craft a message that invited a wide breadth of discussion and requests from students and faculty. To do so, we both defined our suite of services and promoted them on newly created Data Visualization service pages on our libraries' websites. These services included, but were not limited to, instruction, reference, and consultations on topics ranging from preparing data, choosing visualization types and tools, best practices, critical data visualization literacy, and providing constructive feedback on data visualizations.

Assessing Services

This initial outline of services was particularly based on assessments conducted at our libraries prior to our arrival. Thanks to the needs assessment by the Digital Scholarship Centre at YUL, Wong found several key facts related to data visualization without repeating a campus survey. Nearly 50 percent of all interviewees mentioned data visualization, often in the capacity of desiring skills training for faculty or for workshops within their classes on tools, including Tableau, Python, Excel, SPSS, and Gephi.²¹ It further emphasized the need for inclusivity across all of digital scholarship. McMaster also conducted an assessment in the form of a review of digital scholarship centres across North American universities to pinpoint areas within data visualization to offer, such as workshops on popular tools like Tableau.

Soon after our arrival, to compare our initial suite of data visualization services to other libraries, Sivajothy and Wong collaborated to research and assess the landscape of data visualization services within Canada. We conducted a content analysis of the research guides and websites of all twenty-nine university libraries within the Canadian Association of Research Libraries and found that 41 percent of their libraries (n=12) had a research guide on data visualization. While the breadth and depth of the guides varied widely, all of them referenced data visualization software as well as blogs and websites that shared data visualizations. The next most common categories of data visualization

resources shared were books teaching data visualization skills, academic journals, books on data visualization theory, and databases for data visualization.

We further counted seventy-eight different tools referenced; 71 percent of the tools were specifically for or included options for data visualization, but the research guides also mentioned tools that were for visualization-adjacent functions, including data analysis tools (13 percent), design tools (5 percent), and databases to acquire data (5 percent). This helped validate our understanding that our library data visualization services needed to incorporate other skills like analysis and data discovery as well.

It is interesting to note that all the research guides shared resources on software options, blogs, and websites, with the majority, but not all of them, sharing books and journals held within the libraries. This indicates that many of the perceived needs of library patrons are akin to, “What do I use to create a data visualization?” It further suggests that many of the most illustrative examples of data visualizations and the most accessible tutorials on data visualizations are on blogs and websites; the domain’s leading scholars and practitioners exist in academia and industry, and we should be learning from professionals as well as researchers.

Data Visualization Research Guide

After roughly defining our services, we independently created Springshare LibGuide research guides to communicate our services and share data visualization library resources in one place. Wong chose to create the guide with three sections for ease of user navigation: reading data visualizations (types of data visualizations, examples, citing guide, and biased examples); creating data visualizations (process, choosing the right tool, information design principles, accessibility, EDI, and finding data); and learning resources (books, e-books, blogs, articles, and tutorials).

Sivajothy similarly leveraged the Springshare LibGuide platform to communicate the services with a research guide dedicated to data visualization; it introduced data visualization, a process to get started, links to tools and online workshops, and how to get in touch for a consultation.

Data Visualization Workshops

In addition to the research guides, we also created several workshops on data visualization early on, as they are one of the most popular services offered by libraries. McMaster’s Sherman Centre especially provides well-attended Digital Scholarship workshops; in the past two years, they have offered more than fifty workshops to thousands of participants.

We each started with creating workshops designed at an introductory level that could be adapted to be used in a variety of co-curricular and curricular courses of any discipline. However, our workshops diverged from there, largely due to the interests of our separate communities.

In Sivajothy's first year, she designed introductory workshops on Tableau and Data Viz Design principles. This was based on previous workshops that were taught by affiliate members of the Sherman Center who are familiar with data visualization concepts. Like the research guide, these workshops introduced the topic of data visualization through the core design principles needed to create an effective visualization but also focused on ethical design that emphasized accessibility and inclusivity in design. She also adapted this foundational workshop for various classroom lectures. She was able to adapt the workshop for a science communication course, an upper-level health science course, as well as communications classes.

