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Introduction

Critical Data Storytelling in the Composition Classroom argues that *critical data literacy* should be incorporated into multimodal composition pedagogy via the practice of *data storytelling*. *Critical data literacy* refers to the ability to ask and answer real-world questions using large and small data sets through an ethical inquiry process. *Data storytelling* is a methodology for communicating a compelling narrative about data to a specific audience. Data storytelling cuts across multimodal genres, serving as a strategy for working with data based in the recognition that data on their own do not speak; they must be interpreted to have any meaning. As such, data storytelling is fundamentally a rhetorical practice, emphasizing how data are *invented* in a rhetorical sense at every stage—from being collected to cleaned and analyzed to presented to an audience.

Though working with data was traditionally regarded as the province of scientists and mathematicians, today data are ubiquitous because of the explosion of technologies that produce data and programs that make working with data more accessible to members of the public than ever before. As a result, data literacy is becoming a critical literacy skill necessary for people to fully participate as members of democratic society. Although rhetoric and composition scholars have developed multimodal composition pedagogy in recognition that the proliferation of multimodal communication technologies have changed what it means to read and write in the twenty-first century, multimodal composition pedagogy has not adequately accounted for the central role that data play in multimodal genres ranging from infographics to social media posts to white papers. At the undergraduate level, instruction in writing about and with data continues to be restricted primarily to

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technical and professional writing courses, which reinforces the notion that data literacy is a highly specialized literacy useful primarily to professionals working in or communicating with those in technical fields such as computer science and engineering.

Critical Data Storytelling is premised on the argument that the *datification* of everyday life has transformed contemporary literacy. According to Viktor Mayer-Schönberger and Kenneth Cukier, who coined the term, datafication refers to the process through which human activities are converted to data, which, in turn, allows for predictions about individuals and groups (Mayer-Schönberger and Cukier 2013, 15). Datafication makes more information and more types of information into data that can be analyzed using quantitative methods of analysis. In doing so, it changes the nature of information, by making almost all information a possible source of data, and information environments, by opening them up to study and monitoring through a variety of datafied ways of knowing such as specialized algorithms and data visualization. While the full effects of datafication on individuals and society are not yet completely understood, it is clear that the landscape in which writing, research, and learning take place is changing significantly, with far-reaching implications for all instructors who want to prepare students with the information literacy skills necessary to fully participate as members of society and who are increasingly confronted by data-based arguments about what constitutes good teaching and learning.

This book details a plan of action for including data literacy in multimodal composition pedagogy, supported by research exploring the various opportunities and challenges presented by data literacy: recognizing how data circulate online, evaluating the use of data in multimodal texts, curating corpuses of data, and navigating among various tests, technologies, and visualizations to analyze and present data. Questions taken up in the book include: In what ways can a rhetorical approach to data informed by multimodal composition pedagogy foster students' critical data literacy skills? Also, how can a rhetorical framework for critical data literacy productively contribute to multimodal composition pedagogy and curriculum development?

The genesis of this study was, appropriately enough, in data. When I began including multimodal assignments in my first year writing and professional writing courses by replacing one of my students' research essays with an infographic, I knew I needed to provide lessons and activities related to visual rhetoric, page design, information literacy, and how to use free online programs such as Piktochart and Canva. At that time, I did not anticipate the

need to include instruction in data literacy to help students create successful infographics. However, though my students generally liked the assignment, and it helped them improve the organization and development of their arguments, I was troubled by the ways that students' use of data could go wrong and undermine their arguments. Though students were not required to include data in their research infographics (and some did not), the genre of infographics does facilitate the presentation of data, and by including data, students were demonstrating awareness of genre conventions for infographics. Often, though, they just did not have the data literacy skills necessary to work with data. What's more, in reviewing classroom grades and demographic data, I could see that students in particular majors, specifically in STEM-related fields, received higher grades on multimodal projects in which they used data than were students in other majors. I realized that I needed to design and assess multimodal projects carefully so as not to advantage and disadvantage students based on their background working with data and to help all my students be more critical users of data. However, I found no recognition of this gap in the scholarly literature on multimodal composition and few suggestions for including data literacy instruction in multimodal composition.

Consequently, I began exploring how to teach data literacy in the context of multimodal composition, and in 2016 I formally applied for IRB approval to begin collecting the student writing, surveys, and interviews that serve as the backbone for this book.[1] *Critical Data Storytelling* is based on data I collected at two different institutions, one a private, highly selective regional comprehensive university on the east coast and the other a large, regional public university designated an Hispanic-Serving Institution (HSI) and an Asian American and Native American Pacific Islander-Serving Institution (AANAPISI) on the west coast. These data include material from thirteen writing classes of various levels (three first-year writing courses; five upper-level undergraduate professional writing courses; and five upper-level undergraduate digital writing and rhetoric courses). Materials I have collected include introductory biodata surveys, student planning documents, in-progress data stories, revised data stories, and student reflections on working with data and completing critical data storytelling assignments.

