# Data Literacy Skills: Industry Perspectives and Professional Practice

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**abstract:** Recent discourse and research in academic and business settings emphasize the growing importance of improving data and information literacy in both settings. This exploratory study examines the relevance of a set of proposed baseline business data literacy competencies for the workplace, developed by librarians for undergraduates. The authors conducted an online survey of 164 professionals within the supply chain and logistics industry to assess the alignment of these competencies with professional data literacy practices. The survey addresses respondents' self-perception of data literacy skills and asks how the data literacy competencies are reflected in individuals' daily work. The findings suggest that the data literacy skills presented to respondents are highly valued across various job categories and experience levels. Moreover, there is an observed alignment between the data literacy competencies and real-world workplace practices, particularly when considering non-technical skills. The discussion contextualizes these findings within broader librarian work in the data literacy ecosystem.



## Introduction

Data literacy skills are highly valued in the workforce; companies equipped with a data literate workforce have a notable competitive advantage. In turn, data literate employees have increased marketability, reported higher job satisfaction and lower job stress, and felt more empowerment over their career trajectories.[1] However, business and academic literature and professional practices lack agreement on shared vocabularies, competencies, and strategy for educating the workforce on data literacy concepts. While the list of parties invested in the discourse shaping the future of data literacy is diverse, it is important to consider the specific role of librarians as a contributing voice to the conversation. With an established foundation in information literacy and as educators in the data literacy ecosystem, academic librarians can leverage their work to support student learning of these needed workforce skills.

*portal: Libraries and the Academy*, Vol. 25, No. 2 (2025), pp. 271–298.

Data literacy is a burgeoning topic of interest in the professional workplace, but not expressly articulated in the core literacy efforts of librarianship. Information literacy has been a foundational tenet of librarianship, reflected by the Association of College and Research Libraries (ACRL) *Information Literacy Competency Standards for Higher Education* and the more recently adopted *Framework for Information Literacy for Higher Education* (the Framework).[2] These documents guide the work of the profession and provide librarians with a shared vocabulary to shape their professional practice. While speaking broadly to information, the document has lacked clear recognition of data literacy. However, librarians have found relevance in extending the information literacy work to data literacy through research and professional practice, including in developing skills needed for the workplace.[3] Various definitions of data literacy exist, and as noted by Bahareh Ghodoosi et al (2024), these nuanced definitions are helpful given the many contexts in which data literacy can be applied.[4] As with their previous research on this topic, the authors of this study employ this definition of data literacy from Annika Wolfe et al.:

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> the ability to ask and answer real-world questions from large and small data sets through an inquiry process, with consideration of ethical use of data. It is based on core practical and creative skills, with the ability to extend knowledge of specialist data handling skills according to goals. These include the abilities to select, clean, analyse, visualise, critique and interpret data, as well as to communicate stories from data and to use data as part of [decision making].[5]

This research study builds upon the foundation of Wendy Pothier and Patricia Condon's proposed baseline business data literacy competencies and their subsequent mapping to the Framework by exploring how those competencies manifest in professional practice.[6] Previous scholarship introduced the baseline business data literacy competencies and initiated a "call for improving data literacy skills for business students by suggesting a baseline set of data literacy competencies that librarians can help incorporate into the business school curriculum."[7] The authors identified seven key skill areas essential for preparing business students to enter a data literate workplace:

1. Data organization and storage
2. Understanding data used in business contexts
3. Evaluating the quality of data sources
4. Interpreting data
5. Data-driven decision making
6. Communicating and presenting effectively with data
7. Data ethics and security[8]

The set of competencies was intended to equip undergraduates with foundational data literacy skills needed on the job and provide them with a jumping-off point for learning more advanced data skills. The authors then documented the relevance of the data literacy competencies to the Framework and the field of librarianship through mapping each competency directly to the frames. As noted by the authors, "The mapping further articulates the relevancy of the business data literacy competencies to business librarians and the relationship of data literacy to the foundations of librarianship."[9] The authors have acknowledged the value of these competencies in addressing the data literacy gap in organizations and have expanded the potential scope to include preparation of undergraduates across disciplines for success in the workforce.[10]

This exploratory study examines the relevance of the proposed data literacy competencies within the context of workforce skills and in what ways they extend from the undergraduate classroom to business practitioners. While student self-perceptions of data literacy have been studied, limited empirical research has investigated a broad population of business professionals with regards to their data literacy skills or professional development of work-related data literacy competencies.[11] Insight gained from such a study would help refine the proposed baseline business data literacy competencies, contextualize data literacy and workforce development as one of the changing needs for librarians teaching information literacy, and contribute to the understanding of the practical application of data literacy competencies in a professional setting.

In this article, the authors report on the findings from a survey of 164 workers employed in the supply chain and logistics industry in United States and Canada. This research explores two primary research questions. First, in what ways do the proposed data literacy competencies align with professional data literacy practices in the context of the workplace for supply chain and logistics employees? This question broadly addresses which, if any, data literacy competencies are valued by the surveyed employees. Second, how can the findings from the survey inform librarians' approach to teaching data literacy to prepare students to enter the workforce? The answer to this question will inform the future approaches librarians and other educators who teach data literacy might take.



