3-16-2023

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This is an open access article published by University of Alberta Library in *EBLIP*, in 2023, available online:
https://dx.doi.org/10.18438/eblip30138

Recommended Citation

Condon, P., Exline, E., & Buckley, L. (2023). Data Literacy in the Social Sciences: Findings from a Local Study on Teaching with Quantitative Data in Undergraduate Courses. Evidence Based Library and Information Practice, 18(1), 61–75. https://doi.org/10.18438/eblip30138

Evidence Based Library and Information Practice

Research Article

Data Literacy in the Social Sciences: Findings from a Local Study on Teaching with Quantitative Data in Undergraduate Courses

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Received: 29 Apr. 2022 **Accepted**: 23 Nov. 2022

Data Availability: Due to the small, local sample used in this research study, participants were not asked to agree for their data to be shared publicly, so supporting interview transcripts are not available.

DOI: 10.18438/eblip30138

Abstract

Objective – The University of New Hampshire (UNH) Library conducted an exploratory study of the pedagogical practices of social science instructors at UNH who teach using quantitative data in undergraduate courses. This study is connected to a suite of parallel studies at other higher education institutions that was designed and coordinated by Ithaka S+R.

The four aims of this study were to explore the ways in which instructors teach and engage undergraduates in the social sciences using quantitative data; understand the support needs of these instructors; develop actionable recommendations for campus stakeholders; and identify opportunities for the development of resources, services, or activities in the library to support the use of quantitative data in the classroom.

Methods – For the UNH study, the research team recruited eleven participants through convenience sampling for one-on-one, semi-structured interviews. The study sample included lecturers, assistant professors, associate professors, and full professors across seven social science disciplines from the Durham and Manchester campuses.

Results – Courses using data provide a unique opportunity for students to gain experience by working with hands-on examples. The two overarching themes identified speak to both the motivations of instructors who teach with data and the challenges and opportunities they face: teaching with data for data literacy and scientific literacy and teaching with data for statistical, data, and tools skill building.

Conclusion – Data literacy is an important set of competencies in part because of the quality and quantity of data students encounter; they need to have the ability to critically evaluate data, methods, and claims. This study directed attention to an area that had not previously been examined at UNH and is an important first step toward creating greater awareness and community of practice for social science instructors teaching with data. The UNH Library offers research data services and is exploring new ways of supporting data literacy. UNH has opportunities to create additional supports for instructors and students that could improve student learning outcomes. Such efforts may require cross-college or cross-department coordination as well as administrative support.

Introduction

Teaching undergraduate students to work with data is essential—not only for handling data in research-intensive fields but also for gaining valuable skills for entering the workforce and as informed members of society trying to interpret news stories and public policy. Incorporating data use into the curriculum gives undergraduate students opportunities in the classroom to learn data literacy skills ranging from finding, collecting, and analyzing data to interpreting visualizations to effectively presenting an argument using data. Because of data literacy's corresponding relationship with information literacy, librarians are key stakeholders in conversations to foster data literacy education and instruction efforts across campus.

As the University of New Hampshire (UNH) Library continues to develop its data services and information literacy programs, including support for data literacy, understanding the local practices and needs of instructors can help in making evidenced based decisions about services. Additionally, informing campus stakeholders outside the library (such as the office of Academic Technology, the Center for Excellence and Innovation in Teaching & Learning, and college deans and department chairs) of potential opportunities for interdisciplinary efforts to enhance instruction in this area can lead to increased awareness of data literacy across campus. Knowing more about teaching practices used for incorporating data use into the curriculum can also support improved data literacy instruction and better prepare undergraduates with necessary data-related skills.

To learn more about teaching with data on campus and as part of a larger Ithaka S+R research project, librarians at the UNH Library conducted a study of the pedagogical practices of social science instructors at UNH who teach using quantitative data in undergraduate courses. Ithaka S+R designed the project and invited participation from libraries. Each participating library conducted a local research study using the methodology established by Ithaka S+R. In this article, we summarize the findings from the study conducted at UNH and discuss how the findings address the aims of the study. This was an exploratory qualitative study that used one-on-one semi-structured interviews. The goal of the study was to better understand instructors' undergraduate teaching practices related to the use of quantitative data for meeting course learning objectives in the social sciences.

Literature Review

The literature on teaching with data in the social sciences is substantial and varied in topic. This review focuses on literature that discusses characterizing and fostering data and statistical literacy, instructional strategies for integrating quantitative skills into curricula, and barriers to learning data concepts. A sizable portion of the studies reviewed focus on Research Methods and Statistics courses, often in sociology, although a cross section of social sciences disciplines is represented.