1. All participants have been given pseudonyms. My procedures for gathering and analyzing artifacts, surveys, and interviews and disseminating the results of this work were approved by the Institutional Review Board (IRB). See the appendix for more information on the participants and my methods.

I have also conducted interviews with fifteen students from across these courses who represent a variety of backgrounds and comfort levels working with data. Through analysis of the data that I have gathered through this work, I have been able to determine that including critical data literacy instruction in multimodal pedagogy can make a significant difference to students' conceptual and practical understanding of how data operate rhetorically in ways that improve their abilities to analyze and compose data stories. I have also gained insight into the process through which students progress in understanding data literacy and have used this information to develop instructional materials and assignments designed to scaffold students' data literacy acquisition in writing courses of various levels. The model for critical data literacy in multimodal composition pedagogy that I present in *Critical Data Storytelling* is the result of these years of exploration.

Why Critical Data Literacy Is Needed Urgently in Multimodal Composition Pedagogy

This work is needed because the significant role data play in multimodal communication has not been sufficiently considered in multimodal composition pedagogy. While composition scholarship is beginning to recognize the value of big data methodologies for researchers and administrators (Licastro and Miller 2021), only sporadic attempts have been made by individual practitioners to develop a consistent pedagogy for rhetorically reading and critically using data in effective and ethical ways in the context of rhetoric and composition instruction (e.g., Beveridge 2015; Beveridge 2017; Danner 2020b; Moxley 2008; Moxley 2013). The prevalence of data in multimodal communication will be a barrier to more widespread inclusion of multimodal composition pedagogy in writing classes and programs without the development of pedagogical strategies to deal with data. As we ask students to read and write multimodal texts, equipping them with a repertoire of rhetorical strategies for working with data will strengthen how they approach and understand multimodal genres and media.

Critical Data Storytelling promises to positively impact composition in at least three important ways. First, it contributes to our ongoing interest in critical literacy, which is a burgeoning area of research and pedagogy. Students—and all members of the public—must contend with a seemingly endless flow of mis- and disinformation circulating in online contexts today. Data often play a role in the spread of mis- and disinformation, injecting

confusion into public discourse with serious implications for democratic decision-making processes. When data circulate quickly "through botnet networks that use algorithms to profile users and feed them stories that fit their individual biases" (Miller and Leon 2017, 10), it can be difficult to detect when data have been subject to cherry-picking, misinterpretation, or even outright fabrication. Although detecting and countering mis- and disinformation has always been challenging, increasingly, the fake news that individuals encounter takes the form of data stories that combine data with textual information and iconography to make succinct, persuasive arguments. Mis- and disinformation presented via data stories can be particularly difficult for readers to detect and combat because interpreting these arguments requires unpacking a complex combination of statistical, visual, and textual expressions. Additionally, fake data stories, like fake news stories in general, "often emulate the look and titles of professional news sources," so that "even if a story has been shared a million times on social media, and if it is found on a website that looks and sounds newsy, and if it is repeatedly linked from a popular hashtag, there's no guarantee that it's a credible story" (Laquintano and Vee 2017, 46). The problem of mis- and disinformation is poised to become even greater with the widespread use of generative artificial intelligence (AI). Freely available and largely unregulated generative AI programs make it possible for anyone to generate false information and fake content in vast quantities, including imitating the voices of real people and creating photos and videos, referred to as deepfakes, that are indistinguishable from real ones.

It is in this context that students are being asked to create rhetorically effective texts using information drawn from sources that can be difficult to evaluate using traditional methods. Scholars have produced numerous publications on equipping students with critical literacy skills to help them navigate the sea of mis- and disinformation circulating online. Among the many approaches advocated by scholars, news-as-text pedagogy (Reardon 2021), rhetorical ethics (Duffy 2019), and civic literacy (Leake 2021; Lockhart and Hofmann 2021) have been proposed to help teachers and students cultivate the conscious, thoughtful practices needed today. Across this scholarship, the significance of students' critical data literacy has not received adequate attention. It is crucial to integrate critical data literacy into the teaching of multimodal composition because students who understand how data stories are constructed are more likely to be thoughtful readers and creators of such texts. In addition to frameworks and tools aimed at helping instructors to introduce and students to understand the use of modes, media, and page

design principles in multimodal composing, we need frameworks and tools for data literacy instruction as well. *Critical Data Storytelling* moves toward filling this gap by presenting a critical data literacy pedagogy grounded in examination of students' data literacy practices and development.

