Adventures in data visualization support assessment: When the gap you were trying to identify turns out to be a chasm

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Abstract

In an era where post-secondary students are seen as digital natives and novel knowledge mobilization is becoming an expected part of scholarly discourse, this paper synthesizes insights from multiple surveys about this topic. This research was conducted in 2020 and 2022 with participants from programs across the University of Manitoba (a Canadian public research university of around 30,000 students). This paper aims to illuminate the campus landscape and assess library support and resources for research visualization; additionally, the authors also explore challenges and potential pathways for improvement.

Keywords

Data literacy, data visualization, GIS, knowledge mobilization, academic libraries

Background

Academic researchers' traditional knowledge mobilization (KM) activities include journal articles, conference presentations and reports. As technology has evolved, KM practices are beginning to shift towards communicating with a more diverse audience beyond academic. Novel communication methods are being proposed to do this (Weller, 2011), with the idea of data storytelling emerging. Dykes defines data storytelling as being "more than just creating visually-appealing data charts. Data storytelling is a structured approach for communicating data insights, and it involves a combination of three key elements: data, visuals, and narrative" (Dykes, 2016, para. 2).

In the not-so-distant past, data visualization was considered a specialist field, requiring certification to use the tools. As technology has become more embedded in our daily lives, there is an expectation for researchers to integrate it into their professional practice (Stevens, 2016; Weller, 2011). Based on the author's experience at various institutions and conversations with peers, many institutions - including the author's own - offer few training opportunities outside of computer science programs and often do not acknowledge these as emerging practices.

The University of Manitoba is a research institution which, as of 2024, had over 30,000 students, split between the smaller Health Sciences Campus and Main Campus (at the south end of the city) located in Winnipeg, Manitoba, Canada. Geographic Information Systems (GIS) and data visualization research support is an area of growth in academic libraries (Chin Roemer & Kern, 2019; Neville & Crampsie, 2019; Pagowsky & McElroy, 2016; Saba & Shearer, 2018). The University of Manitoba Libraries defined providing GIS and data visualization support in its strategic mandate. One of the ways to enact this mandate was with the newly created GIS & Data Visualization Librarian role, which the author, Miller,

was the first to occupy in 2019. In this role, she assists all faculty and graduate students at the University of Manitoba in these functional areas. Unlike many GIS and data librarian roles at other institutions, the GIS & Data Visualization Librarian at UM has no subject area or liaison responsibilities. Duties are split between consultation work, teaching, planning and systems development. Miller's previous career as a GIS professional provides an applied lens for how she navigates this role. To try and work efficiently and to be able to better direct her efforts, the author decided to formally identify gaps researchers were experiencing in their research visualization practices by conducting multiple surveys to assess the library's supports and resources in this area.

Context

After having spent a year in their new position, Miller commenced an exploratory project in collaboration with the subject librarian for Earth and Environmental Resources (Grace Romund), seeking to identify the researchers using novel knowledge mobilization methods in their work, framing it around the emerging trend of 'data storytelling' (this study will be referred to as the Data Storytelling Project in future references). A literature review revealed two significant themes: knowledge mobilization effectiveness in specific fields and data storytelling as an emerging trend, especially in journalism. While existing literature helps discuss the area within a specific context, it does not address the question of whether researchers generally adopt these new trends in communicating their research and how they do that. Our study sought to identify novel research mobilization method use patterns and support structure needs in order to understand how libraries could support this user group better. While revealing some interesting trends (implication of online learning, desire to push beyond traditional knowledge mobilization methods, factors that influence selection of data visualization resources and more), and measurable outcomes, the results did not encompass every facet of the original question the authors sought to address.

In 2022, Miller with the assistance of Sanni-Anibire undertook a second study further exploring another area identified in the Data Storytelling Project: learning support. This was proposed as a sister project and would echo the four subject area breakdowns used in the previous study and assess how Miller's implementation of GitHub Pages as a platform to host training materials worked for users. This platform was adopted as lockdowns from the Covid-19 pandemic forced a move to online instruction.

Some studies exist in the literature where the aim is to evaluate pedagogical techniques in software instruction (Al Hashlamoun & Daouk, 2020; Rickles et al., 2017), identify the challenges of creating and using online learning objects (Acosta et al., 2018; Diaz, 2018), record user experiences from non-traditional programs adopting data visualization tools (Harmon & Gross, 2010; Henshaw & Meinke, 2018) or document the rise of open tools (Neville & Crampsie, 2019; Pugachev, 2019). In terms of library instruction - traditional library instruction is approached as a series of one-off sessions (Chin Roemer & Kern, 2019). This model, however, conflicts with pedagogical approaches to software instruction suggested in the literature, where a scaffolded method using practical/local examples is accepted as the appropriate way to engage with the student (Al Hashlamoun & Daouk, 2020; Fouh et al., 2012; Rickles et al., 2017).

Miller's approach to instruction is to structure materials as an academic curriculum with a valiant attempt to incorporate epistemology in support. Their background in Geographic Information Systems, where they became accustomed to using open tools such as GitHub to keep materials as accessible, interoperable and as organized as possible informed their selection of GitHub as a platform. The author

has also incorporated some of this pedagogy into their practice as a librarian by implementing the workflows discussed by Kaitlin Newson (2017).

The second study (referred to as the GitHub Assessment Project in future references) sought to assess using GitHub Pages in data visualization instruction and to identify gaps in library support for novel knowledge mobilization (KM) and examine them through the lens of library instruction grounded with the student voice.

In both of these studies the author was trying to determine:

- Who is doing visualization work on campus?
- What supports are lacking?
- How can libraries help?

Methods

Data Storytelling Project

This exploratory study sought to identify academic research translation patterns, methods and needs in novel knowledge mobilization support that libraries could adopt to better support this user group. To do this, the University of Manitoba employees with an active research portfolio were recruited and asked to complete a web-survey asking questions about their demographics/user groups and practices (See Appendix A).

GitHub Pages Assessment Project

This exploratory study sought to assess the effectiveness of GitHub Pages as a platform for data visualization instruction materials and if their content provided the support that University of Manitoba learners required. Workshop participants over the course of the spring 2022 semester were recruited to complete a web survey to answer questions around user values and needs (See Appendix B).