Data and Statistical Literacy

Data literacy and statistical literacy are separate but related concepts. They overlap and interact with the broader concepts of information literacy and scientific literacy and with adjacent concepts such as scientific thinking (Hosein & Rao, 2019), social scientific reasoning, and quantitative literacy (Caulfield & Persell, 2006). Data literacy has typically been described as the ability to understand data and representations of data, to draw and support conclusions, and to evaluate claims, and it may extend to functional use of data such as data collection, analysis, and interpretation (Carlson et al., 2011; Wolff et al., 2016). In disambiguating statistical literacy and data literacy, Wolff et al. (2016) define statistical literacy as assessing the validity of statistics being presented but with an awareness of the processes by which statistics and associated visualization were created. In this way, data literacy informs statistical literacy.

Instructional Strategies

Instructors who teach with data employ an array of pedagogical strategies to foster students' data literacy skills and knowledge of discipline-specific methodologies. Many of these strategies fall into the broad categories of active learning, experiential learning, and student-centred learning that rely on engaged student participation in the learning process. Examples include student-led creation of learning materials that can then feed back into the curriculum (Clark & Foster, 2017), working in collaborative groups that

aim to enhance learning through discussion and accomplishing shared project goals (Caulfield & Persell, 2006; Lovekamp et al., 2017), collecting data or analyzing available data (Lovekamp et al., 2017), or conducting data projects in partnership with community organizations (Nurse & Staiger, 2019; Wollschleger, 2019). Neumann et al. (2013) suggest that the use of real-world data enhances the significance of the course experience for students. Additional instructional strategies include using data analysis modules or labs (Fellers & Kuiper, 2020), surveying members of a course and analyzing the resulting data (Brown, 2017), using games (Lawrence, 2004), and data mining (Hartnett, 2016).

Barriers to Learning

Statistical anxiety and math anxiety are frequently discussed as barriers to learning in courses using data. Summarizing the literature that defines these associated phenomena, Cui et al. (2019) state that math anxiety has to do with the manipulation of mathematical symbols, while statistical anxiety has to do with understanding the language used to describe and interpret data within statistics. These anxieties are overlapping in definition and tend to coexist in individuals (Cui et al., 2019). Other studies found statistical anxiety to be related to student perceptions of past math performance, insufficient math background (Condron et al., 2018; Rode & Ringel, 2019), other types of academic anxiety, and self-concept (beliefs about one's intrinsic abilities) around quantitative skills (Faber & Drexler, 2019; MacArthur, 2020). Faber and Drexler (2019) also found a connection between statistical anxiety and student beliefs about the usefulness (utility value) of learning statistics, which they suggest can be addressed by emphasizing the practical and vocational application of such skills.

Reviews of the empirical evidence find that the negative relationship between statistical anxiety and academic performance may be overstated (MacArthur, 2020; Ralston et al., 2016) and require additional study to establish causation (Filiz et al., 2020). Instructors may attribute hesitancy to work with data as the result of insufficient math preparation or anxiety when the issue is a preference for non-mathematical methods (Chamberlain et al., 2015). Providing math and statistics support, such as drop-in consultations and peer tutoring, can help overcome these anxiety barriers (Cantinotti et al., 2017; Elbulok-Charcape et al., 2019; Intepe & Shearman, 2020). A survey-based assessment of a project implementing the American Sociological Association's and Social Science Data Analysis Network's *Integrating Data Analysis* project modules (see Hilal & Redlin, 2004) into the curriculum at Lehman College identified the removal of barriers, such as insufficient math skills, and a well-sequenced curriculum as key factors in teaching quantitative concepts (Wilder, 2010).

Aims

This review of the literature highlights that teaching with data in social science courses is a valued pedagogical approach for improving data literacy skills in undergraduates. The UNH study investigates local pedagogical practices and instructor needs to inform the augmentation of services on campus. The aims of this study are to

1. explore the ways in which instructors teach and engage undergraduates in the social sciences using quantitative data;
2. understand the support needs of these instructors;
3. develop actionable recommendations for campus stakeholders; and
4. identify opportunities for the development of resources, services, or activities in the library to support the use of quantitative data in the classroom.

Methods

The study undertaken at UNH was connected to a suite of parallel studies conducted locally at other higher education institutions. Ithaka S+R, a not-for-profit research and consulting organization that supports academic, cultural, and publishing communities, coordinated this multi-institutional effort. Ithaka S+R conceptualized and designed the research project "Teaching with Data in the Social Sciences," including developing the methodology and providing local teams guidance on conducting the project at their institutions (Cooper, 2019). After obtaining IRB approval, the UNH research team carried out the research at our institution, including recruitment of participants, data collection and processing, and analysis and interpretation of our dataset to identify local themes (see Condon et al., 2021 for a detailed methodology).