## Literature Review

In the business world, the need for data literate employees to improve and conduct business processes is evident. The report *Data Literacy: The Upskilling Evolution* states that "85% of C-suite executives believe being data literate will be as vital in the future as the ability to use a computer is today."[12] Sara Brown states that automation just increases the need for data literate human judgement in decision-making, while others suggest that data literacy, including non-technical skills, is now the job of all employees.[13] IBM further emphasizes the need for data literacy will increase with the growth of artificial intelligence.[14] Tim Stobrieski reiterates the growth of the data literate workforce, suggesting the need has moved beyond just being able to access data to more interpretive skills.[15]

The value of data literate workforce is obvious in terms of revenue and competitive advantage, but also extends in more nuanced ways.[16] Poor data literacy, defined as a lack of common understanding and language around data, is considered the third

largest roadblock to success within data and analytics teams.[17] Employees experience stress with managing information overload in terms of volume creation and access.[18] Accenture shared that 74 percent of surveyed employees felt unhappy or overwhelmed when working with data, and that data-related stress resulted in five lost workdays per year per employee.[19]

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While Forrester found that roughly 70 percent of workers are anticipated "to use data heavily" in the workplace by 2025, there is discussion over the responsibility for educating the workforce in data literacy. Forrester found that many employees advance their data literacy through their own upskilling efforts and on the job through coworkers.[20] Based on Accenture's findings, just 17 percent of workers report that they invested a significant amount of time in higher education focused on using data effectively in the workplace. This is consistent with feedback from workers in both Europe and Asia.[21] Josh Bersin and Marc Zao-Sanders point to higher education as having a slow response time, which pushes the responsibility to companies and organizations or individuals.[22] However, Mike Capone shares that only 1 in 5 surveyed employees feel that their employer is readying them for a workplace that is increasingly focused on data and automation.[23] A DataCamp survey articulated some of specific data literacy barriers found by company leadership:

> "When surveyed about the biggest challenges leaders face when improving their workforce's data skills, a combination of cultural, logistical, and financial obstacles were the key culprits. Namely, lack of budget (40%), inadequate training resources (36%), lack of executive support (29%), lack of ownership of the training program (29%), and employee resistance (27%) stood out as their top five challenges."[24]

Capone suggests that the responsibility for data literacy skill development is shared as "corporations bear some responsibility for providing these skills, education systems at every level also need to begin teaching these critical skills to adults and children alike."[25] To help further employee education and organizational efforts, there are emerging consulting and other third-party firms aimed to help companies manage their pathways for addressing employee data literacy.[26]

The impacts of data literacy education and workplace training can reach into areas like employee satisfaction and retention as well as salary range and job placements for recent graduates.[27] A Qlik study found that "45% of global employees would change jobs if they felt they could get better preparation and training for the future workplace elsewhere – and 35% had done so within the previous 12 months."[28] Reports project that employees with data literacy skills can expect to have significantly increased salaries and job opportunities.[29]

Academic literature emphasizes centrality of research data and the necessity of data literacy education for researchers. Data literacy has emerged as a distinct skillset with roots in media literacy, visual literacy, scientific literacy, and statistical literacy.[30] However, across business and higher education literature, the concept of data literacy is not

yet standardized, leading to a variety of definitions.[31] Bahareh Ghodoosi et al. express that a lack of definition exists because contexts of data literacy vary.[32] Annika Wolff et al. point out that "it is clear that [the terms and definitions] each have a different focus – which tends to reflect the context in which it was derived." [33] However, definitions provide a foundation for operationalizing work. Sara Brown suggests that companies need to establish what data literacy looks like and why it matters for each employee, along with determining baseline skills and common language.[34]

This same lack of standardization also extends to developing data literacy competencies for data literacy education. Bahareh Ghodoosi et al. explain that "[t]eaching data literacy is complicated by three factors: continual change in technologies and the data they generate, the changing context of business, and the broadness of contexts in which data literacy is relevant." Various data literacy competency models have been developed, ranging from broad frameworks to more comprehensive sets of competencies. These primarily come from the library and information science fields and often synthesize previous efforts or align with the Framework or its predecessor.[35] While much of the focus has been on graduate and post-graduate researchers, there are also efforts to translate instructional efforts to accommodate undergraduate students who may require baseline data literacy skills for research or workforce readiness.[36] Yasmeen Shorish notes:

> Data information literacy skills are relevant even if students do not go on to advanced degrees. The majority of individuals receiving postsecondary education in the United States seek a bachelor's degree as their terminal degree. Moreover, these skills are critical to most aspects of business today.[37]

While conversations around data literacy across higher education and business frequently remain disparate, librarians are demonstrating tangible examples of how partnerships may evolve. Recent book publications, including the *Data Literacy Cookbook* and *Data Literacy in Academic Libraries*, illustrate ways that librarians are engaging with data literacy in the classroom through library instruction.[38] Further practical applications include initiatives like the Federal Reserve Economic Divisions' "Librarians Teaching with Data" cohort, which published data literacy lesson plans that highlight alignment with the Framework.[39] Two recently funded Institute of Museum and Library Services (IMLS) grants focus on data literacy in professional librarianship. One project involved a program to enhance data literacy leadership for librarians.[40] The other initiative organized a series of expert panel webinars on improving librarians' capacity to evaluate data quality, incorporating industry perspectives.[41] These efforts largely build on previous works that seek to establish data literacy foundations within the discipline.

In exploring literature specific to data literacy, workforce skills, and librarianship, Merak Deja et al. noted that data literacy skills are helpful to institutional alumni in terms of empowerment in the workplace and that measurable outcomes for workforce preparation can be a pathway to increased efficacy of higher education.[42] Charissa Jefferson notes that business and economic librarians are suited to lead the library profession around workforce data literacy, but she remarked that lack of professional roles and structures are a barrier to this work.[43] Pothier and Condon have proposed baseline business data literacy competencies to establish the conversation around data literacy instruction, workforce skills, and the role of the librarian.[44] Outside of librarianship literature, some

professional conversations have pointed out that librarians are relevant parties to this discussion, as librarians have training that could provide support to develop data literacy skills for the workplace.[45] In a recent article in the *Journal of Business & Finance Librarianship*, researchers conducted a systematic review of data literacy education and highlight the need for empirical studies in this area.[46] The article also notes that only 5percent of the literature reviewed focused on business undergraduate students, demonstrating a strong need for representation of this population as they directly relate to the conversation initiated by the industry driven QlikTech and Forrester reports.[47]

## Methods

The purpose of this research study is to investigate in what ways the proposed baseline business data literacy competencies can translate from the undergraduate classroom into workplace applications by surveying working professionals. The authors surveyed professionals currently employed within the supply chain and logistics industries to develop an understanding of how the data literacy competencies align with current workforce practices. The survey addresses workers' self-perception of data literacy skills and in what ways the data literacy competencies are reflected in their daily work.