Shared

In both of these exploratory cases, surveys offered participants opportunities to answer structured and unstructured questions. Participants were grouped under the following program categories: Health Sciences, Science and Technology, Arts and Humanities, and Social Sciences. Grounded theory (Charmaz, 2014) (discussed below) was then used to analyze the results to identify themes and trends. To achieve this outcome, data analysis was iterative; researchers considered the emerging patterns as they worked through the data cleaning process (Charmaz, 2014). Initial impressions of the data were noted while reading through the response. After that, the researchers coded the data in two phases: initial coding and focused coding. Coding was carried out inductively, meaning that the researcher let the data determine the themes. Using open coding, the response to each survey question was considered—which allowed the researcher to immerse themselves in the data (Charmaz, 2014) -- and assigned a word or phrase that best described the responses. These words and phrases served as the initial codes. During focused coding, researchers compared the initial codes with one another and grouped similar ideas together to form the themes. Finally, these derived themes were compared against the entire data set to check that they captured the essence of the participant responses.

Findings

Data Storytelling Project

This project's survey contained questions grouped into the following sections: demographics, data, software, knowledge mobilization, and storytelling.

One hundred thirty-three people responded to the survey which was sent out to all (1264) campus members with an active research portfolio. 59% (n=79) of participants were faculty and librarians, 34% (n=45) were grad students and nine respondents (7%) were staff. The responses from faculty members were similar to those of students, with additional themes emerging from specific subject areas.

Figure 1 (below) depicts the breakdown of the study population by subject area clusters.

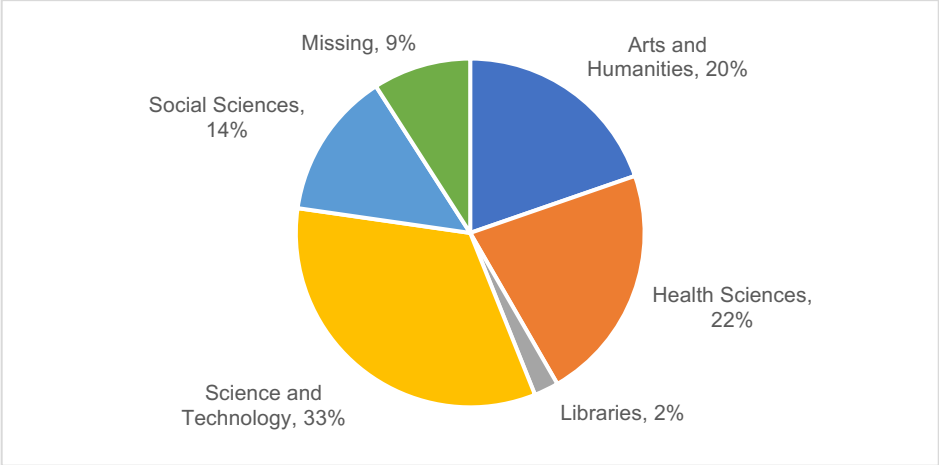


Figure 1: Study population by subject area clusters

Regarding subject areas, the largest group of respondents were from Science and Technology (33%), with Health Sciences making up the second largest group.

In terms of the types of data being collected, different subject clusters tended to different types of data. Below are the subject clusters with the highest usage data type highlighted.

	Arts & Humanities N=26	Science & Tech N=44	Health Science N=29	Social Sciences N=18
Qualitative	35%	16%	17%	17%
Both	**58%**	30%	34%	**50%**
Quantitative	7%	**52%**	**48%**	33%

Table 1 Types of data collected by different subject clusters

Of the respondents who used supplementary data sets to augment their work, 9% of respondents said they always use the most current data possible, 33% expressed a preference for using mostly current data, 45% (the largest group) responded they use a mix of current and historical data, and finally 11% of respondents said they mostly use historical data to supplement their work.

In terms of how study participants initially learned and stayed up to date with the software and methods used to visualize their data, some interesting trends were revealed. The majority of respondents

reported using formal training to receive initial training and shifting to self-learning for additional training. It is interesting to note that while students seem to depend more heavily on peers and work experience for ongoing learning (16% of respondents), only 4% of faculty followed this trend.

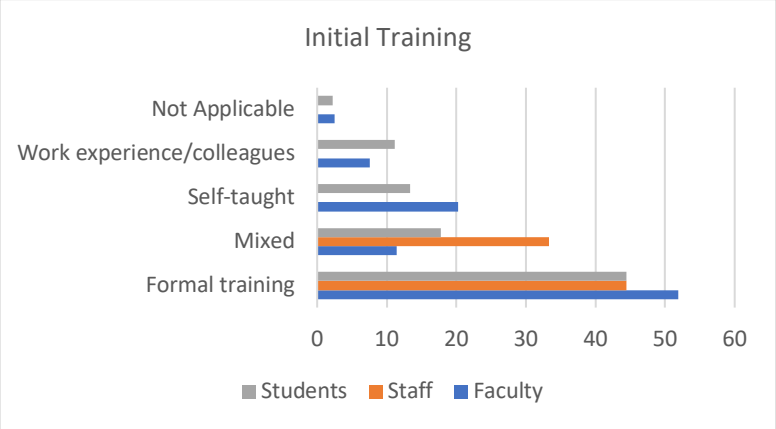


Figure 2: Initial software data and training methods by participant group (percentages)

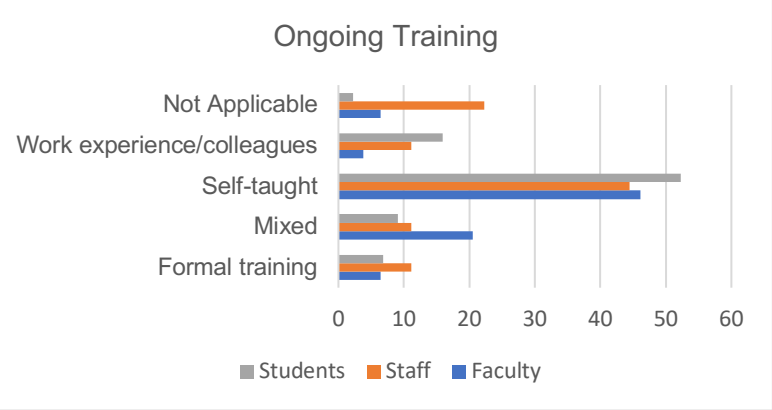


Figure 3: Software and data training methods by participant group (percentages)

Most respondents indicated they consider their audience when they are creating their outputs. A higher percentage of faculty than students reported that they always or frequently write to the room. Interestingly, 6% of faculty and 13% of student respondents indicated that they never considered the needs of their audience.