Second, paying attention to data literacy can add to our understanding of how the rhetorical canons of invention, arrangement, and delivery have changed in the "post-truth" media era. A challenge associated with critically engaging data is the issue of transparency. Data transparency refers to understanding who gathered data and for what purpose; how data were cleaned, analyzed, and visualized; and how data stories circulate through online networks. The lack of transparency around data circulating online means that it can be difficult to determine who gathered data and for what purpose. There have been pushes to make data more transparent and open as a result, so that greater numbers of people can access data and so, for example, consumers can become more aware of how data collected by companies online are using that data. However, I argue the problem is more complex than that. It is not only that data need to be transparent but that people need to understand how data are invented, arranged, and delivered. As the editors of *Literacy and Pedagogy in an Age of Misinformation and Disinformation* contend, "Without critically investigating the mechanisms by which information is shaped, manipulated, and selectively shared or amplified, any critical reading and understanding will be inevitably decontextualized and thus potentially inaccurate" (Lockhart et al. 2021, 4). A focus on data storytelling can help us to understand how data are invented, arranged, and delivered to serve persuasive ends and how readers learn to construct data stories in a range of genres and sources. It can also make visible the role technology plays in mediating reader encounters with multimodal texts as students consider how technology obscures or reveals the intentions behind the text. In this book, I outline a rhetorical approach to critical data literacy for use in writing classes based on making visible to students the choices involved in inventing, arranging, and delivering data. This research can contribute to further investigations into how invention, arrangement, and delivery relate to multimodal composing, and it can aid teachers in helping students learn how to analyze and use data in rhetorically effective and ethical ways in a variety of contexts.

Third, the book provides the foundational knowledge of data literacy necessary to engage generative AI critically. Generative AI refers to the ability of an AI model, such as ChatGPT and DALL-E, to produce new content,

ranging from text to images to videos, based on the data it has been trained on. Generative AI has been much in the news since 2022 when text-to-image AI models such as MidJourney, DALL-E, and Imagen were released to the public. These models were quickly followed by OpenAI's ChatGPT, an AI chatbot with natural language processing (NLP) that allows users to have human-like conversations to complete various tasks.

We do not yet have a full understanding of the societal—and pedagogical—implications of generative AI. However, already it is clear that generative AI will impact human behavior and cognition. Within writing studies, much of the emphasis currently is on sketching out what is needed to understand, use, and guide generative AI—frequently grounding this work in earlier scholarship on emerging writing technologies (Graham 2023; Johnson 2023; Stanton 2023). Understandably, given how recently generative AI has been introduced to the public and how quickly it is evolving, there is a considerable focus on identifying the basic functional skills required to use generative AI, such as how to operate AI user interfaces, write effective prompts, and cite information generated by AI (Aguilar 2024; Byrd et al. 2023; Gallagher 2023). The importance of critical data literacy to working with AI has not been fully recognized within writing and rhetoric scholarship so far. Nevertheless, being able to effectively, ethically, and responsibly use AI requires a critical understanding of data because generative AI does not exist without data. As Ben Snaith (2023), a researcher at the Open Data Institute, explains, "Data is foundational to AI models. It provides the information that a machine learning model is trained on and learns from. It is collected, wrangled, curated, aggregated and then used in the model. Data is used to test and benchmark the model's success. And data is inputted for utilisation once the model is operational" (2). Figure 0.1, which was created with the assistance of generative AI, further details the role data play throughout the AI life cycle. Because data are so crucial to the operation of AI, it will not be possible for writing and rhetoric studies to engage AI critically without also engaging data. The framework for critical data literacy pedagogy presented in *Critical Data Storytelling* focuses on helping students and instructors cultivate the foundational knowledge necessary to recognize the ethical dimensions of using generative AI and the strengths and limitations of data generated by AI, understand the level of information a reader needs and how to choose the correct data insight approach, including the use of AI, and evaluate data analysis and visualizations generated by AI.