The authors asked participants to complete an online survey using Qualtrics survey software. The survey took about 15 minutes to complete and included 20 questions plus an optional open-ended question for general comments. The survey included personal and professional demographic questions and a series of Likert-like questions asking about the participants' use of data literacy competencies in their current and past job roles (see Appendix A for survey instrument). The authors developed the survey questions based on the proposed baseline business data literacy competencies and pilot tested the instrument with both survey design consultants and members of the potential participant pool. After feedback, the authors adjusted the language to remove field-specific jargon, which included mapping competencies to associated data-related activities. Table 1 maps the data-related activities explored in the survey to the data literacy competencies.[48]

The study was approved by the University of New Hampshire Institutional Review Board (UNH IRB#FY2023-46). The authors began recruiting participants in January 2023 using both direct email communication and social media (LinkedIn and Reddit) to invite participants. They identified potential participants through personal networks and strategic searches using Pitchbook and the Council of Supply Chain Management Professionals membership directory. The authors asked potential participants to share the invitation with their contacts and professional networks. To be eligible to take the survey, participants had to be 18 years or older and be an employee in a company in the United States or Canada within the supply chain or logistics industry or in a supply chain or logistics position within a non-industry related company. The authors selected the supply chain and logistics industry as an initial population to sample because one of the authors has expertise in this area, and they selected the North America region to limit for workplace and education culture. The authors closed the survey in May 2023. To incentivize participation, the authors invited participants to enter a drawing by submitting their name and email address. From those who opted in, the authors randomly selected the names of 20 participants to each receive $100.00 cash gift card. The funding for the gift cards was received through an internal library grant.

# Table 1.

## Proposed baseline business data literacy competencies mapped to data-related activities represented in the survey.

| Data-related activities from survey | Proposed Baseline Business Data Literacy Competencies |
|---|---|
| Data storage activities | Data organization and storage |
| Data organization activities | Data organization and storage |
| Identifying available sources of data | Understanding data used in business contexts |
| Evaluating sources of data | Evaluating the quality of data sources |
| Interpreting data | Interpreting data |
| Advanced data processing and analysis activities | Interpreting data |
| Using data to make decisions | Data-driven decision-making |
| Presenting with data | Communicating and presenting effectively with data |
| Data ethics and security activities | Data ethics and security |



Online surveys with broad distribution methods are susceptible to fraudulent responses. To address this potential, the authors did not advertise the incentive on social media platforms and included a CAPTCHA in the survey. However, that was not enough to deter bots and survey fraud. The authors developed a rigorous validation protocol to identify fraudulent survey responses based on James Dewitt, et al and June Wang, et al.[49] The process included manually reviewing the data and flagging for suspicious activity. Examples of flags include:

- Patterns in email format and time stamp: Flagged if email address followed a specific format and multiple responses with similar email format come in during a condensed time.
- Time to complete: Flagged if it took under four minutes for the participant to complete the survey.
- Internal validity checks: Flagged for inconsistency between questions 12 and 14.
- Unusual patterns in data: Flagged if multiple entries showed patterns in responses.

Entries with three or more flags were considered fraudulent and excluded from the final dataset and incentive drawing. The authors received 847 surveys: 42 respondents did not consent to be in the study; 179 did not complete at least 80 percent of the questions; and 462 were flagged as fraudulent.

## Findings

### Respondent Demographics

In total, there were 164 respondents who submitted a valid survey. While not all respondents filled out every question on the survey, each valid respondent completed at least 80percent of the survey. Because of the survey distribution method, the response rate is unknown. The authors analyzed the data using descriptive statistics.

Fifty-three percent of the sample identified as white males with at least a four-year college degree. Seventy percent of the sample identified as male, and 78 percent identified as white or Caucasian. Forty-five percent had a bachelor's degree and 41 percent had a master's degree. The sample was biased toward senior-level roles, with 41 percent of the sample indicating that they held director or manager positions and 18 percent indicating that they held executive-level (C-suite) roles. The sample largely consisted of respondents who identified as male, white or Caucasian, and held at least a 4-year college degree. However, as noted by Gartner, the industry lacks diversity in general, with women holding just 26 percent of the C-suite positions in the supply chain industry and making up less than half of the total workforce in the industry.[50]

Only 6 percent of respondents worked in a non-supply chain or logistics position within a supply chain or logistics company (such as sales or human resources). Most respondents indicated that they worked directly in supply chain or logistics related positions. The highest percentage of respondents came from companies with more than 2000 employees (37 percent) or from companies with fewer than fifty employees (22 percent). While respondents represented a range of work experience in the industry, 27 percent had been employed in the industry for more than twenty years (see Table 2).

### Respondent Use of Data Skills on the Job

Ninety-five percent of respondents indicated that they work with data in their current position. The survey data depicted in Figure 1 suggest that respondents rank the following five activities highest in terms of both the frequency performed on the job and importance to conducting work:

1. using data to make decisions,
2. interpreting data,
3. presenting with data,
4. evaluating sources of data, and
5. identifying available sources of data.

The other four activities presented as response choices on the survey were consistently ranked lower both in terms of frequency performed on the job and importance to conducting work:

1. advanced data processing and analysis activities,
2. data organization activities,
3. data ethics and security activities, and
4. data storage activities.