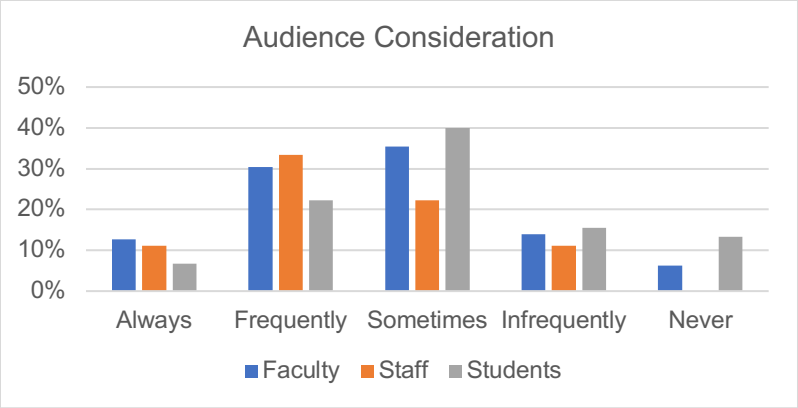


Figure 4: Responses to the question: Do you consider your audience when presenting your results?

Only 77 respondents (57%) answered the questions about knowledge mobilization aspirations. The overwhelming majority (62%) indicated that they were hoping to incorporate novel knowledge mobilization methods (i.e., social media, blogs, infographics, data visualization, apps) in the future. Among the faculty in Health Sciences field, 85% expressed interest in pursuing novel KM methods, while in Science & Technology field, 38% say they focused on traditional KM strategies (e.g., writing for books or journals), and 42% said they use a mix of traditional and novel KM methods.

Constant comparisons of participants' qualitative responses revealed these key themes:

- Desire to push beyond traditional KM
- Need for support
- Tension with key terms used in the study

1. **Desire to push beyond traditional KM**:

Respondents believed that novel knowledge mobilization methods provided opportunities to share their work, with one researcher, noting it allows them *to "communicate in a way that is interesting, but not oversimplified."* A Health Sciences faculty member also stated that:

> *"I find that the more I work to communicate our research to the general public and non-experts, the better I become at telling the story in academic (e.g., journal) formats, too, because I am constantly being forced to think, what does my research really mean, why is it relevant, at its core? I also feel that we have a social responsibility to communicate our results to the public, which has always supported our research financially in some ways. And it's our responsibility to find the right way to communicate with this audience."*

While many respondents wished to be able to engage with other audience than the academy, a faculty member from Science & Technology noted that:

> *"The issue with mobilization with websites or social media or podcasts is that they are far less valued in the publish-or-perish model, aren't as valuable for promotion, tenure, or grant success. So, spending the time to learn how to use these alternative platforms and to put your research out there in these different formats never seems worth it - it's just not valued in the academic markers for success."*

2. **Need for support**

Participants from all faculty subject groups and ranks noted a need for support. One Social Sciences researcher noted that time was their major constraint by saying, *"General help with KM would be appreciated. It feels like researchers have to do more and more - management, budgeting, analyzing, public outreach...it's a lot!"*. Others noted that they felt creative outputs were not their strong suit, with a student noting, *"I would need the help of an artist or another type of thinker to make these efforts more efficient and productive."*

Another gap that was identified was the lack of skills and formal training opportunities, with a science student reporting *"I wish I had better tools or knowledge/ability to make nice figures to visually support my story."* A faculty member from the Health Sciences commented that:

> *"Data visualization, storytelling and effective communication will keep us relevant and help our research have a greater impact. It will also help it have greater uptake to our intended audience. Some universities have entire credited courses on this for grad students. I'm not aware of this at the UofM and think it would be very useful."*

3. **Tension with terms**

The biggest surprise for the authors was an underlying tension that a few researchers expressed regarding the terms 'data' and 'storytelling', and 'novel knowledge mobilization'. This did not seem to link back to participant ranks. Some notable comments were:

Two different articulations of this tension were expressed in the Science & Technology group:

1. *"[…] Words have meaning, stop trying to make yourself sound better with flowery language. Science is NOT THE PLACE FOR STORYTELLERS"*.
2. *Data is a very loaded word/concept to which interdisciplinary and humanities scholars have very different relationships than social sciences and scientific scholars have.*

From the Arts & Humanities group:

> *"[I] see data as constructed and understanding as evolving and so, I don't want to signal a fixed interpretation, which I think the term data tends to convey"*

From the Social Sciences:

> *"Sounds like a nice way to say you will propagandize the results."*

From an unidentified subject grouping:

> *"Knowledge mobilization activities is a term that doesn't make sense outside of your group. I can't answer this because […] I don't even know what the hell you're asking"*

Although these comments have been highlighted, the vast majority of study participants had a positive outlook on data/ data storytelling and novel scholarly communication methods as a way to share their work with others.

GitHub Pages assessment project

This project's survey contained questions grouped into the following sections: demographics/ learner profiles, resource preference, learning object structure assessment, and learning object content assessment.

Nineteen people responded to the survey which was sent out to the ninety-eight learners who had attended workshops on topics covering data visualization theory, GIS, infographics, data cleaning, network visualization and dashboards. One person answered two questions only and was excluded from the analysis. 83% (n=15) of participants were graduate students, 11% were faculty members (n=2), and one respondent was a postdoctoral researcher (6%). The responses from faculty members were overall consistent with students' responses.

The majority of respondents indicated no experience (Figure 4) when asked about their perceived expertise levels of session content.

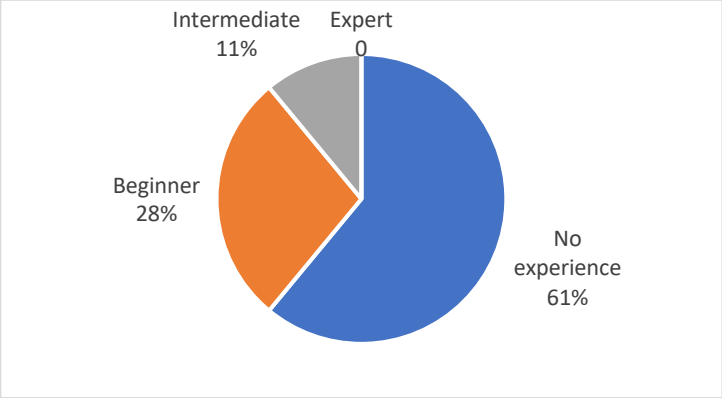


Figure 5: Study population by levels of expertise

In terms of subject areas (29%) were from Environment, Earth, and Resources (traditional geography users), 4 (24%) were from Health Sciences; the other participants were spread across several disciplines including: Arts, Education, Science, Social Work, Engineering, Agriculture and Food Sciences.

In terms of general discussion about learning resources for GIS and data visualization the following responses were shared by participants:

When it came to how session participants preferred to learn a new visualization skill, two categories were highlighted - either an in person or virtual class with an instructor present or via online step-by-step documentation (Table 2).