Data Collection

UNH is a medium-sized flagship Land, Sea, and Space Grant research university that was established as an agricultural and mechanical arts school in 1866. UNH enrolls around 15,000 students, with approximately 12,000 undergraduates and 3,000 graduate students across three campuses: Durham, Manchester, and the UNH Franklin Pierce School of Law in Concord. The College of Liberal Arts (COLA) on the Durham campus houses most of the social science disciplines; however, there are social science disciplines represented in all the other colleges and on the Manchester campus. COLA has the largest enrollment of undergraduates with over 3,100 enrolled in spring of 2022.

The study sample at UNH, recruited through convenience sampling, included eleven lecturers, assistant professors, associate professors, and full professors across seven social science disciplines on two campuses who engaged in teaching undergraduate students to work dynamically with quantitative data (e.g., collecting data through social science research methods, finding existing data to address a research question, using software tools to analyze data, and drawing conclusions from data). We conducted and recorded one-on-one interviews online via Zoom, a video-conference software, during the fall of 2020. All research team members were trained on the informed consent process and interview guide to ensure consistency across interviews. Recorded interviews were transcribed by a third party and de-identified by the research team.

Data Analysis

After the interviews were transcribed and de-identified, the research team conducted qualitative coding of the transcripts based on a coding process using grounded theory methodology that was recommended by Ithaka S+R (Strauss and Corbin, 2014). Using the qualitative analysis software NVivo, coding and analysis were done through an iterative process (see Figure 1). All three team members conducted initial open coding on the same set of three interview transcripts to identify emergent codes in the data (phase 1). The team discussed and compared the initial codes, selected several core themes that emerged from the open coding, and determined a final set of focused codes (phase 2). Once coding of all interviews was complete, the team identified overarching themes that emerged from the focused coding (phase 3) and used these to address the aims of the study (phase 4).

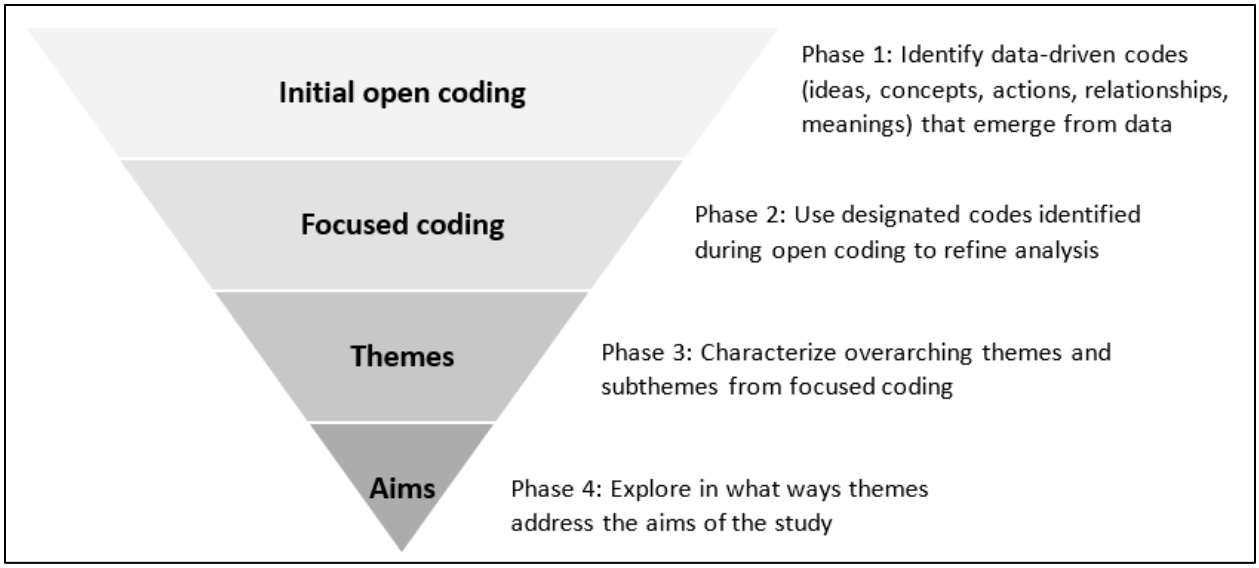

Figure 1
Qualitative coding process used by UNH research team.