# Table 2.
## Respondent demographics

| Education level | Number of Respondents | Percent of Respondents |
|---|---|---|
| High school degree/GED | 4 | 2.4% |
| Associate degree | 4 | 2.4% |
| Bachelor's degree | 73 | 44.5% |
| Master's degree | 68 | 41.5% |
| PhD/Doctorate | 9 | 5.5% |
| Other | 4 | 2.4% |
| Prefer not to say | 2 | 1.2% |
| **Role location** | | |
| Working in a supply chain or logistics related position in company outside of the supply chain or logistics industry | 79 | 48.2% |
| Working in a supply chain or logistics related position in a supply chain or logistics company | 75 | 45.7% |
| Working in a non-supply chain or logistics related position in a supply chain or logistics company | 10 | 6.1% |
| **Years employed in the supply chain and logistics industry** | | |
| Less than 1 year | 7 | 4.3% |
| 1-3 years | 27 | 16.5% |
| 4-6 years | 35 | 21.3% |
| 7-10 years | 20 | 12.2% |
| 11-15 years | 19 | 11.6% |
| 16-20 years | 12 | 7.3% |
| More than 20 years | 44 | 26.8% |
| **Number of employees in current company** | | |
| Less than 50 employees | 36 | 22.0% |
| 51-200 employees | 25 | 15.2% |
| 201-500 employees | 14 | 8.5% |
| 501-2000 employees | 26 | 15.9% |
| over 2000 employees | 61 | 37.2% |

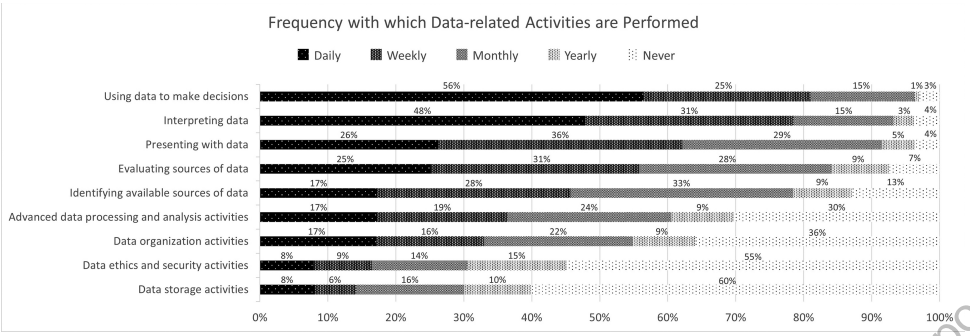


Figure 1. Survey respondents reported the frequency with which they performed these specific data-related activities on the job.

In general, for each data-related activity, relative importance was ranked in the same order as frequency of use, although with relative importance of each activity ranked marginally higher than frequency of use (see Figure 2). As one respondent with more than 20 years in the industry and a master's degree noted in a comment: "Most often used skill does not indicate importance of the skill. For example, 'communicating and presenting effectively with data' is vital but occupies a relatively small portion of my time."

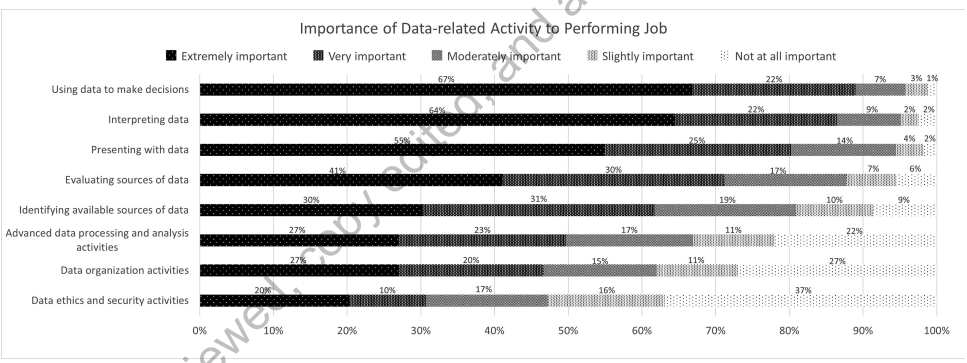


Figure 2. Survey respondents rated several data-related activities in terms of the importance to their job performance.

## Respondent Self-Reported Data Skills

As shown in Table 3, ninety-one percent of respondents strongly or somewhat agreed that they felt confident performing data-related tasks required in their current role.

While respondents overall felt confident working with data for their job-related tasks, their self-perceived skill level compared to others varied based on the data related activity (see Figure 3). This again highlights the relative ranking of skills related to data literacy competencies represented in the survey and suggests that skills related to data sources, overtly corresponding to information literacy skills, lag behind other non-technical data literacy skills.

# Table 3.
## Self-reported confidence in working with data

| "I feel confident working with data tasks required for my job." | Number of Respondents | Percent of Respondents |
|---|---|---|
| Strongly agree | 107 | 65% |
| Somewhat agree | 42 | 26% |
| Neither agree nor disagree | 7 | 4% |
| Somewhat disagree | 2 | 1% |
| Strongly disagree | 6 | 4% |

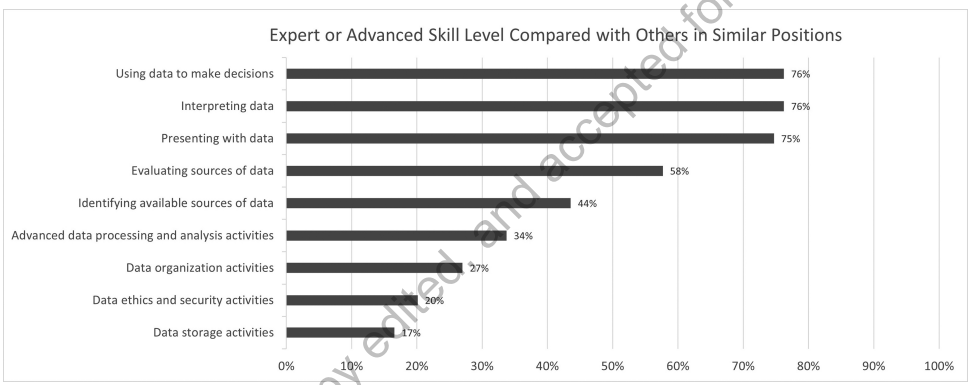


Figure 3. Survey respondents' self-reported expert or advanced skill levels compared with others in similar positions.