Preferred learning method	Responses
In-person/ virtual class	**39% (n=7)**
Online step-by-step documents	**33% (n=6)**
Instruction through an experienced mentor	11% (n=2)
Vendor training	6% (n=1)
YouTube videos	6% (n=1)

Table 2: Preferred learning methods of study participants.

83% of respondents also indicated that they were likely to reuse/return to resources once discovered (always, n=7; frequently, n=8). 78% (n=14) respondents also noted that they were more likely to attend training if it was done using an open resource (now commonly referred to as OERs).

When asked what they were looking for when signing up/ attending sessions respondents identified that they were split between looking for introductory and advanced training (table 3) - this makes sense considering that 89% of respondents self-identified as having no experience or beginner.

Respondent goals	Responses
Introductory training	**41% (n=7)**
Intermediate training	24% (n=4)
Advanced training	**35% (n=6)**

Table 3: Respondent goals in signing up for a session

A likert scale question was used to ask participants about what the author should focus on when creating new content- from deeper content on existing topics, to more basic content on additional topics/ software. Learners identified that there was a strong preference for new materials to focus on building depth (scaffolded materials) (Table 4).

Learner priority	Responses
Depth	17% (n=3)
Mostly depth	**39% (n=7)**
Breadth and depth	**33% (n=6)**
Mostly breadth	11% (n=2)
Breadth	0

Table 4: Learner priority breakdown for training materials

Finally, respondents were asked if they though their responses to the questionnaire would have been different if sessions had been in person and we had not had to switch to online learning because of pandemic lockdowns (table 5).

Respondent response	Responses
Would have been different	**33% (n=6)**
Might have been different	**39% (n=7)**
Would not have changed	22% (n=4)
Unsure	6% (n=1)

Table 5: Impact of training format on responses

Some reasons participants thought their responses would have been different include that *"I would not be able to pay attention in person but can take breaks as needed virtually,"* or that "*in person learning is always different.*" Some believed that the responses may have been different, responding that *"It could be, but I believe that pandemic changed lifestyles, and we should get used to having virtual learning."*

Constant comparisons of participants' qualitative responses revealed these key themes:

- Implications of the move to online learning resources on learner experience
- Factors that influence the selection/reuse of data visualization resources
- Pros and cons of learning objects
- Content versus skills

1. **Implications of online learning**:

Respondents believed that the availability of asynchronous online learning tools (GitHub Pages site) provided opportunities for enhancing their knowledge of technological tools, provided flexibility, and encouraged independence. For example, one noted, "*I think it broadened my familiarity with new forms of technology [visualization tools] that I was familiar with but not using regularly, and now assist in teaching others to use (part of my work function).*" Online learning objects also provided more flexibility for learners as another respondent noted:

> *"I've discovered that I learn a lot better when I have the flexibility to go for walks or multitask with mindless work. I have more time for thinking and therefore for problem solving now that I have more flexibility with my schedule."*

The availability of the GitHub Pages resource has also encouraged learners to "*problem solv[e] on my own*" leading people to take more responsibility for their learning. Faculty noted that in general online learning encouraged them to seek different ways to communicate effectively with their students. On the administrative side, a respondent noted that: *"the pandemic helped the university facilitate online course participation, which helped students take courses that they couldn't because of the time limitation*." However, some respondents felt that online learning had disadvantages, including the lack of a sense of community that accompanied virtual learning and the challenges it poses for atypical learners. One respondent wrote "*I have a sensory processing disorder…I prefer engaging with physical material and physical spaces*". Although the workshops took place virtually due to the university's move to online learning, it is important to consider the positive and negative implications virtual learning has on learners and their ability to engage with data visualization instruction.

2. **Factors that influence selection/reuse of data visualization resources**:

The availability and accessibility of learning resources, reviews, and user-friendly features were some of the factors that respondents considered when choosing data visualization resources in general. The availability of tutorials, troubleshooting resources, and positive feedback from previous users, including colleagues, influenced respondents' decision to choose a particular resource. Regarding specific workshops delivered by the library, respondents liked that the Library research visualization content were presented in a website with slides and pdf. One participant's comment echoes other participants' observations: "*The website organizes pieces of it better. I liked the slides being incorporated into the page. I suspect this is more accessible."* Most participants did not prefer the workshop resource being presented as either a webpage or pdf but thought incorporating both was effective. Respondents also thought that the data visualization instruction being open source and accessible was of great benefit as it allowed them to reinforce their learning by referencing the material multiple times. One person explained, *"it is impossible to learn everything the first time. I always have to go back and read them again. The[m] being available is critical for me."* The GitHub Pages site also served as a reference for inspiration for researchers (who did not attend workshops) seeking ideas to visualize research data.

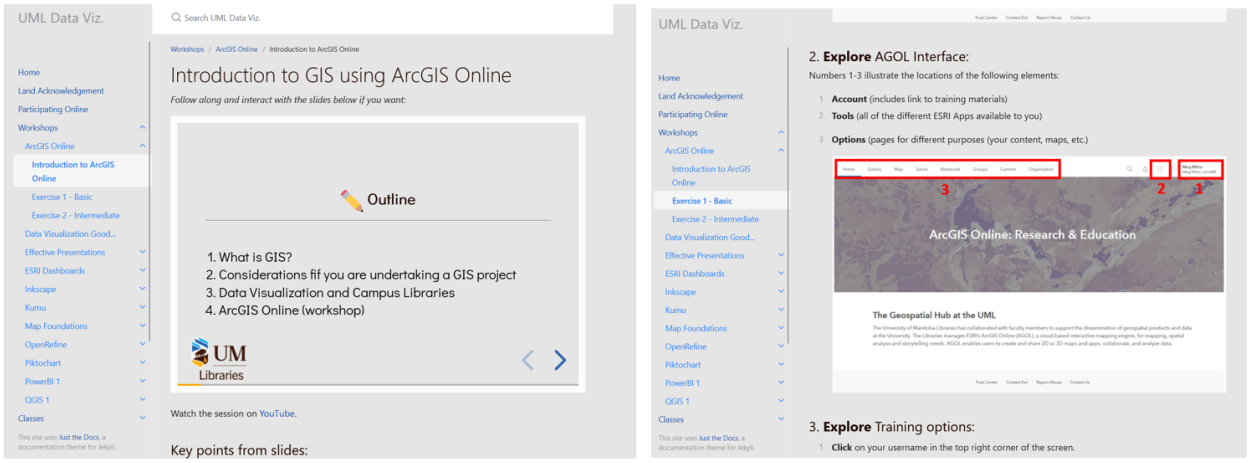


Figure 6: Screenshots of GitHub Pages training resource. Left is a page including embedded slides, right is a page of an exercise walkthrough.