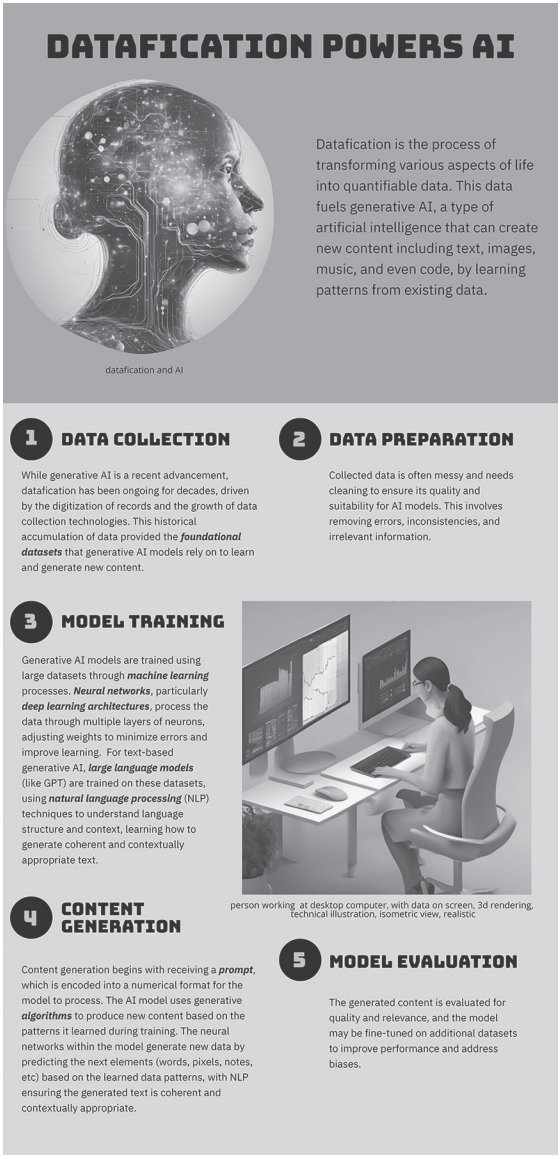

FIGURE 0.1. Infographic "Datafication Powers AI," created in collaboration with AI technologies. Source: Angela Laflen. Note: See the glossary for definitions of the bolded, italicized terms.

The Datafication of Everyday Life

We can appreciate the challenges of reading and composing with data by considering how the concept of data literacy has expanded due to the increasing importance of data in everyday life. Though data stories have always been common in scientific decision-making, technology has resulted in an

information explosion that has led to the datafication of everyday life (Mayer-Schönberger and Cukier 2013). Datafication is the result not only of unprecedented amounts of data being generated (Petroc Taylor [2025] reports that the total volume of data worldwide is expected to reach 182 zettabytes in 2025 and 394 zettabytes by 2028) but also of aspects of the world that had not previously been quantified being rendered into data. For example, social media turns connections and likes into data, satellite imagery and remote sensing techniques change location into data, and learning analytics transform student work and interactions into data. Algorithms are put to work mining these data for information to serve a wide range of ends—from refining online marketing to early identification of infectious diseases based on online search patterns. With the advent of generative AI, algorithms are being applied to large language models (LLMs) to create new and original content and data by predicting and generating natural or humanlike language. However, as Safiya Umoja Noble (2018) has discussed, algorithms are never "'neutral' or 'objective' decision-making tools" (2). Instead, "discrimination is also embedded in computer code and, increasingly, in artificial intelligence technologies that we are reliant on, by choice or not" (1), meaning that as datafication transforms formerly unquantified aspects of the world into data, it also expands oppressive social relations.

The process of datafication necessitates new understandings of how information is processed and the environments in which communication takes place. As Mark Frank, Johanna Walker, Judie Attard, and Alan Tygel explain, "By itself data is not information. For data to be useful people must be able to extract information from it. The ability to do this is rapidly becoming a requirement to participate in modern life—as fundamental as the ability to use a telephone or money. Those who do not have this ability are in an important sense disadvantaged" (Frank et al. 2016, 5). Though data literacy used to be largely synonymous with statistical literacy, "the Internet has fundamentally changed the game by potentially allowing anyone with Internet access to access a vast range of data sources" (5). Consequently, "data is now everyone's responsibility" (Dykes 2020, 6). More recently, generative AI has changed the game again by offering new options for extracting meaning out of data and creating data visualizations. Although generative AI promises to make data analysis and visualization more accessible to the public than ever before, James Fisher (2023), chief strategy officer for the software vendor Qlik, explains that data literacy is still required for users "to select and prepare high-quality datasets, recognize and mitigate biases within the data, and help

interpret outputs to make data-driven decisions." Rather than making data literacy skills less important, easy access to generative AI tools capable of analyzing and visualizing data increases the need for all members of the public to be able to evaluate how data are used for persuasive purposes and to use data in ethical and effective ways.

Rhetorical Readers and Critical Communicators

The growing importance of data literacy as a critical literacy necessary for all citizens to possess is a central concern of this book. Even if Brent Dykes (2020) is correct that "data is now everyone's responsibility" (6), it is also evident that not everyone has the same needs when it comes to data. Scientists and other technical specialists continue to require a highly developed and sophisticated approach to data, with the thorough understanding of statistics and math that is only cultivated through advanced study of these topics. Most other members of the public do not require this degree of data literacy to read and make use of data to solve their problems. Though the importance of data literacy is widely agreed upon, "there is a lack of consistent and appropriate approaches for helping novices learn to 'speak data'" (D'Ignazio and Bhargava 2016, 84). As a result, efforts to cultivate data literacy more widely across the curriculum and in multimodal composition have been sporadic.