The following focused codes developed in phase 2 were used to analyze all transcripts:

- *Learning objectives*. Comments and reflections about learning objectives instructors have defined as desired outcomes for their students within courses.
- *Challenges understanding data*. Comments and reflections about challenges students experience in understanding data concepts and working with data.
- *Student prior learning.* Comments and reflections about expected preparation at the high school level or college level prior to the data course; student skills or viewpoints brought to the data course; perceived student anxiety about math or science; perceived student abilities with mathematical concepts or skills; student motivation; and perceived student challenges with basic software, technical familiarity, and access.
- *Locating and providing data for use*. Comments and reflections about finding datasets for use in teaching, qualities of data that instructors look for, common sources for usable data, and challenges of teaching with data.
- *Support outside the classroom* (for both students and instructors). Comments and reflections about where students go for support regarding data-related questions or needs outside the classroom. Comments and reflections about professional development for instructors around teaching with data and learning new methodologies and tools.

Results

From the focused coding, two overarching themes emerged that spoke to the motivations of instructors for teaching with data and the challenges and opportunities they face. Table 1 presents the themes and subthemes that we derived from the focused coding.

Table 1
Themes and Subthemes That Emerged From the Coding

Phase 3: Themes	Phase 3: Associated subthemes	Phase 2: Focused codes from which themes/subthemes were derived
Teaching with data for data and scientific literacies	• Students as consumers of data • Students interpreting data • Students learning the scientific method	• *Learning objectives* • *Challenges understanding data*
Teaching with data for statistical, data, and tool skill building	• Students working with data • Instructors providing data for use • Sources of support on campus	• *Learning objectives* • *Challenges understanding data* • *Student prior learning* • *Locating and providing data* • *Support outside the classroom*

Teaching With Data for Data and Scientific Literacies

The theme "teaching with data for data and scientific literacies" represents a desire among participants to introduce or strengthen a broad set of foundational skills that they believe students need to be successful. These skills include a wide range of competencies connected to critical thinking, from essential information and data literacies to understanding scientific methodologies and their underpinnings. This theme has three subthemes: students as consumers of data, students interpreting data, and students learning the scientific method.

Students as Consumers of Data

Although data, information, and scientific literacy skills development are not always explicit learning objectives in courses using data, they are addressed by most participants because of their importance as life skills and as foundations for more explicit learning objectives around scientific thinking and disciplinary research methods. When participants do emphasize learning data literacy among their implicit goals for a course, this is often expressed as helping students to "be savvier consumers" of data of all kinds (Participant 05).

One driver for including data literacy as course objectives is the shared perception among participants that there is a flood of low-quality online representations of data and that much of what students will encounter in their everyday lives is, as one participant bluntly stated, "complete garbage" (Participant 06). Another participant mentions that "depending on where they're coming from in life, [students] may or may not have had any life experience to really give them a foundation to think about data from"

(Participant 09). As savvy consumers of data, students need to be equipped to assess the validity of claims. They need to be able to recognize misleading or false claims and to identify claims that might be intentionally deceptive, are based on faulty reasoning, or have poor methodology. Conversely, students should be able to recognize sound methodology where the arguments and conclusions presented are supported by the data cited.

Students Interpreting Data

There is a sense of urgency around helping students navigate the challenges of an information environment in which accuracy is sometimes secondary to messaging and "the difference between opinion and argument" can be difficult to discern (Participant 07). Students need to know enough about data to begin to ask interrogative questions, identify biases, and recognize misrepresentations:

> Are there other data sources that might tell a different story? Or is there something about the way this data is being presented that biases the presentation toward a certain type of conclusion? . . . I want them to ask those kinds of questions of me. And then, also, of themselves, as they work with data. Because we're being bombarded all the time with information, and oftentimes with just conclusions and statements about this is the way things are (Participant 01).

Data literate students should be equipped to question the data and claims they encounter and to understand that data "doesn't tell a story by itself" (Participant 01), but is interpreted, analyzed, and presented by people. Students also need a level of data proficiency to progress to more advanced courses, to be members of the workforce in which those skills are increasingly important, and to be "a good citizen" (Participant 01) in a participatory democracy in which even accurately presented data can be used to tell conflicting stories.

Students Learning the Scientific Method

Many courses using data have explicit learning objectives to introduce students to disciplinary research methods. Students transition from data literacy as academic and life skills to contextualizing these skills in an understanding of the scientific method and social science disciplinary research methodologies, setting the stage for deeper learning about methods and knowledge building. To this end, participants use data as a tool to help acclimate students to scientific thinking:

> It's a very important part of the process of helping students understand what scientists do, and what people who are real researchers do . . . it's really emphasizing the use of data and empirical knowledge to make sense of what we see (Participant 11).