3. Pros and cons of GitHub Pages site:

Although some found the information presented at the workshops to be basic (it was an introductory workshop), respondents were unanimous in their observation that the learning objects allowed for information to be presented clearly and gradually. Respondents indicated that they found the information to be *"useful and useable."* They found the instructions easy to follow, and *"helpful"* and found that the GitHub Pages site was *"intuitive"* and had *"accurate headings for navigation"*. Some of the cons, however, included the look and feel of the resource, the lack of adequate practice exercises, the duration of most workshops (1 hour was too short) and the online mode of delivery. Respondents suggested the *"infusion of colourful elements"* and a more attractive interface. Respondents also thought that having more practice exercises, access to more workshop data, and increasing the workshop duration would be beneficial. Finally, some participants expressed a preference for in-person workshops.

4. Content vs skills:

Respondents thought that learning the skills for data visualization was most important regardless of whether local (geographically) or field-specific data was used. Some expressed that using local data was appropriate except when the data being used influenced the kind of visualization skill that could be learned. One respondent explained that:

> *"The subject matter is not necessarily relevant, however the subject often influences the type of data available or being used. This in turn will affect the examples and methods being shown. Therefore, data typical in my field of study will be more useful than an example with data that is not."*

Although they found the workshops helpful, many respondents expressed the need for data visualization instruction using data specific to their field of study/research area, including qualitative data visualization.

Respondents were also given the opportunity to suggest improvements to the learning objects. Feedback here could be grouped into four major categories:

- Communication
- Multi-modal delivery
- Using relatable data
- Access to resources

Respondents thought the GitHub Pages site was helpful and valuable and suggested better communication about the availability of workshops to students and faculty. They suggested contacting students through listservs and limiting the number of attendees to facilitate deeper engagement.

Also, while respondents were pleased with the workshop delivery, they suggested that *"a combo of web, power point, and in-person packages will deliver more."* Many respondents wanted more in-person workshops and opportunities to follow up with data visualization experts later (this service is already available via the library - future training may emphasize the availability of additional or follow-up supports).

Respondents suggested that the workshop data be discipline/field-specific to make the workshop more relatable and applicable to their research work. Respondents also requested workshops on data visualization of qualitative data as quantitative data *is "often really challenging to do in a clear and concise way"*

Finally, respondents suggested that data used in the workshops should be available to participants for future reference and to reinforce their learning.

Discussion

This paper was born out of one of the author's starting a new job (a newly created role for the institution) and wondering where they could fit into the campus data literacy landscape. The initial study was conceived to answer the question of where researchers were in their knowledge mobilization practices and what type of support they were seeking. During conversations with faculty and students, they expressed frustration with the lack of support for digital communication tools on campus. The author, prioritized creating supports for campus users by working with their internal Learning and Instruction team. This included consultation hours, lab drop-ins, workshops integrated into Graduate Studies programming, class integration, and embedding into lab groups. On top of this forward-facing work, they also took on roles in systems development and software and data license management to build a base in libraries.

The outcome of both of these surveys was that key user groups and needs were identified, and the critical connection between learner and content creator identified by Ain et al. (2016) would be created. Below are the current trends in data literacy at UM.

Users

Users from all program groupings (Health Sciences, Science & Technology, Social Sciences and Arts & Humanities) are interested in using digital tools to improve their communication. They recognize that different audiences will be able to understand the information shared by using innovative communication methods. However, many of our research participants, including faculty, staff or students, experience barriers to accomplishing this due to lack of tools, training and time.

Ongoing training in these tools is usually self-directed, with original exposure in a class, workshop put on by libraries, or other formal training environment. Users expressed interest in using sample data where they can 'see themselves'. Making online training materials available allowed users to work through them on their own time and at their own pace outside formal training sessions.

Learners also expressed frustration at not knowing what type of support was available on campus in terms of software, data, and services. Many researchers whom the author had met via consultation bookings assumed they were alone in their tool use or lack of training. Users with intermediate levels of expertise in tools, often had experience for a previous workplace or educational institution.

Librarian implemented supports

In response to this feedback, the author adjusted the supports they were providing, they will be discussed below.

Resources:

1. **Creation of Libguides - GIS & Geovisualization, and Data Visualization**

Provide listings of data sets that researches could integrate into their work, as well as links to different tools and resources with notes to what is supported by the institution. These were in the top three used subject guides at the University of Manitoba in the last calendar year.

2. **Integrated GIS analysis environment (GIS Hub)**

Researchers did not know which visualization tools were available and found the process to access the GIS tools too convoluted to bother with. The author streamlined the process of Esri (GIS Software for Mapping and Spatial Analytics) license management on campus by implementing SAML authentication and developing an Enterprise instance that integrates with ArcGIS Online, desktop and mobile applications. This authentication integration, built trust with the central IT department as well as other researchers on campus. The system also acts as an open and proprietary data repository highlighting authoritative data that users can use in their work. Managing users as named accounts allows UM to restrict access to active university users easily. From the implementation date to the time of writing, the population of researchers using the GIS Hub has grown from less than one hundred to over nine hundred active users.

3. **Workshop and teaching content hosted in GitHub Pages**

The move to online learning during the pandemic lockdown provided impetus for the author to create an open online repository of their training materials integrating slides, walk-throughs, and in some cases, recordings. While it took a lot of work to create this repository, the feedback overall has been very positive. Drupal (used by UM) would be an alternative platform that provides a more polished experience, but the author values the ability to host and share content openly in GitHub.

Programming

Survey responses indicated a level of disconnect among users which was previously unknown to the author. To resolve this tension, I changed how I talk about and describe the data visualization support I offered.

1. **Teaching and Workshops**

Hearing how desired skill sets were less tied to specific programs and tension around certain terms prompted workshops to be rebranded. "Data Dashboards for beginners" shifted to "PowerBI: A gentle introduction" and most recently, "Integrating word-clouds into research" has proven more popular than its predecessor, "Data cleaning for with OpenRefine," which is the same session with the same description.

This approach is also taken when describing how to use a tool during workshops. For example, if a menu item is labelled as 'Data', then describing its intended use to the users is reframed to "this is where you will click to find the file you want to visualize" instead of "this is where you import your data."