Nevertheless, studies focused on data literacy have found that students and members of the public generally struggle when asked to read and use data even in relatively simple ways. As an example, the Stanford History Education Group (SHEG) (2016) has sounded an alarm about the state of US students' "civic online reasoning," which SHEG defines as "the ability to judge the credibility of information that floods young people's smartphones, tablets, and computers" (3). The results of SHEG's large national study of elementary- through college-level students revealed that "overall, young people's ability to reason about the information on the Internet can be summed up in one word: *bleak*" (4). Based on the exercises used in the study (which are available online at the SHEG website), SHEG clearly considers the ability to read data stories critically an important part of civic online reasoning. For example, one exercise for college-level students presents them with a tweet from MoveOn.org that shares a surprising statistic about NRA members' beliefs about background checks and asks them to explain (1) why this tweet might be a useful source about NRA members' beliefs about background checks and (2) why this tweet might not be a useful source about NRA

members' beliefs about background checks. Few students were able to evaluate the usefulness of the tweet: "Only a few students noted that the tweet was based on a poll conducted by a professional polling firm and explained why this would make the tweet a stronger source of information. Similarly, less than a third of students fully explained how the political agendas of MoveOn.org and the Center for American Progress might influence the content of the tweet" (23). The authors of the SHEG study conclude that "when it comes to evaluating information that flows through social media channels, ['digital natives'] are easily duped" (4), and as a result, "we worry that democracy is threatened by the ease at which disinformation about civic issues is allowed to spread and flourish" (5).

Certainly, data stories can be effective vehicles for spreading mis- or disinformation quickly online. Increasingly, fake news creators include misleading or false data displays to imbue their stories with an aura of credibility and increase online engagement. As Randall Chun (2017) explains, the appeal of data stories is their accessibility: "A tweet with an embedded image gets 150 percent more retweets. . . . Sharing an eye-catching data visualization that has an air of credibility (because it's scientific!) is hard to resist, especially with the low-friction tap of a retweet." The appeal of data stories makes them particularly effective at injecting false and misleading information into decision-making and public discourse.

The spectrum of data literacy is wide, with scientists who require advanced mathematical training on one end and members of the public who need to be able to evaluate claims based on data they encounter in daily life on the other. Consequently, appropriate approaches to training "novices to speak data" will also necessarily vary widely depending on the instructional context and goals for the data literacy instruction. The question is, what kind or level of data literacy is appropriate for inclusion in multimodal composition pedagogy?

To help students read data stories critically and use data effectively in their multimodal arguments, I believe that writing instructors primarily need to focus on students' skills as rhetorical readers and critical communicators. In delineating the four types of citizens according to the situations in which they would need to use data shown in figure 0.2, Annika Wolff et al. (2016) have defined readers as those who "need skills to interpret data that is increasingly presented as part of their everyday life," while communicators "make sense of and tell stories about data for others to digest" (18). The other two types of citizens, labeled data scientists and makers, require more advanced training in math and statistics to use data to solve the problems they face. Wolff and

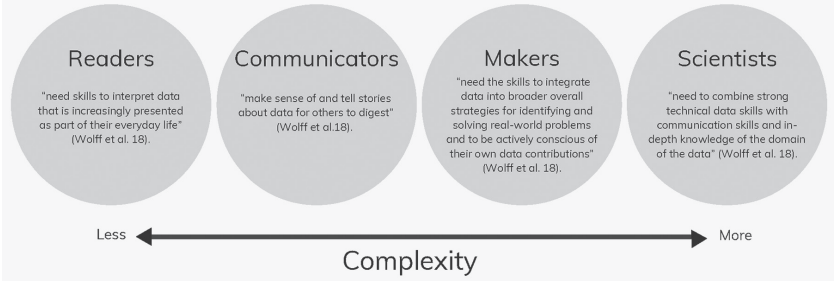

FIGURE 0.2. Types of data literate citizens adapted from Wolff et al. 2016, 18.

colleagues' approach is valuable for suggesting that rather than adopting a one-size-fits-all approach to data literacy, more attention should be paid to the ways different types of people "need to use data intelligently for solving real world problems" (18). Their point is that few people require the level of literacy necessary for a data scientist and that the data literacy skills necessary to function as readers and communicators can be taught across the curriculum separate from advanced statistical training. Indeed, writing teachers are uniquely positioned to help students adapt critical reading skills to data stories and understand how data are invented, arranged, and delivered to advance persuasive arguments.

What the Focus of This Book Does Not Include

It is important that I make it clear what I am not suggesting or advocating for in this book. To begin, I am not suggesting that including critical data literacy in multimodal composition necessarily requires instruction in math or statistics. While it may be appropriate and necessary to focus on math or statistics skills or the use of statistical software in the context of some advanced writing courses or to achieve particular learning outcomes, instructors can often design critical data literacy assignments that foster students' skills as rhetorical readers and critical communicators of data without providing instruction in math or statistics. To this point, work by scholars such as Carol Rutz and Nathan D. Grawe (2009) indicates that students do not have to use advanced math skills or complex technologies to achieve literacy benefits and that student motivation and engagement may be improved when assignments are more accessible. Quantitative reasoning (QR)-across-the-curriculum advocate Lynn Arthur Steen described QR as "sophisticated reasoning with elementary mathematics more than elementary reasoning