The scientific method and its core principle of using empirical evidence to substantiate arguments is a different way of learning about the world than students may have encountered previously. It may even bump against other ways of learning that students have internalized, such as those with an arts and humanities focus where "the whole scientific method is sort of not their ballpark" (Participant 05), and they may have developed a "pattern of learning" (Participant 02) that works against their interpretation of numeric data, presumably a pattern based on textual rather than numeric analysis. Additionally, popular notions on how to conduct research, such as participation in informal polls and surveys, may cloud students' understanding of methods: "they've grown up in a world, unfortunately, where every

fool with a modem and internet connection does what they call a survey, there is so much misperception about how to do survey research. I think that's really damaging" (Participant 02).

Teaching With Data for Statistical, Data, and Tool Skill Building

While the previous theme focused on contextualizing motivations for teaching with data in terms of a holistic understanding of data and scientific literacies, the theme "teaching with data for statistical, data, and tool skill building" focuses on working with datasets and the development of skills such as understanding statistical concepts, variables and measurements, and tools for working with data. Participants expressed working with data as a continuum of concepts and skills that build upon one another. Students tend to move from a basic understanding of variables —how variables are measured and how data is structured—to interpreting graphic visualizations of data and conducting and interpreting statistical analyses. Finally, they move to providing a written interpretation of findings and their significance. This theme has three subthemes: students working with data, instructors providing data for use in the classroom, and sources of support on campus.

Students Working With Data

The participants emphasized the challenges that students face when working with data. As noted by one participant, "I always have to try to remember how unfamiliar they are with using data" (Participant 07). Students struggle for a variety of reasons, including difficulty with or anxiety around math skills, lack of experience with or lack of retention of math or statistical concepts, obstacles learning to use analysis software, or problems specific to how data is structured and manipulated. Students in a course are unlikely to have uniform knowledge or exposure to data concepts. This diversity of experience results in what one participant described as a "heterogeneous knowledge base" (Participant 11) within a single course that makes teaching course content at the appropriate level more difficult. In some cases, software serves a pedagogical role in helping students practise analytical concepts; in other cases, participants consider working knowledge of software packages as transferable job skills.

A common theme from participants was about students' math anxiety or difficulty with math skills. Prior experiences around learning math in K-12 can lead some students to develop a mindset that they are not going to be good at math or science:

> So, technical challenges [are] one aspect, obviously, of it. I feel like, depending on their comfort level with statistics, depending on their comfort level with math and with numbers, there's a level of anxiety that goes with it. That, they see a lot of numbers and just freak out (Participant 10).

It is each student's "own math ability, understanding, and their comfort level with numbers that plays a role" (Participant 10). Participants viewed math anxiety as a barrier for students to overcome to gain a positive outcome that will be helpful after graduation. Participants described students as being capable of working with mathematical concepts, statistics, and data but needing to overcome the mindset of not being able to.

Instructors Providing Data for Use

Carryover of learning from one course to another and retention of knowledge by students was described by participants as inconsistent as it pertained to basic statistics or specific software. This lack of retention can impact the scaffolding of learning objectives; students' tentative grasp of data concepts can lead to

struggles with higher-order tasks such as data analysis, interpretation, and application of findings. In turn, providing data for students allows them to focus on specific skills or learning outcomes. If the learning objectives for the course do not include data collection or data processing, then including those activities distracts students from concentrating on data analysis and interpretation of findings. As one participant explained:

> I . . . bring them data that's already cleaned . . .. It makes it a lot easier . . .. Then they can start to get into what the story is with the data, rather than thinking about, . . . what do you mean there are missing cases? . . . I think [the higher-order concerns] just throw them for a loop (Participant 02).

While providing data required participants to spend time locating and preparing data prior to the start of the course, it saved time for the students. Among our participants, it was most common to find students engaging in data collection or acquisition and data processing in research methods courses or courses concerning the scientific process. In some courses, locating data from instructor-vetted sources was required. But in courses where students collected or located their own data for use, those skills were tied to course learning objectives.

Sources of Support on Campus

To address challenges faced by students who struggle with math, statistical software, and understanding data, participants noted limited support available outside the classroom. The most common support participants mentioned that was available for their students were graduate assistants, teaching assistants, and lab instructors. Many participants expressed that they are "lucky enough to have a grad research assistant" (Participant 03) as additional support for their courses, someone who could provide one-on-one attention to students who need extra help. Most participants were unaware of other resources that their students might use outside of those that the instructor or course provided. Although participants mentioned video tutorials as options, they warned against advanced tutorials (such as those from software vendors) that provide more detail than students require and likely only lead to further frustration and confusion.