2. **GIS Days**

The previous map librarian ran a day of GIS programming, bringing in speakers from local governments and organizations and highlighting large projects with a GIS component at the institution. As author's role is broader, they took a different approach to moving this initiative forward. Instead, UM is partnering with Western University to offer a week of researcher-focused virtual programming from presenters at all stages of GIS expertise. In 2023, two in-person panels were also run, one of students and the other of faculty from different areas, to discuss their experiences in GIS at UM. This was very well received and prompted the resurrection of the Data-Viz Drop-in.

3. **Data Viz Drop-in**

UM is quite a siloed institution, internally and externally. While there are pockets of interdisciplinary work going on, there are not many opportunities for researchers to come together across departments and learn from one another. The author had run a drop-in session out of a library lab for a short time before the lockdowns and did not prioritize it once the campus opened back up; however, one of the students articulated its value during a GIS Day panel. The drop-in session was restarted in the winter semester (2024) as it gives students from different programs an opportunity to become aware of peers with similar interests and have the opportunity to follow up with one another and share expertise. This peer-assisted learning method has been identified in the literature (Al Hashlamoun & Daouk, 2020; Harding & Engelbrecht, 2015) as an effective way for student learners to build their skills.

A lack in digital tool support across campus is not a gap one person in libraries can or should be expected to fill. All this information gathered has allowed the author to better articulate the overwhelming demand and maxed-out capacity narrative driving their professional life for the past four years. In consulting with their unit coordinator, new boundaries have been laid, and many of the conversations and meetings with faculty have shifted to one of hiring priorities. During faculty meetings, the author advocates that if a program promotes these novel knowledge mobilization techniques within the data visualization sphere to students, academic departments cannot depend on Libraries alone to troubleshoot, advise and teach – they need to hire their own experts. And slowly it is beginning to happen - in the last six months, new professors in agriculture and architecture have been hired, both of whom have expertise in the digital realms of their field, and teaching release time has been provided to a linguistics department member to build a new course on GIS methods. The author writes letters of support for researchers applying for grants to hire RAs with the required technical skills and helps them craft these job descriptions. While this approach results in fewer reference stats being recorded by the librarian, it feels much more sustainable and has started a broader conversation on campus that dovetails with other data service questions, especially those related to research data management.

Future

While these findings are specific to the author's institution, they offer questions a data services provider could ask themselves. Discussion of data visualization as an emergent trend has been the focus in the literature, and this instead focuses on what is being done to support users in the library and will advance the practice of engaging with and instructing this group of users.

References

Acosta, M. L., Sisley, A., Ross, J., Brailsford, I., Bhargava, A., Jacobs, R., & Anstice, N. (2018). Student acceptance of e-learning methods in the laboratory class in Optometry. *PLOS ONE*, *13*(12), e0209004. https://doi.org/10.1371/journal.pone.0209004

Ain, Q., Aslam, M., Muhammad, S., Awan, S., Pervez, M. T., Naveed, N., Basit, A., & Qadri, S. (2016). A technique to increase the usability of e-learning websites. *Pakistan Journal of Science*, *68*(2), 164-169.

Al Hashlamoun, N., & Daouk, L. (2020). Information technology teachers' perceptions of the benefits and efficacy of using online communities of practice when teaching computer skills classes. *Education and Information Technologies*, *25*(6), 5753–5770. https://doi.org/10.1007/s10639-020-10242-z

Burton, M., & Lyon, L. (2017). Data science in libraries. *Bulletin of the American Society for Information Science and Technology*, *43*(4), 33-35. https://doi.org/10.1002/bul2.2017.1720430409

Charmaz, K. (2014). *Constructing grounded theory* (2nd ed.). Sage.

Chin Roemer, R., & Kern, V. (Eds.). (2019). *The culture of digital scholarship in academic libraries* American Library Association.

Diaz, C. (2018, June 7). *Jekyll and institutional repositories*. Northwestern University Research and Data Repository. https://arch.library.northwestern.edu/concern/generic_works/6q182k274

Dykes, B. (2016). *Data storytelling: The essential data science skill everyone needs*. Forbes. https://www.forbes.com/sites/brentdykes/2016/03/31/data-storytelling-the-essential-data-science-skill-everyone-needs/

Fouh, E., Akbar, M., & Shaffer, C. A. (2012). The role of visualization in computer science education. *Computers in the Schools*, *29*(1–2), 95–117. https://doi.org/10.1080/07380569.2012.651422

Harding, A., & Engelbrecht, J. (2015). Personal learning network clusters: A comparison between mathematics and computer science students. *Educational Technology & Society*, *18*(3), 173–184. https://www.jstor.org/stable/jeductechsoci.18.3.173

Harmon, J. E., & Gross, A. G. (2010). *The craft of scientific communication*. University of Chicago Press.

Henshaw, A. L., & Meinke, S. R. (2018). Data analysis and data visualization as active learning in Political Science. *Journal of Political Science Education*, *14*(4), 423–439. https://doi.org/10.1080/15512169.2017.1419875

Herther, N. K. (2019). Library Carpentry: A toolkit for researchers. *Information Today*, *36*(3), 16–18.

Neville, T., & Crampsie, C. (2019). From journal selection to open access: Practices among academic librarian scholars. p*ortal: Libraries and the Academy*, *19*(4), 591–613. https://doi.org/10.1353/pla.2019.0037

Newson, K. (2017). Tools and workflows for collaborating on static website projects. *The Code4Lib Journal*, *38*. https://journal.code4lib.org/articles/12779

Pagowsky, N., & McElroy, K. (2016). *Critical library pedagogy handbook: Essays and workbook activities* Association of College and Research Libraries.

Pugachev, S. (2019). What Are "The Carpentries" and what are they doing in the library? *portal: Libraries and the Academy*, *19*(2), 209–214. https://doi.org/10.1353/pla.2019.0011

Rickles, P., Ellul, C., & Haklay, M. (2017). A suggested framework and guidelines for learning GIS in interdisciplinary research. *Geo: Geography and Environment*, *4*(2), e00046. https://doi.org/10.1002/geo2.46

Saba, F., & Shearer, R. L. (2018). *Transactional distance and adaptive learning: Planning for the future of higher education*. Routledge. https://doi.org/10.4324/9780203731819

Stevens, H. (2016). [Review of the book *Big data, little data, no data: Scholarship in the networked world*, by Christine L. Borgman]. *Technology and Culture*, *57*(3), 706–708. https://doi.org/10.1353/tech.2016.0099

Weller, M. (2011). *The Digital scholar: How technology is transforming scholarly practic*e. Bloomsbury Academic. https://doi.org/10.5040/9781849666275

Appendix A: Data storytelling survey

Consent form:

User clicks ***"I Consent"*** at bottom of letter and the following survey opens:

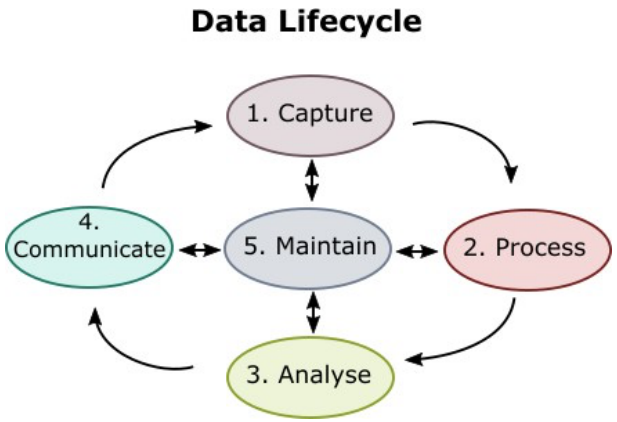
Page 1: Demographics: The following section looks at who you are within the institution:

	Type	Question	Option:
1	Dropdown	Please select your primary faculty:	• Faculty of Agricultural and Food Sciences • Faculty of Architecture • School of Art • Faculty of Arts • H. Asper School of Business • Faculty of Education • Price Faculty of Engineering • Clayton H. Riddell Faculty of Environment, Earth and Resources • Extended Education • Faculty of Graduate Studies • Libraries • Rady Faculty of Health Sciences • School of Dental Hygiene • Dr. Gerald Niznick College of Dentistry • Max Rady College of Medicine • College of Nursing • College of Pharmacy • College of Rehabilitation Sciences • Faculty of Kinesiology and Recreation Management • Faculty of Law • Desautels Faculty of Music • Faculty of Science • Faculty of Social Work • University 1 • University Administrative Units

2	Radio Buttons	Please select your position:	Radio buttons for question 2 asking for participant's position on campus. Options include: Instructor I, Insturctor II, Senior Instructor, Lecturer, Assistant Professor, Associate Professor, Professor, Archivist, General Librarian, Assistant Librarian, Associate Librarian, Lbirarian, PhD Candidate, Master's Cadidate, Researcher Other.
3	Radio buttons + text line	Are you cross appointed? If yes, with what other faculty?	Yes/ No + line that appears if 'yes' is selected
4	Radio buttons + text line	Do you have professional affiliation with any other centres/institutes? If yes, with what centre/institute?	Yes/ No + line that appears if 'yes' is selected

Page 2: Data: In thinking about your research data

	Type	Question	Option:
5	Check boxes	What type of data do you typically collect?	Check boxes for Always qualitative, Mostly qualitative, qualitative and quantitative, mostly qualitative, always quantitative.
6	Multi-line open text	Are there secondary data sets that you regularly use to supplement the data you collect (Crop inventory, census etc.)? Please include the dataset name and producer.	

7	Check boxes	How old are the data sets you regularly use to supplement your data?	Check boxes for age of data sets: Historical, Mostly historical, Current and historical, Mostly current, Always most current available.
8	Ranking	Looking at the data analytics lifecycle below, rank from most to least how much time you spend in each section of the cycle. 	Randomly sorted list of elements from the data analytics lifecycle: Maintain, Process, Analyze, Communicate, Capture.

Page 3: Software: In thinking about the software that you/your lab group use for your analysis

	Type	Question	Option:
9	Multi-line open text	What software or coding language(s) do you use for analysis?	
10	Multi-line open text	Where did you initially learn to use those tools?	
11	Multi-line open text	Where do you get your ongoing training and/or support for using these tools?	
12	Radio buttons + text line	Does the software you use significantly alter the format of your original data? (Eg: csv file to cartographic output) If yes, how?	Yes/ No + line that appears if 'yes' is selected
13	Radio buttons + text line	Do you use different software than you use for analysis to create your data visualizations? If yes, what software and why?	Yes/ No + line that appears if 'yes' is selected

Page 4: Knowledge mobilization

SSHRC defines knowledge mobilization as "moving knowledge into active service for the broadest possible common good."

	Type	Question	Option:
14	Check boxes + text line	What knowledge mobilization activities do you do?	Check boxes for: Conference posters, Conference presentations, Journal articles, Trade publication articles, Podcast, Blog/social media, Professional website, and other. *Randomly sorted each time, if 'other' is selected , text input opens for user to type

15	Check boxes + text line	Who is the audience for these knowledge mobilization activities?	Check boxes for: Industry, Students, Government agencies, Academics across various fields, General public, Academics in your field, Other. Randomly sorted each time, if 'other' is selected , text input opens for user to type

16	Check boxes	Do you create different data products for different audiences?	Check boxes for Always, Frequently, Sometimes, Infrequently, Never
17	Multi-line open text	Are there knowledge mobilization activities that you do not currently do, but you have plans to or would like to in the future? If yes, please describe.	

Page 5: Data storytelling:

Keeping Dyck's definition of data storytelling in mind ("a structured approach for communicating data insights, and it involves a combination of three key elements: data, visuals, and narrative."); answer the following section for yourself.

	Type	Question	Option:
18	Multi-line open text	What is data storytelling to you?	
19	Multi-line open text	Do you consider yourself a data storyteller? If yes, why?	
20	Multi-line open text	Do you have any additional comments about data storytelling?	