with sophisticated mathematics" (Steen 2004, 9, quoted in Rutz and Grawe 2009, 1). Building on this idea, Rutz and Grawe argue that students specifically benefit from opportunities to practice using numbers in rhetorically effective ways to provide context, make evidence specific, show change over time, and impart precision in language since "much of their experience with numbers is limited to formal situations that require them to solve problems with correct answers." Similarly, Daniel Anderson (2008) has recommended the use of what he refers to as "low-bridge technologies," or free, consumer-level technologies (42), in multimodal composition instruction. He argues that low-bridge technologies can reduce student "difficulties that can shut down flow, but the challenge of composing with unfamiliar forms opens pathways to creativity and motivation" (44). The model for critical data literacy pedagogy that I present in this book is flexible enough to accommodate a wide range of assignments, from those that rely only on elementary mathematics and low-bridge technologies to those that include more advanced math and/or technologies.

I am also not proposing that we abandon previous approaches to preparing students to conduct research for and in the context of academic argument. The traditional academic research skills that are currently emphasized throughout higher education remain valuable for preparing students to conduct research and write for academic audiences in academic contexts. However, there is evidence that differences between academic literacies and the literacies required to navigate datafied information spaces are growing, especially given the emergence of generative AI. A recent report by researchers at Project Information Literacy (PIL) found evidence of a "large gap between the information literacy skills [students] practice for courses and their grasp of our current information environment" (Head et al. 2020, 11). They describe the information environment that students inhabit as less "a cloister of scholarly knowledge" and more of "an overgrown jungle where every resource must be tested for toxicity, and where students are stalked relentlessly, their data harvested as fodder for unknowable uses" (28). The result is that traditional strategies for evaluating information sources, which grew out of and remain suitable for print-reading practices, are not well-suited to evaluating much of the information students encounter online. PIL researchers also found that "the critical work of understanding the torrent of information flowing through a variety of channels, from social media to commercial search engines, is rarely considered in assignments and classroom discussions" (28). In the absence of critical strategies, students develop

a range of informal defensive strategies, which nevertheless leave them feeling "resigned" in the face of datafication (14). AI promises to widen the gulf between traditional academic information literacy skills and those that students need to interact with information in their daily lives and after graduation. My insistence in this book on the importance of attending to students' critical data literacy in multimodal pedagogy is not a call to replace traditional research strategies but a call to supplement and enhance information literacy instruction with the addition of strategies for critically navigating datafied information environments.

Theoretical Foundations

In *Critical Data Storytelling*, I offer a model for critical data literacy pedagogy that can be flexibly adapted for different and changing technological and educational contexts. Specifically, I provide multiple examples and activities to illustrate how the model can be applied rather than recommending a single assignment or syllabus. Focusing on the choices available to data storytellers and the implications of the choices that data storytellers make are central to this approach.

MULTILITERACIES PEDAGOGY

My model for critical data literacy pedagogy is informed by Stuart Selber's (2004) work related to multiliteracies pedagogy. Building on the concept of "multiliteracies" that was articulated in 1996 by the New London Group as a call to develop literacy theory and pedagogy based on linguistic diversity and multimodal forms of communication, Selber described the "conceptual landscape of a computer multiliteracies program" in 2004 as consisting of functional literacy, which positions students as users of technology; critical literacy, which positions students as questioners of technology; and rhetorical literacy, which positions students as producers of technology (25). Selber insisted that instructors not prioritize one type of literacy over another but rather "help students learn to exploit the different subjectivities that have become associated with computer technologies" (25).

Selber designed his framework to accommodate "the continuous and contingent interplay between context and technology" (26), and today this framework remains useful as we chart a course for critical data literacy in multimodal composition pedagogy. In fact, I believe that data literacy in the context of big data is best understood as a different form of digital literacy

rather than an entirely distinct literacy (Polizzi 2021). This is not to overlook the fact that computational methods have a far longer history than digitization does as they have been practiced and developed for centuries (Porter [1986] 2020; Poovey 1998) but rather to recognize that the process of datafication operative across society today depends on digitization even though it is not synonymous with it. Mayer-Schönberger and Cukier (2013) explain that "the arrival of computers brought digital measuring and storage devices that made datafying vastly more efficient," although "the act of digitization . . . by itself does not datafy" (83). In addition to digitization, datafication also relies on digitized information being made "indexable and thus searchable" (84). Digital information become data when they can be analyzed for meaning, often through the use of natural language processing and computer algorithms. As a result, working with data in the context of big data involves using computers to collect, organize, analyze, and visualize data. Thus, becoming data literate today, although there is no universally agreed upon definition of what that means, inevitably involves the ability to use computers at some level in the process of asking and answering questions with and about data. For this reason, the conceptual landscape of a computer multiliteracies program that Selber maps out remains relevant to charting the conceptual landscape of data literacy. Although some of the metaphors that Selber used to conceive of computer multiliteracies require tweaking to account for how the concept of data differs from the concept of a computer, as indicated in table 0.1, thinking of data literacy in terms of functional, critical, and rhetorical literacy is useful in delineating the different kinds of data literacies that instructors can emphasize in writing courses to "help students move among them in strategic ways" (Selber 2004, 24).