Discussion

Our review of the literature suggests that social science instructors use a range of pedagogical strategies to teach data and statistical literacy concepts, but they encounter math and statistical anxiety as significant barriers to learning. Our study supports these earlier findings and expands on why UNH instructors see data concepts as essential to student academic and life success and what strategies for overcoming barriers to student learning they employ in the classroom. In this section, we discuss how the findings address the aims of the study including a discussion of evidenced based actions to support data instruction and learning.

Our study findings directly address the first two of our study aims: (1) explore the ways in which instructors teach and engage undergraduates in the social sciences using quantitative data and (2) understand the support needs of these instructors. Social science instructors teach with data in the classroom to support both general and course-specific learning outcomes that focus on building data and scientific literacies and skill building. The participants expressed challenges that students face working with data and how they, as instructors, mediate these challenges though course design and navigate the minimal support on campus. Depending on a course's learning objectives and content, participants concentrate on different combinations of analytical, conceptual, and technical skills.

Table 2
Recommended Actions for Local Stakeholders Based on Findings

Recommended actions	Rationale
Provide support for instructors in locating and sharing data for teaching	Identifying, locating, and cleaning datasets that are appropriate for students to use can be time consuming, and the findings suggest that instructors often provide datasets for students to analyze so that specific data literacy skills can be targeted.
Provide support for students who need extra help with math and statistics	The findings suggest that instructors have some concern about the math skills and retention of their students and that this has the potential to interfere with understanding data concepts and statistical analysis concepts. While UNH, like many campuses, has a centralized writing centre there is no general tutoring for math or specific support that caters to students working with math or statistics in social science contexts.
Provide enhanced software support for both students and instructors	Sometimes developing proficiency with a tool or software is a learning objective; other times the tool supports the learning objectives. Decisions around which tool to use may be based on criteria such as type of data, user preference, pedagogical purpose, or disciplinary practice.
Provide learning opportunities for instructors on teaching with data, student skills retention, and new research methodologies and data analysis and visualization practices	At UNH, like many other universities, the Center for Excellence and Innovation in Teaching & Learning already provides resources and professional development opportunities for best practices in teaching. Librarians can build partnerships with teaching and learning centres to help expand opportunities that focus on teaching with data.
Enhance library support for teaching with data and foster partnerships with campus stakeholders to explore these collaborative actions	Support needed by social science instructors cannot be addressed by a single campus stakeholder. For many of the collaborative actions, the library's role is as partner; however, there are areas for which the library can provide leadership or build on existing support for data-related activities.

Courses using data provide a unique opportunity for students to gain experience by working with hands-on examples. There was a strong thread throughout many of the interviews associated with students learning to work with datasets and to engage with data and scientific literacies through application of

concepts—learning by doing. This aligns with a comment made by one participant about the difference between understanding due to reading or listening and the deeper comprehension resulting from the actual experience of doing and practicing.

Based on the findings, we propose five evidence based collaborative actions that local stakeholders can take to better support social science instructors teaching with data (see Table 2). These proposed actions address the last two aims of our study: (3) develop actionable recommendations for campus stakeholders and (4) identify opportunities for the development of resources, services, or activities in the library to support the use of quantitative data in the classroom. In many cases, these are opportunities for stakeholders to collaborate or partner with one another and with the library. Most build on or extend the support already provided by the library and other units on campus.

The study we conducted at UNH is both a stand-alone project and part of a larger project that included 19 other institutions conducting local versions. While the UNH study sheds light on teaching with quantitative data in the social sciences at UNH, the findings and evidenced based actions are potentially transferable to other settings. Additional insight into this topic at the local level can be found in the other local reports available in participating institutions' institutional repositories. Ithaka S+R prepared a consolidated report that analyzes interviews across all 20 institutions as a single dataset (Ruediger et al., 2022). Findings from that publication report on high-level themes identified across institutions.

Limitations

There are some limitations to the methods used in this study. While the sample size for our local study was small and consisted of self-selecting participants, this is appropriate for an exploratory study. It is worth noting that "this study does not purport to be statistically representative nor are the recommendations meant to be prescriptive; rather, the report and its recommendations are intended to be suggestive of areas for further investigation" (Ithaka S+R, n.d.). The data from this local project is included in and complemented by the capstone report from Ithaka S+R that provides an aggregated analysis of interviews conducted at 20 institutions. This broader analysis provides additional perspective and context for this local study and mitigates the limitation of its small size. Another limitation of this study is that the focus was on undergraduate social science courses using quantitative data. Including graduate courses as well as the use of qualitative data would have provided a more holistic look at data literacy and teaching practices in social science courses. Future work involves exploring these areas as well as courses beyond the social sciences.