### Workplace Expectations and Skill Development

Participant interpretation of employer expectation of having certain data skills largely aligned with the importance participants assigned to the skill required to perform their job (see Table 4).

While participants suggested that their employers expected certain data skills, there was a noticeable gap in participant knowledge of professional development opportunities offered by their employer. Between 45 to 62 percent of participants did not know of any professional development or were unsure if opportunities existed (see Table 5).

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# Table 4.

Participant perspective of whether employers expect them to possess specific data-related skills

| Data-related skill | Response to whether employer expects skill | | |
|---|---|---|---|
| | Yes | No | Unsure |
| Presenting with data | 93% | 6% | 1% |
| Using data to make decisions | 91% | 7% | 1% |
| Interpreting data | 91% | 8% | 1% |
| Evaluating sources of data | 81% | 17% | 2% |
| Identifying available sources of data | 75% | 22% | 3% |
| Advanced data processing and analysis activities | 55% | 40% | 5% |
| Data organization activities | 48% | 46% | 5% |
| Data ethics and security activities | 36% | 58% | 6% |
| Data storage activities | 29% | 66% | 6% |

# Table 5.

Participant knowledge of professional development opportunities offered by employer

| Data-related skill | Response to whether employer offers professional development in this skill | | |
|---|---|---|---|
| | Yes | No | Unsure |
| Presenting with data | 56% | 30% | 15% |
| Using data to make decisions | 52% | 33% | 15% |
| Interpreting data | 52% | 33% | 15% |
| Evaluating sources of data | 44% | 37% | 19% |
| Identifying available sources of data | 42% | 39% | 19% |
| Advanced data processing and analysis activities | 41% | 38% | 22% |
| Data organization activities | 39% | 41% | 20% |
| Data ethics and security activities | 38% | 38% | 24% |
| Data storage activities | 39% | 38% | 24% |

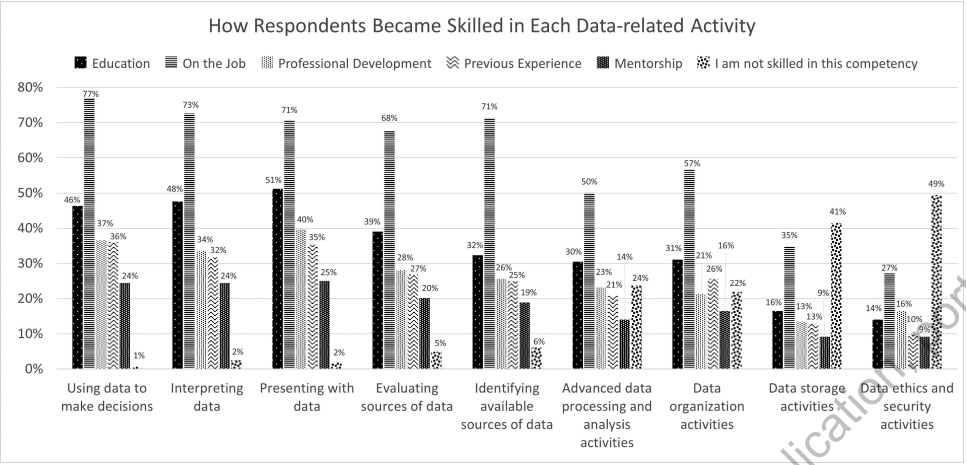


Figure 4. Survey respondents reported the ways they became skilled in each data-related activity.

Figure 4 illustrates that participants overwhelmingly indicated that they became skilled in relevant data activity through on-the-job training and experience.

### Ranking the Seven Baseline Business Data Literacy Competencies

In returning to the original language of the proposed baseline business data literacy competencies, participants ranked the 7 competencies from most often used to least often used. The rankings of the competencies agreed with the responses provided for frequency of use and perceived level of importance to the associated data-related tasks (see Table 6). One respondent with a master's degree and 11-15 years of experience in the industry noted:

> While [evaluating the quality of data sources, data organization and storage, and data ethics and security] are important, those are a given and should always be a requirement for [understanding data used in business contexts, interpreting data, data-driven decision making, and communicating and presenting effectively with data].

## Discussion

The findings of this study suggest a pervasive use of data within the workplace and begin to explore discrete aspects of data literacy skills needed by employees to work with data in their jobs. The findings demonstrate that working with data was ubiquitous in our sample across all categorial divisions of time in industry, education level, and job category, with 95 percent of respondents indicating that they use data in their current professional roles. One respondent with 7-10 years of experience in the industry, from a company with over 2,000 employees, noted that "[d]ata is absolutely becoming a critical element across pretty much all business disciplines." Across this broad spectrum of employees from diverse position types, the findings suggest that data is increasingly important to their job, which supports what is being reported in the literature.

# Table 6.

Seven proposed baseline business data literacy competencies ranked from most often used to least often used in the workplace.

| Business data literacy competencies in ranked order | Mean | Variance | Median | Mode |
|---|---|---|---|---|
| Interpreting data | 2.78 | 2.30 | 2 | 2 |
| Understanding data used in business contexts | 3.02 | 2.46 | 3 | 4 |
| Data-driven decision making | 3.18 | 2.81 | 3 | 2 |
| Communicating and presenting effectively with data | 3.61 | 3.20 | 4 | 4 |
| Evaluating the quality of data sources | 4.34 | 2.29 | 5 | 5 |
| Data organization and storage | 4.80 | 3.36 | 6 | 6 |
| Data ethics and security activities | 6.28 | 2.37 | 7 | 7 |



### Data Literacy Competency Alignment with Professional Practices

The findings suggest a broad relevance of the data literacy competencies in the workplace. While the frequency of use and relative importance of each data-related skill varied, all competencies were invoked and corresponded to core business practices and processes. A comment from one respondent, with 7-10 years of experience in the industry and working in a company with over 2000 employees, highlighted this relevance:

**While the frequency of use and relative importance of each data-related skill varied, all competencies were invoked and corresponded to core business practices and processes.**

> It's hard to rank them… because they are building blocks for one another. Receive data, ensure it is securely stored, organize the data properly, evaluate the data, understand what's useful and what isn't, run analyses on the data, then communicate findings back to stakeholders.