Instructors attend to students' functional literacy when they ensure students have the basic skills necessary to use data as a resource in ethical and effective ways. Though the basic skills needed will differ depending on context, examples could include being able to identify different types of graphs and the parts of graphs, how to choose among different interpretive levels, and how to use software programs like Excel or Sheets. Instructors foster students' critical literacy by helping students develop a critical consciousness about the role data play in society and strategies for engaging data critically. Asking students to read about or research topics such as online surveillance, data privacy, and generative AI; evaluate sources of information that use data; and identify the affordances and constraints associated with data visualizations or with datafied ways of knowing more generally

TABLE 0.1. Adapting Selber's conceptual landscape of a computer multiliteracies program for data literacy

Category	*Metaphor*	*Subject Position*	*Objective*
Functional Data Literacy	Data as human-made resource	Students as users of data	Effective and ethical use
Critical Data Literacy	Data as cultural artifact	Students as questioners of data	Informed critique
Rhetorical Data Literacy	Data as assemblage	Students as producers of data	Reflective praxis

Source: Adapted from Selber 2004, 24.

are examples of activities that could position students as questioners of data and promote the objective of informed critique. Selber describes rhetorical literacy as "mediat[ing] the binary division between functional and critical literacies to some extent" and suggests that "a curricular implication of this relationship . . . is that rhetorical literacy might prove to be a particularly challenging place to start" (Selber 2004, 25). Instructors cultivate students' rhetorical literacy by highlighting how data are invented at every stage of the composition process—from how they are collected to how they are organized, analyzed, and visualized—to serve persuasive aims and by providing opportunities for students to analyze their own rhetorical situation and compose data stories suited to that situation.

CONSTRUCTIVIST PHILOSOPHY

As the metaphors used to describe data indicate, the conceptual framework outlined in table 0.1 reflects a constructivist perspective on data. Constructivist philosophy is associated most with learning theory and has been applied in educational settings for almost fifty years (Honebein 1996). Although interpretations of constructivism vary, I follow Johanna Drucker (2011) and Christian Hennig (2002) by thinking of constructivism broadly as an approach to epistemology. Hennig outlines three principles common to constructivist approaches to philosophy: "There is no observation without observer," "Observations are constructed in social dependence," and "Perception is a means of self-organization, not of representation" (2). When applied to data, constructivist philosophy challenges the idea that data can ever be raw or simply represent the world as it is (Gitelman 2013), which constitutes a more traditional realist view of data. Rob Kitchin and Tracey P. Lauriault (2014) describe the realist view of data: "As the concept of data

developed, data largely came to be understood as being pre-analytical and pre-factual, that which exists prior to interpretation and argument; the raw material from which information and knowledge are built." From this point of view, data are taken to be "benign, neutral, objective and non-ideological in essence, reflecting the world as it is subject to technical constraints; they do not hold any inherent meaning and can be taken at face value" (Kitchin and Lauriault 2014). The realist view of data makes humanistic engagement with data difficult if not impossible. As Drucker (2011) explains, "Humanistic inquiry acknowledges the situated, partial, and constitutive character of knowledge production, the recognition that knowledge is constructed, *taken*, not simply given as a natural representation of pre-existing fact" (emphasis in original). Consequently, Drucker argues for "*reconceiv*[*ing*] *all data as capta*. Differences in the etymological roots of the terms data and capta make the distinction between constructivist and realist approaches clear. *Capta* is 'taken' actively while *data* is assumed to be a 'given' able to be recorded and observed. From this distinction, a world of differences arises" (emphasis in original).

Drucker's work testifies to the value that humanistic inquiry has to understandings of data—within and outside the humanities. In the humanities, engagement with data makes possible the investigation of new questions and offers new methods for investigating longstanding questions. For example, in *Composition and Big Data*, editors Amanda Licastro and Benjamin Miller (2021) discuss how big data methods provide new ways to approach longstanding questions about writing, such as the extent to which students transfer knowledge of writing gained in one context to another, while raising new questions for researchers to consider, such as how to ensure the ethical treatment of research participants in big data studies. However, in addition to the benefits offered by humanistic inquiries of data to those working in the humanities, Drucker insists that the constructivist approach to data is also valuable to "those that presume an observer-independent reality available to description." These scholars can benefit from "the methods of presenting ambiguity and uncertainty in more nuanced terms." The constructivist approach to data that informs my model for critical data literacy pedagogy is valuable for both facilitating humanistic engagement with data and usefully complicating more realist approaches to data analysis and visualization. In the classroom, this has the effect of making space for contributions from the widest possible range of students, regardless of how their disciplinary background informs their data literacy.