Conclusion

This exploratory study investigated the teaching practices of social science instructors at UNH who engage with undergraduate students using quantitative data in the classroom. The participants we interviewed teach both general and discipline-specific data concepts as academic, work, and life skills. Primary challenges discussed by the participants that students face in engaging with these topics are understanding math and statistical concepts, learning new software and computing skills, limited prior exposure to data, and lack of retention of content from earlier courses. Participants addressed challenges in several ways in order to lower barriers to learning, including finding, vetting, and cleaning data for their students to use. Participants could use additional support and new strategies to alleviate student challenges, and we presented recommended actions based on the findings of this study.

Data literacy is an important set of competencies in part because of the quality and quantity of data students encounter in their academic, work, and daily life; they need to have the ability to critically evaluate data, methods, and claims. This study directed attention to an area that had not previously been focused on at UNH and is an important first step toward creating greater awareness of the challenges of teaching with data and creating opportunities for building a community of practice for social science instructors grappling with these issues. UNH has opportunities to create additional supports for instructors and students that could improve student learning outcomes. In addition to library partnership, such efforts may require cross-college or cross-department coordination as well as administrative support.

Funding Statement

Funding for this project was provided by the UNH Library.

Acknowledgements

The researchers extend a sincere thank you to the study participants, each of whom was generous with their time and provided thoughtful remarks. The researchers also thank Ithaka S+R and their staff, especially Dylan Ruediger and Danielle Cooper, for the high level of support provided to the local teams throughout the process, which, like so much else, was impacted by the pandemic.

Author Contributions

Patricia Condon: Investigation (equal), Formal analysis (equal), Project administration (lead), Writing – original draft (equal), Writing – review & editing (equal) **Eleta Exline:** Investigation (equal), Formal analysis (equal), Writing – original draft (equal), Writing – review & editing (equal) **Louise Buckley:** Investigation (equal), Formal analysis (equal), Writing – original draft (equal), Writing – review & editing (equal)

References

Brown, M. (2017). Making students part of the dataset: A model for statistical enquiry in social issues. *Teaching Statistics*, *39*(3), 79–83. https://doi.org/10.1111/test.12131

Cantinotti, M., Désormeaux-Moreau, M., & Balbinotti, M. (2017). Mapping psychology students' perspective on group peer-tutoring in statistics. *Mentoring & Tutoring: Partnership in Learning*, *25*(4), 466–484. https://doi.org/10.1080/13611267.2017.1403609

Carlson, J., Fosmire, M., Miller, C., & Nelson, M. S. (2011). Determining data information literacy needs: A study of students and research faculty. *portal: Libraries and the Academy 11*(2), 629–657. https://doi.org/10.1353/pla.2011.0022

Caulfield, S. L., & Persell, C. H. (2006). Teaching social science reasoning and quantitative literacy: The role of collaborative groups. *Teaching Sociology*, *34*(1), 39–53. https://doi.org/10.1177/0092055X0603400104

Chamberlain, J. M., Hillier, J., & Signoretta, P. (2015). Counting better? An examination of the impact of quantitative method teaching on statistical anxiety and confidence. *Active Learning in Higher Education*, *16*(1), 51–66. https://doi.org/10.1177/1469787414558983

Clark, T., & Foster, L. (2017). 'I'm not a natural mathematician': Inquiry-based learning, constructive alignment and introductory quantitative social science. *Teaching Public Administration*, *35*(3), 260–279. https://doi.org/10.1177/0144739417711219

Condon, P., Exline, E., & Buckley, L. (2021). *Teaching with quantitative data in the social sciences at the University of New Hampshire: An Ithaka S+R local report.* UNH Scholars Repository. https://dx.doi.org/10.34051/p/2021.39

Condron, D. J., Becker, J. H., & Bzhetaj, L. (2018). Sources of students' anxiety in a multidisciplinary social statistics course. *Teaching Sociology*, *46*(4), 346–355. https://doi.org/10.1177/0092055X18780501

Cooper, D. M. (2019, July 29). Announcing two new S+R projects on supporting data work. *Ithaka S+R Blog.* https://sr.ithaka.org/blog/announcing-two-new-sr-projects-on-supporting-data-work/

Corbin, J., & Strauss, A. (2014). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Sage Publications.

Cui, S., Zhang, J., Guan, D., Zhao, X., & Si, J. (2019). Antecedents of statistics anxiety: An integrated account. *Personality and Individual Differences, 144*, 79–87. https://doi.org/10.1016/j.paid.2019.02.036

Elbulok-Charcape, M., Grandoit, E., Berman, L., Fogel, J., Fink, L., & Rabin, L. (2019). Improving exam performance in an undergraduate statistics course for at-risk students through peer tutoring. *Psychology Teaching Review, 25*(2), 3–17.