The survey data indicated the greatest alignment of the data literacy competencies with professional data literacy practices in five of the nine data-related activities. The data suggests that respondents rank five activities highest in terms of frequency performed on the job and importance in conducting work: using data to make decisions; interpreting data; presenting with data; evaluating sources of data; and identifying available sources of data. The other four activities were consistently ranked lower by respondents in both categories of frequency performed on the job and importance in conducting work: advanced data processing and analysis activities; data organization activities; data ethics and security activities; and data storage activities.

For the data-related activities consistently ranked lower by respondents, participants' comments suggest some rationale as to why this might be the case. Comments suggest that some participants view data ethics and security as activities delegated to specialized information technology (IT) teams. One respondent with 11-15 years of experience in a company with 201-500 employees noted that for "data ethics and security we… have an extensive IT team that support us and the overall security of our data and system. This is very important but not in the context of my position or experience." Another respondent with 16-20 years of experience in a company of 51-200 employees noted that "[d]eep dive security… is often completed by data specialists outside my teams." Data organization and storage may have been interpreted as database management or seen as tangential to respondents' deliverables. One respondent with 16-20 years of experience in a company of 51-200 employees noted "[database] creation is often completed by data specialists." Another respondent with 1-3 years of experience in a company with fewer than 50 employees, cared more about the accuracy of the data for making data-driven decisions than basic data or database management actions noting, "[f]or me, how it's stored and organized is of no material concern to the decision as long as the data is accurate."

Advanced data processing and analysis activities were intentionally not included in the original proposed baseline business data literacy competencies. The competencies were introduced to provide a minimum level of essential non-technical knowledge and skills broadly applicable to using and working with data, and data processing and analysis activities were viewed as technical and specialized. Basic skills in these areas can be mapped to the competency "interpreting data," as Pothier and Condon note: "Data by itself does not provide answers to questions. Data must be processed [and analyzed], and findings interpreted to separate meaning from noise."[51] For this survey, activities associated with data processing and analysis were added to capture what could be considered a gap in the proposed competencies and an area of data-related activities that data scientists and other specialists are performing. One respondent with 16-20 years of experience in a company of 51-200 employees noted that "[w]hen I was an individual contributor, I spent most of my time obtaining data, analyzing, and understanding what the data was saying. Now I do this less often directly but help develop teams to perform this type of work." These activities are advanced activities and often delegated to specialists.

Notably, the five data-related activities that were consistently ranked highest in terms of frequency performed on the job and importance in conducting work, can be categorized as non-technical skills, emphasizing critical thinking, problem-solving, communication, decision-making, adaptability, and domain knowledge. In the context of both information and data literacy, critical thinking plays a pivotal role. The Framework emphasizes critical thinking and other non-technical skills and Jordan Morrow explores what he refers to as "the three Cs of data literacy": curiosity, creativity, and critical thinking.[52] In the recent edited volume, *Data Literacy in Academic Libraries: Teaching Critical Thinking with Numbers*, librarians contributed their experiences teaching data literacy at the undergraduate level highlighting the importance of critical thinking when working with data.[53] Annika Wolff et al. note that foundational skills for data literate citizens allow individuals to "apply their knowledge of a data-driven inquiry process… and can use

this knowledge to critically assess data-related arguments."[54] The broad need for non-technical data literacy is echoed both by Bersin and Zao-Sanders, and Bahreh Ghodoosi et al., who state that "businesses focus on thinking about data critically and convert the data to actionable knowledge."[55] With the relationship between information literacy and data literacy established, and the findings emphasizing the need for non-technical skills, the role of librarians in helping provide students with skill development that is vital to their success in the workforce is increasingly apparent.[56]

### How Results can Inform Librarians' Practice

Librarians are well situated in the data literacy education ecosystem with established foundations in information literacy, which extend to data literacy. While data literacy has been a burgeoning conversation in library literature, researchers have noted a lack of clear direction for librarians working to support skill development in business education.[57] The literature increasingly discusses data literacy, but there has been a slower response in higher education in addressing the need to educate students for post-graduation workforce requirements.[58]

**Librarians are well situated in the data literacy education ecosystem with established foundations in information literacy, which extend to data literacy.**

The findings of this study demonstrate a broad need for data literacy among employees in business settings across position type, years in industry, workplace size, and educational background, and suggest that the proposed baseline business data literacy competencies extend from the undergraduate curriculum into professional practice. The literature presents various perspectives on the responsibility of providing data literacy education as distributed across industry, employee, and higher education. However, without higher education providing the foundation for data literacy, students may lack pathways to lifelong learning in this key area of professional development.

Data literacy education is seemingly a multi-pronged approach across educational and organization settings. While higher education plays a key role in data literacy skill development, less than 50 percent of respondents indicated that they became skilled in these data-related areas through their education. However, more than 90 percent of respondents had attained at least a bachelor's degree. In general, respondents overwhelmingly indicated they learned these skills on the job. One participant who holds a bachelor's degree, has more than 20 years of experience in the industry, and works in a company with fewer than 50 employees noted in the comments section: "All of my data skills and knowledge were gained on the job or by my seeking out resources." Another participant with a bachelor's degree, 16-20 years of experience in the industry, and works in a company with fewer than 50 employees commented on how the different avenues for acquiring skills are complementary but serve different needs:

> On the job and experiential knowledge is crucial to staying abreast of changes and advances. Formal education is important for a solid base.... Ongoing professional development and remaining engaged in outside resources is important to stay up to date.