Chapters

Critical Data Storytelling represents my attempt to enact a multiliteracies data literacy pedagogy based on a constructivist perspective on data within multimodal composition pedagogy, focused on cultivating students' abilities as rhetorical readers and critical communicators of data stories. Chapter 1 details a model for implementing critical data literacy pedagogy in multimodal composition that is grounded in rhetoric and composition scholarship and focused on preparing students to act as data storytellers. I begin by discussing the exigence for this model in more detail by considering how datafication changes information and knowledge-making practices, using the example of learning management systems in higher education to illustrate how the process of datafication works and the possibilities for and limitations of datafied ways of knowing. I focus on learning management systems because they exemplify how the information environments in which students compose texts and interact with course materials, instructors, and other students are being shaped by computational and algorithmic modes of thinking that neither (most) students nor (most) instructors fully understand or are prepared to engage critically. Next, I review recent scholarship that indicates that despite the widespread transformation of information and information environments, writing instruction—and higher education generally—continues to be characterized by a static approach to information that does not account for or prepare students to engage critically datafied ways of knowing. I outline my model for critical data storytelling pedagogy and explore the connections between literacy and storytelling. I argue that the position of data storyteller is an agentive role that can encourage students to ask and answer genuine questions with and about data. In the current context in which students often feel powerless to resist datafication and datafied ways of knowing, claiming the right to tell one's own stories about and with data is a critical way to respond. At the end of the chapter, I describe a speculative design assignment I have included in first-year composition to encourage my students to engage critically the learning analytics dashboard of our course's LMS site.

In chapter 2, I focus on the first part of the model of critical data storytelling pedagogy, which prepares students to act as rhetorical readers of data stories. I define rhetorically reading data stories as being able to recognize when data stories use data ethically to support arguments and which data stories might help a reader answer their own questions or solve specific problems.

I begin by considering the challenges of reading data stories in the current post-truth era, the stakes of which were clearly exemplified by the spread of mis- and disinformation during what scholars have termed the "misinfodemic" that accompanied the viral spread of COVID-19. Next, I review recent scholarship on reading digital information sources critically and discuss how the range of strategies that scholars advocate using to read digital texts are useful but insufficient for reading data stories due to the unique challenges associated with reading and evaluating data stories. I present my model for a rhetorical approach to reading data stories, which addresses the unique difficulties associated with reading data stories by focusing students' attention on the context surrounding data stories to increase their comprehension. To demonstrate the efficacy of my model for a rhetorical approach to reading data stories, I offer a case study of two data stories to show how it can be used to read data stories critically.

Chapter 3 considers the second half of the model of critical data storytelling pedagogy, which focuses on preparing students to communicate about and with data. I begin by discussing the context for what is often referred to as a data literacy crisis, one precipitated by the rapid and widespread transformation of information in the big data era. Next, I compare approaches to cultivating data literacy, which vary considerably despite generally embracing the concept of data storytelling as a way to make data actionable. I also discuss how the emphasis on critical data storytelling in rhetoric and composition scholarship makes this approach particularly suitable for use in a wide range of writing courses. I present a variety of pedagogical resources I have developed to assist in the process of designing critical data storytelling assignments for different levels of writing classes and students. To represent the range of possibilities for critical data storytelling assignments, at the end of the chapter I share three critical data storytelling assignments and include a sample student response for each assignment.

Chapter 4 focuses on an instructive approach to responding to and assessing students' data stories aimed at preparing students to both evaluate and compose data stories simultaneously. The chapter opens by defining instructive assessment and contextualizing it within multimodal pedagogy. I report results from my research of students' development of data literacies that indicate the extent to which critical data storytelling assignments require students to engage in a process of trial and error and risk failure as they acquire the new skills necessary to complete these assignments. I discuss specific instructive assessment strategies I use to help students understand criteria

for evaluating data stories and how to assess their own and others' work, and I share one example of a data storytelling assignment from a first-year writing class to demonstrate how these strategies can support students in the data literacy learning process. The chapter closes by considering how instructive assessment can be used with different grading schemes and by offering recommendations for using instructive assessment with critical data storytelling assignments.

While the first four chapters of *Critical Data Storytelling* focus on preparing students to navigate the changes that big data has brought to information environments and ways of knowing and emphasize the value of a critical perspective to examine and respond to these changes, in chapter 5 I explore how rhetoric and composition teachers can use data for teaching purposes. The chapter begins by considering calls from within the field of rhetoric and composition for instructors to cultivate data literacy and the kind of data literacy described as being necessary for rhetoric and composition teachers. I also examine some of the concerns that surround data use, in particular, the use of data to monitor students and teachers. Next, I discuss how the concept of data literacy for teachers (DLFT) can be adapted by college instructors. Then I share resources that instructors can use to cultivate their own data literacy and design data inquiries, and I present an extended example of a classroom data inquiry. The chapter closes with recommendations for using data in teaching contexts.