In contrast, at YUL, Wong's earliest construction of the modular introductory workshop was built upon a previous connection of the Open Scholarship department, a series of workshops on data discovery, maps, and GIS data for a Master of Urban Planning program. Due to time constraints and student needs, the workshop focused on data visualization literacy and roughly equated to the Reading Data Visualization section of the LibGuide.

Wong then extended this introductory workshop into a longer modular one, consisting of five sections:

1. An introduction to data visualization definition, exploratory vs. explanatory purposes, and visual principles
2. An introduction to the various types of data visualizations
3. Critically understanding and assessing data visualizations
4. Finding and citing data visualizations
5. Creating data visualization: 5-step process and considerations for each step

Wong offered the workshop first as a co-curricular workshop with a survey at the end of the workshop to ask for feedback and request students to share which subtopics students would find most useful to learn more about. Similarly, Sivajothy found the workshops to be a great way to assess participants' interests for future workshops. Sivajothy also found that recording the workshops meant that she could refer students to the modules so they could learn foundational concepts of data visualization asynchronously.

In her second year, Sivajothy tried incorporating more active learning and self-learning exercises in her workshops, asking questions and posing problems that participants could respond to and discuss. During her second year, she also felt comfortable teaching more specific and advanced data visualization courses while also branching into related fields. This included workshops on visualizations with Gephi, Voyant, MATLAB, and R, as well as a workshop focused on sound data. Furthermore, as part of a Sherman Centre event, Sivajothy also presented on a panel facetiously titled "How to Lie with Data." As the title suggests, it was focused on the potential misuse of data. This also points to an improvement in newer workshops, where critical data literacy concepts have been incorporated to address the abuses and misuses of data visualizations. This aligned with the interests of Sherman Centre colleagues, who incorporate data justice principles and

concerns in their research and instruction, as well as the interests of participants and graduate residents who engage with the Centre in various ways.

Similarly, in Wong's second year, the data visualization workshop portfolio expanded to incorporate various hands-on workshops in addition to the more lecture-focused introductions. From a referral from the YUL Digital Scholarship Centre, Wong built a series of data visualization workshops into an undergraduate Digital Humanities course. Students were taught the introductory workshop on data visualization, how to create Wikidata items (a structured linked data platform, sister to Wikipedia), and how to then create data visualizations in Google Sheets and Wikidata's SPARQL to tell stories.

Wong also taught several workshops to a new graduate course on data visualization for the health sciences and advised on desired learning outcomes; to create strong data visualizations, students would need to know how to find secondary data, how to clean data in OpenRefine, how to critically assess visualizations, data visualization principles, and finally how to use Flourish software to create visualizations.

The other expansion of data visualization workshops came in the form of co-curricular workshops, which offer opportunities to pilot new material for future potential faculty collaboration. Due to the findings of the Digital Scholarship needs assessment and the literature on creating inclusive digital learning spaces, the next expansion of co-curricular workshops included a network visualization workshop, focused on Gephi and adaptable to any discipline, and a data physicalization workshop. A form of data visualization, data physicalization uses physical objects and their materiality to visually encode data. The workshop creatively used the method of crochet, a traditionally feminine-coded craft, to introduce data and data visualization fundamentals to undergraduate students.

Reference and Consultations

As our data visualization services were new offerings at our libraries, most of our reference questions and consultations have been organically generated from referrals from our colleagues, co-curricular workshops, and the library websites.

Wong has found that many of her consultations involved researchers desiring to create data visualizations, with varying levels of experience. Given the complexity and variety within creating visualizations, conducting the reference interview to understand specific researcher needs and purposes was crucial. Frequently, earlier steps in the process, like finding data, data cleaning, and data analysis, were also discussed. By documenting the reference questions, a consultation guide, co-created with students and researchers, has been drafted to act as a framework for future consultation requests.