This comment speaks to the value of broad development of data literacy skills to establish baseline competencies or "a solid base." Incorporating this work broadly at an undergraduate level will provide students with skills that are desirable in the workplace. The role of academic librarians in the data literacy education ecosystem merits ongoing attention as evidenced both by the established information literacy foundations of the profession and the stated data literacy workplace competencies as reinforced by this study.

While the data literacy competencies need further refinement, they lay the groundwork for developing a shared professional vocabulary and understanding of ways librarians can support data literacy education and workforce development within higher education settings. For example, the data-related activities that showed the greatest alignment between the data literacy competencies and professional data literacy practices relate closely to the foundational principles of information literacy. The Framework emphasizes that, as a core document to librarianship, it stands "to create wider conversations about student learning." Data literacy, as an extension of information literacy, serves to empower students in the classroom and in their future professional lives. This is further underscored in an alumni-focused study by Marek Deja et al., who note that "since information literacy is one of the conditions for self-efficacy in the workplace, then it is also data literacy…that can increase [employees'] agency and self-efficacy."[59] Condon and Pothier's mapping of the business data literacy competencies to the Framework demonstrate which frames and knowledge practices align with the specific competencies and provide relevant practical implementations for each.[60]

**While the data literacy competencies need further refinement, they lay the groundwork for developing a shared professional vocabulary and understanding of ways librarians can support data literacy education and workforce development within higher education settings.**

These proposed baseline business data literacy competencies are knowledge and skills that foster informed workers and citizens. It is vital for librarians to consider how data skills translate from research data to data "on the job," to our data consumption as citizens. The need for data literacy merits specific and nuanced consideration in the library profession. This call comes in an era when data literacy skills are essential, and the demand is projected to increase across disciplines and settings.[61] Librarians are key players in the data literacy ecosystem and need to be further empowered and supported to aid in the development of data literacy in our society.[62] With expertise in information and data literacy, academic librarians could provide influential guidance within higher education's role in the data literacy education ecosystem. Building on the authors' own previous articles that focused on alignment of data literacy with information literacy and suggestions for strategies to incorporate workforce data literacy more holistically into the profession, this study adds increased value to the conversation by illustrating the ways practitioners interact with specific competencies in their jobs. These findings can help librarians understand the practical applications of data literacy beyond classroom experiences.

## Limitations

This research study has several limitations. In terms of sample size, this exploratory research survey utilized several methods of recruitment, including snowball sampling through social media platforms, emails to student and alumni groups to encourage distribution, and emails to corporate contacts requesting distribution to employees. Therefore, the total population and response rate cannot be determined. Additionally, recruitment strategies tended to bias away from early career professionals. For example, one source the authors used for locating emails for direct distribution notes that most of their members are executive-level leaders, and another source provides contact details for either a general contact or heads of organizations.[63] This bias toward senior-level professionals is noticeable in the data. Also apparent in the sample is a bias toward white, educated, male respondents. Future research in this area may want to consider quotas to ensure a more diverse sample. Furthermore, the use of social media as a recruitment method increased the number of fraudulent survey responses, which resulted in the authors removing a large number of invalid responses from the final dataset. The use of a survey design to collect self-reported skill level produces some limitations, including potential for not fully understanding vocabulary or subject matter. Due to these limitations and the scope of the study focusing on workers employed in the supply chain and logistics industry in United States and Canada, findings may lack generalizability.

## Conclusions

This exploratory study investigated potential areas of agreement between the proposed baseline business data literacy competencies and actual data literacy practices in the workplace. The study sample was drawn from supply chain and logistics employees in the United States and Canada. Overall, the findings suggest that the data literacy skills presented to respondents are highly valued and in demand across job categories and experience levels. The findings further suggest an alignment between the data literacy competencies and professional data literacy practices in the context of the workplace for supply chain and logistics industry employees, particularly for activities related to the competencies of interpreting data, understanding data used in business contexts, data-driven decision making, communicating and presenting effectively with data, and evaluating the quality of data sources. While the proposed data literacy competencies were drafted without input from key stakeholders, this study provides support for their value as baseline skills.

This study further sheds light on areas in which librarians and higher education play a key role in workforce development. Underscoring this study's investigation is a complex information challenge: the extension of data and information literacy from the classroom to the workplace. By understanding the application of data literacy competencies in professional settings, these findings can inform instruction in the classroom and assist librarians, business faculty and researchers, and business professionals to more holistically approach data literacy challenges faced in workforce preparation and development. Data literacy skill development could be a meaningful outcome for college students. Recognizing the need for non-technical skill development, academic

librarians' role may contribute to shaping the data literacy ecosystem through expanding existing professional frameworks. It is important for librarians to participate in this conversation, particularly in terms of student and alumni success and empowerment. By leveraging a comprehensive interpretation and approach to information literacy inclusive of data literacy education, librarians can better prepare students to enter the workforce skilled in data literacy. In future work, the authors plan to conduct follow-up interviews with survey respondents who opted to be contacted. This second phase of the study aims to further contextualize the data literacy competencies within professional and educational settings.

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## Data Availability Statement

The data that support the findings of this study are openly available in *figshare* at http://doi.org/10.6084/m9.figshare.25521241

## Funding Statement

Funding for this research was provided by a University of New Hampshire Library internal research grant.

# Appendix

## Survey Instrument

**Questions displayed after Informed Consent Form**

Question 1
Are you 18 years of age or older?
- Yes
- No

Skip To: End Survey If Are you 18 years of age or older? = No

Question 2
Are you currently employed in the supply chain and logistics industry or in a supply chain and logistics-related professional role within the United States and Canada?
- Yes
- No

Skip To: End Survey If Are you currently employed in the supply chain and logistics industry or in a supply chain and lo... = No

Question 3
Do you currently work in the United States or Canada?
- United States
- Canada
- Neither

Skip To: End Survey If Do you currently work in the United States or Canada? = Neither

Question 4
Do you consent to participate in the research study?
- Yes
- No

Skip To: End Survey If Do you consent to participate in the research study = No
Display This Question: If
- Are you 18 years of age or older? = No
- Or Are you currently employed in the supply chain and logistics industry or in a supply chain and logistics-related professional role within the United States and Canada? = No
- Or Do you currently work in the United States or Canada? = Neither
- Or Do you consent to participate in the research study? = No

Thank you for your interest in our research survey, however you do not qualify for participation. If you have any questions pertaining to the research you can contact Wendy Pothier (wendy.pothier@unh.edu) to discuss them.