Faber, G., & Drexler, H. (2019). Predicting education science students' statistics anxiety: The role of prior experiences within a framework of domain-specific motivation constructs. *Higher Learning Research Communications*, *9*(1). https://eric.ed.gov/?id=EJ1221253

Fellers, P. S., & Kuiper, S. (2020). Introducing undergraduates to concepts of survey data analysis. *Journal of Statistics Education*, *28*(1), 18–24. https://doi.org/10.1080/10691898.2020.1720552

Filiz, M., Early, E., Thurston, A., & Miller, S. (2020). Measuring and improving university students' statistics self-concept: A systematic review. *International Journal of Educational Research Open*, 1, Article 100020. https://doi.org/10.1016/j.ijedro.2020.100020

Hartnett, J. L. (2016). Using data mining to teach applied statistics and correlation. *Teaching of Psychology*, *43*(2), 142–146. https://doi.org/10.1177/0098628316636292

Hilal, S. M., & Redlin, M. M. (Eds.). (2004). *Integrating data analysis: Instructional materials for integrating data analysis into sociology courses*. American Sociological Association.

Hosein, A., & Rao, N. (2019). The acculturation and engagement of undergraduate students in scientific thinking through research methods. In M. Murtonen & K. Balloo (Eds.), *Redefining scientific thinking for higher education: Higher-order thinking, evidence-based reasoning and research skills* (pp. 157–175). Springer International Publishing. https://doi.org/10.1007/978-3-030-24215-2_7

Intepe, G., & Shearman, D. (2020). Developing statistical understanding and overcoming anxiety via drop-in consultations. *Statistics Education Research Journal*, *19*(1), 149–166. https://iase-web.org/ojs/SERJ/article/download/127/35

Ithaka S+R. (2020). *Teaching with data in the social sciences ethics review instructions*. [Unpublished internal documentation].

Lawrence, R. (2004). Teaching data structures using competitive games. *IEEE Transactions on Education*, *47*(4), 459–466. https://doi.org/10.1109/TE.2004.825053

Lovekamp, W. E., Soboroff, S. D., & Gillespie, M. D. (2017). Engaging students in survey research projects across research methods and statistics courses. *Teaching Sociology*, *45*(1), 65–72. https://doi.org/10.1177/0092055X16673136

MacArthur, K. R. (2020). Avoiding over-diagnosis: Exploring the role of gender in changes over time in statistics anxiety and attitudes. *Numeracy: Advancing Education in Quantitative Literacy*, *13*(1), 1–26. https://doi.org/10.5038/1936-4660.13.1.4

Neumann, D. L., Hood, M., & Neumann, M. M. (2013). Using real-life data when teaching statistics: Student perceptions of this strategy in an introductory statistics course. *Statistics Education Research Journal*, *12*(2), 59–70. https://doi.org/10.52041/serj.v12i2.304

Nurse, A. M., & Staiger, T. (2019). Teaching data reproducibility through service learning. *Teaching Sociology*, *47*(4), 350–357. https://doi.org/10.1177/0092055X19860577

Ralston, K., MacInnes, J., Crow, G., & Gayle, V. J. (2016). *We need to talk about statistical anxiety. A review of the evidence around statistical anxiety in the context of quantitative methods pedagogy* [Working paper]. NCRM. https://eprints.ncrm.ac.uk/id/eprint/3987/

Rode, J. B., & Ringel, M. M. (2019). Statistical software output in the classroom: A comparison of R and SPSS. *Teaching of Psychology*, *46*(4), 319–327. https://doi.org/10.1177/0098628319872605

Ruediger, D., Cooper, D. M., Bardeen, A., Baum, L., Ben-Gad, S., Bennett, S., Berger, K., Bonella, L., Brazell, R., Bruce, S., Buckley, L., Burrows, T., Calvert, S., Condon, P., Curty, R., Davis, H., Exline, E., Feerrar, J., Finch, E., . . . Yatcilla, J. (2022). Fostering data literacy: Teaching with quantitative data in the social sciences. Ithaka S+R. https://doi.org/10.18665/sr.317506

Wolff, A., Gooch, D., Montaner, J. J. C., Rashid, U., & Kortuem, G. (2016). Creating an understanding of data literacy for a data-driven society. *The Journal of Community Informatics*, *12*(3), pp. 9–26. https://doi.org/10.15353/joci.v12i3.3275

Wollschleger, J. (2019). Making it count: Using real-world projects for course assignments. *Teaching Sociology*, *47*(4), 314–324. https://doi.org/10.1177/0092055X19864422