Sivajothy has received a mix of questions in one-time consultations, from requests on how to use tools such as Tableau and Gephi (both taught through co-curricular workshops) to asking more methodological questions about how to categorize certain types of data or integrate certain statistical tests and to how to visualize large quantities of information and create interactive visualizations. As she continues to grow the service,

as well as relationships, the consultations are starting to be more frequent as well as more in-depth with ongoing projects that need support. During her second year, Sivajothy also joined the Data Analysis Support Hub (DASH), which offers services pertaining to data analysis. This role has been to help supervise the graduate students who work as student consultants, but she has also helped take on consultation requests that may be more involved or specific to her skills. Through DASH, she has also been trying to create more partnerships with community organizations to share teaching resources and materials.

Discussion

Prioritization

Despite working at two very different institutions, we both focused on very similar outputs in our first year. As data visualization services were a new offering for our libraries, with both of us new to our institution (and relatively new to the field of librarianship), we both focused on building the foundations of the suite of services first.

As librarians, this meant that we prioritized teaching not just the skills to create data visualizations but critical data literacy as well. We were both aware of the need for data justice, EDI, and accessibility and have been consistently intentional in building these important topics into our instruction and consultation services.

However, we differed on the services that were already offered in our respective libraries. While our positions created independent data visualization portfolios at our libraries, there were workshops on the topic that preceded our arrival. McMaster already regularly offered a data visualization workshop on Tableau, so Sivajothy continued delivering it. Wong maintained YUL's regularly offered data cleaning workshop using OpenRefine. Thus, these inherited services created different priorities.

Department Location of Data Visualization Services

One of the largest differences between our two services is the placement of our roles. While both institutions are in discussion of department structures, at the time of writing and for the first two years of both positions, York situates data visualization within the Data Services team (itself part of the Open Scholarship department), while McMaster mapped data visualization services into their Digital Scholarship department, the Sherman Centre.

Co-locating data visualization within certain services means that we have each built connections more closely with colleagues on our respective teams, taking on projects that align with our departments' goals. Thus, Sivajothy is part of the Data Analysis Support Hub (DASH) and is supporting exhibit-making with Omeka (for service coverage), whereas Wong offers neither data analysis nor support on Omeka, a tool that aligns heavily with

digital scholarship. Instead, Wong was cross-trained and offers support on data services, such as finding data, financial data, maps, geospatial data, and GIS software. YUL does not directly offer data analysis services as the university supports the Institute for Social Research, where the community can book consultations with specialized faculty or graduate students.

Growing Relationship Organically

As both portfolios and positions were new, this has been a slow and organic process so far, with relationships forming through referrals, previous interactions, and encounters during workshops. As we both started our roles in 2021, the year after the start of the COVID-19 pandemic, there continued to be a shift in services being offered in a virtual or hybrid manner, and it was often a challenge to properly establish relationships with students, faculty, and researchers. While it may have been a slower start, by our second year, we had established growing connections with various people.

Our department placements influenced our data visualization portfolios directly by building connections with different faculty members. The Sherman Centre provides several connections to faculty members, often one within the humanities and social sciences. Wong was referred to professors that Data Service members were connected to, such as those within the Department of Environmental and Urban Change and York's Glendon campus.

These partnerships led to co-constructing our respective data visualization portfolios in occasionally divergent ways. For example, Sivajothy's long-term collaboration on data sonification stems from a connection through the Sherman Centre, while Wong is planning to build a small collection of physical data visualizations based on the success of physical map-based curricular workshops with various faculty members.

We are also influenced by our institutions' focuses. McMaster University is renowned for its science and health sciences programs, so direct referrals within those faculties have been successful. In comparison, York University is weighted towards the liberal arts and social sciences, so early partnerships with courses like Digital Humanities and Digital Capitalism are perhaps unsurprising.

Creating Inclusive Practices and Spaces

While we continue to grow our respective data visualization portfolios, we are cognizant of the importance of equitably offering our services to all communities and levels of curriculum. While we appreciate all connections thus far with faculty, students, and community, we endeavour to be reflective of our services and strategic with our outreach so that we do not disproportionately support one part of our community over another. Crucially, as both of our Digital Scholarship Centres have understood, we may need to conduct

outreach to groups who are traditionally marginalized from data, data visualization, and technology-related fields, including BIPOC, women, and 2SLGBTQ+ people.