Skip To: End of Survey If Thank you for your interest in our research survey, however you do not qualify for participation.... Displayed

**Begin Survey Questions**

*These questions address demographic information and current employment.*

Q1 What is your current job title?

Q2 How long have you been in your current position?
- Less than 1 year
- 1-3 years
- 4-6 years
- 7-10 years
- 11-15 years
- 16-20 years
- More than 20 years

Q3 How would you describe your current employment setting?
- working in a supply chain or logistics related position in a supply chain or logistics company
- working in a non-supply chain or logistics related position in a supply chain or logistics company
- working in a supply chain or logistics related position in company outside of the supply chain or logistics industry

Display This Question: If How would you describe your current employment setting? = working in a supply chain or logistics related position in company outside of the supply chain or logistics industry

Q4 How would you categorize your job?
- Distribution
- Inventory Control
- Logistics
- Manufacturing Management
- Materials Management
- Packaging
- Procurement
- Quality Control
- Receiving
- Sourcing
- Transportation
- Warehousing
- Other, please specify

Display This Question: If How would you describe your current employment setting? = working in a supply chain or logistics related position in a supply chain or logistics company

Q4 How would you categorize your job?

- Distribution
- Inventory Control
- Logistics
- Manufacturing Management
- Materials Management
- Packaging
- Procurement
- Quality Control
- Receiving
- Sourcing
- Transportation
- Warehousing
- Other, please specify

Display This Question: If How would you describe your current employment setting? = working in a non-supply chain or logistics related position in a supply chain or logistics company

Q4 How would you categorize your job?

- Management
- Human Resources
- IT
- Data Analytics
- Marketing
- Sales
- Research and Development
- Customer Service
- Other, please specify

Q5 In terms of number of employees, what is the overall size of your current employer?

- Less Than 50 employees
- 51-200 employees
- 201-500 employees
- 501-2000 employees
- over 2000 employees
- Unsure

Q6 How many years have you been employed in the supply chain and logistics industry?

- Less than 1 year
- 1-3 years
- 4-6 years
- 7-10 years
- 11-15 years
- 16-20 years
- More than 20 years

Q7 Please select your highest degree obtained
- High School Degree / GED
- Bachelor Degree
- Master Degree
- PhD / Doctorate
- Other, please specify
- Prefer not to say

Q8 With which gender do you identify?
- Male
- Female
- Non-binary / third gender
- Prefer not to say
- Not listed, please specify

Q9 Which best describes your race or ethnicity? (select all that apply)
- American Indian or Alaska Native
- Asian
- Black or African American
- Hispanic or Latino
- Native Hawaiian or Pacific Islander
- White or Caucasian
- Prefer not to say
- Other, please specify

*These questions address how you work with data in your current and/or previous jobs.*

Q10 In your current role, do you work frequently with data?
- Yes
- No
- Unsure

Q11 Do you agree with this statement?
"I feel confident working with data tasks required for my job."
- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

*Use for Questions Q12-Q19*
- Data organization activities. Examples: create and manage databases OR create metadata or documentation about data OR data entry
- Data storage activities. Examples: design data architecture frameworks OR manage storage infrastructure
- Identifying available sources of data. Examples: provide access to data OR locate / acquire data OR identify potential sources of data

- Evaluating sources of data. Examples: considering relevancy of data OR currency of data OR quality of data sources
- Interpreting data. Examples: comparing data to other findings OR creating visualizations from data OR applying critical thinking to data
- Using data to make decisions. Examples: ask questions based on data OR contextualize data to specific scenarios OR using data to inform decision making
- Presenting with data. Examples: sharing data in written or oral presentations OR creating charts or graphs OR presenting data to others for decision making purposes OR creating reports incorporating data
- Data ethics and security activities. Examples: encoding data for privacy OR create policies for sharing data, cyberinfrastructure, data governance, or access controls
- Advanced data processing and analysis activities. Examples: clean/validate data OR apply data analysis tools or techniques

Q12 Is this activity part of your current job?

- Yes
- No
- Unsure

Q13 Is having skill in this area an expectation of your employer?

- Yes
- No
- Unsure

Q14 How often do you perform these activities in your job?

- Daily
- Weekly
- Monthly
- Yearly
- Never

Q15 How important is this activity to conducting your work?

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not at all important

Q16 Did you do this activity in the job previous to your current position?

- Yes
- No
- Does not apply

Q17 Compared with others in similar jobs, please rate your own skill level for each activity:

- Expert skills
- Advanced skills
- Intermediate skills
- Beginner skills
- No skills

Q18 How did you become skilled in this activity (select all that apply)?

- Education
- Mentorship
- Professional development
- On the job
- Previous experience
- Other
- I am not skilled in this competency

Q19 For your job, does your employer offer any professional development or training for these activities?

- Yes
- No
- Unsure

Q20 Last Question: Please rank these activities in order from MOST OFTEN USED to LEAST OFTEN USED in your current job. (Note: Use your cursor to drag and move into your selected order.)

- Data organization and storage
- Understanding data used in business contexts
- Evaluating the quality of data sources
- Interpreting data
- Data-driven decision making
- Communicating and presenting effectively with data
- Data ethics and security

Q21 Comments (optional):

Thank you

Q22 Please enter your name and email if you would like to be included in the drawing for one of twenty $100 cash gift cards.

Q23 If you are interested in participating in future studies related to this research study, please enter your name and email. We will keep your contact information on file separate from your survey responses.



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