SUBMIT

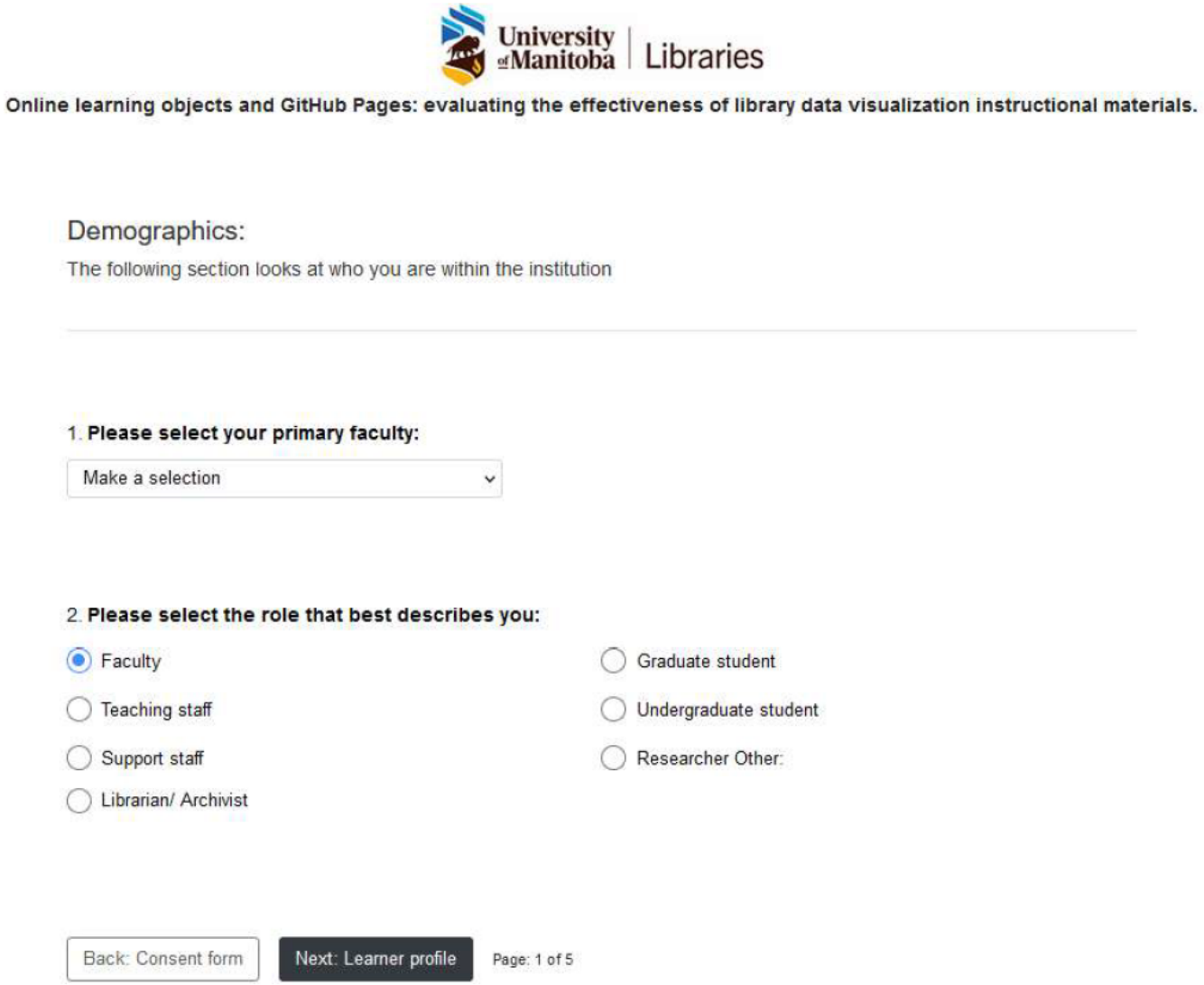
Page 6: Exit + option to submit contact info to be part of focus groups in a future study (stored in separate form)

Thank you for taking the time to fill out our survey. Results of this study will be made available by December 2020 at the following URL: https://libguides.lib.umanitoba.ca/ktrs.

Would you like to participate in focus groups for phase two of our study to look at your knowledge mobilization practice in greater detail?

Click this link to enter your email address if you would like to be contacted to follow-up in a future focus group.

Appendix B: GitHub Pages survey



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Who are you as a data visualization learner?

Tell me more about your learning preferences.

3. **Before attending the session, how much experience did you have with it's subject?**

	No experience	Beginner	Intermediate	Advanced	Expert
Experience:	☐	☐	☐	☐	☐

4. **Use the slider below to show how much support do you prefer when learning a new skill.**

0 (I never ask for help) (I like to be lead, show me where to click!) 10 Clear

5. **What is your preferred way to learn a new software?**

- (●) In person/ Virtual class
- ( ) Vendor training

- ◯ Experienced mentor
- ◯ YouTube videos
- ◯ Online step-by-step document
- ◯ Other:

6. **Now that you have a year and a half of online learning experience, are you more willing to learn new software skills on your own?**

	Definitely won't	Probably won't	Probably will	Definitely will	Undecided
Probability:	☐	☐	☐	☐	☐

7. **Do you feel like being forced into a virtual sphere was a net positive or negative towards your problem solving skills? How?**

Back: Demographics | Next: Resources | Page: 2 of 5

Online learning objects and GitHub Pages: evaluating the effectiveness of library data visualization instructional materials.

Resources:

In thinking about the software training resources that you use:

8. **Use the slider to select which is more important to you when selecting a resource.**

Usefulness Useability Clear

9. **What is your approach to selecting the right resource when you are trying to solve a software related problem?**

10. **If you find a resource that serves you well, do you return for future reuse or start a new search each time?**

	Always	Frequently	Sometimes	Infrequently	Never
Reuse:	☐	☐	☐	☐	☐

11. **Would it influence your selection if you knew a training resource was created using open tools?**

	Not likely	Somewhat likely	Very likely
Selection:	☐	☐	☐

Back: Learner Profile | Next: Learning object structure | Page: 3 of 5

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Online learning objects and GitHub Pages: evaluating the effectiveness of library data visualization instructional materials.

Learning object structure:

The resources used for your session workshop were built using GitHub Pages, with the idea of creating a repository of learning materials that are open for reuse.

12. **How would you rate the organization of the workshop content?**

Make a selection

13. **Now that you know that these training materials exist, do you think you will come back and reuse them?**

○ No ○ Yes ○ Maybe

14. **Why or why not?**

15. **What did you like the most about the design of the workshop learning space?**

16. **What would you change about the design of the workshop workspace?**

17. **Did you find it helpful to have the workshop content formatted as a web page as opposed to slides, a pdf or oral instructions? What works for you and why?**

Back: Resources | Next: Learning object content | Page: 4 of 5

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Online learning objects and GitHub Pages: evaluating the effectiveness of library data visualization instructional materials.

Learning object content:

In thinking about what kind of content would be useful to you as a web resource...

18. What is more important to you: breadth (many different software) or depth (different skill levels) of content?

	Breadth	Mostly breadth	Breadth and depth	Mostly depth	Depth
Priority:	☐	☐	☐	☐	☐

19. **Use the slider to show what you are hoping for when you come to a data visualization session put on by Libraries. To be introduced to a new topic or to learn to master a software?**

Introduction Advanced mastery Clear

20. **When attending workshops, do you care about the subject matter?**

Ie: Do you prefer to work through examples using local data, or are you impartial to the subject as long as someone is present to answer questions and facilitate the session?

21. **Do you think your answers to this questionnaire would have been different had the training been held in person as opposed to in the virtual environment?**

22. **What are your suggestions to improve the data visualization workshop experience as a whole, or do you have any other feedback?**

Back Submit Survey Page: 5 of 5

End notes

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