We have started to do so in a couple of ways: Wong's data physicalization workshops purposely use crochet and collage to ground the workshops in feminist perspectives. Sivajothy researches alternative methods like data sonification and offers workshops on data justice. We both strive to continue learning and unlearning to create spaces that are welcoming to all.

Professional Development

Library and information science programs may offer a course or two on data visualization, but they are unlikely to teach at such a level to fully equip a graduate to become a hired data visualization librarian, particularly as the breadth of data visualization continues to rapidly advance. This results in the need for regular professional development, regardless of the librarianship stage.

There are several conferences dedicated to data visualization that we have collectively attended to continue to develop our skills. A small advantage of the largely virtual work environment in 2020 and 2021 due to the global pandemic meant that conferences were offered online, often for free or with minimal fees. This meant we could attend many professional development opportunities on data visualization, including the IASSIST conference, IEEE VIS: Visualization & Visual Analytics conference, the Information+ Conference: Interdisciplinary Practices in Information Design and Visualization, the Visualizing the Future Public Symposium, and Outlier by the Data Visualization Society (a largely industry-based cohort). These conferences provided a solid foundation to better understand how researchers are thinking of data visualization's future and how instructors may teach the topic. It helps highlight where libraries may help solve a gap, thus providing another route to build the portfolio together, albeit indirectly.

In addition, a data visualization librarian's knowledge entails not just data visualization but also pedagogy and instructional skills. To that end, Sivajothy took a McMaster Instructional Skills workshop to improve her skills and learn to incorporate more active student learning; Wong similarly became a Carpentries instructor where she trained to become a more effective technical and data literacy instructor.

Future Plans

Roughly two years into our data visualization portfolios, the foundations of our services are set in place. We hope our next steps will include furthering connections across faculties, deepening current ones, and consciously extending our network to unreached areas. These future relationships will ideally help us create an interdisciplinary space committed to fostering inclusivity, diversity, and equity.

We are invested in expanding into new areas of visualization, in tandem with our institutions' research interests. For example, we hope to investigate applications of visualization in VR or AR and their potential in the classroom. With the rise of generative AI, we are interested in not just its applications for data visualization but also looking to assess AI's quality and the impact of these visualizations through the lens of critical data ethics.

While neither of our job responsibilities includes the traditional model of collection development, we do have an opportunity to build a robust library collection of data visualization resources, including books, e-books, physical prints of data visualizations, and technology. This has not been the focus for either of us, but we plan to make small purchases to build the available resources for instruction and reference over time.

Weaving our personal interests with the data visualization needs of our campuses, we will continue to investigate how traditional data visualizations represent only one way of knowing. Sivajothy will continue to collaborate with faculty and library colleagues to expand their research into data sonification and 3D printing. Wong plans to continue building connections across campus on the topics of data physicalization and critical making. In both cases, we are intrigued by the narrative trending away from the traditional Tufte school of thought for data visualization focused on efficiency; instead, we are interested in how to humanize the process of understanding and creating data visualizations.

Further, as many within libraries can attest, growing sustainably is of utmost importance. We need to balance what services we offer to sustain both the growth and quality of our data visualization services. By building as they come, we have been able to stagger the development of our offerings, but that is no guarantee for the future. Creating asynchronous learning opportunities, such as videos or HP5 modules, should allow for better maintenance of our current suite of instruction while allowing time for expansion into new areas and technologies.

Finally, we plan to build a community of practice for data visualization and data visualization of services within libraries. This will hopefully create a small cohort of librarians and library staff to learn and develop professionally together.

Conclusion

We expect data visualization applications to continue to expand along with the services within our libraries. As both of our two case studies show, despite institutional differences, the building blocks for materializing the data visualization service were very similar. Upon our hiring, we both built introductory resources: a research guide, a services page integrated within the libraries' offerings with contact information for consultation or reference, and a workshop to introduce the basics of data visualization. These initial first steps helped to establish the service and showcase the potential to students and faculty members to co-create new workshops and research projects together. From there, though our paths diverged due to the needs of our libraries and community, we shared an understanding

of critical data visualization pedagogy and a desire to continue to deepen relationships across campus remained.

Notes

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