

CHAPTER 14.

REFLECTIVE LEARNING IN DATA STORYTELLING

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This chapter describes reflective activities to strengthen data literacy in hybrid learning. Specifically, the authors consider the role of reflection to highlight how data knowledge can advance student progress toward professional or personal goals. The reflective activity is then used as a foundation to reinforce both conceptual and operational definitions of data. In describing the “better practice,” this chapter addresses the themes of multimodal learning and practices in motion across teaching and learning.

FRAMEWORKS AND PRINCIPLES IN THIS CHAPTER

- **PARS Online Writing Instruction, Strategic:** Focusing on the student user experience (UX). After all, students are our primary users!
- **PARS Online Writing Instruction, Personal: Showing** your students you are a human! Writing is personal and teaching is personal so make it that way in your OWC. Build community and foster instructor/student & student/student connections.
- **Framework for Success in Postsecondary Learning, Metacognition:** The ability to reflect on one’s own thinking as well as on the individual and cultural processes used to structure knowledge.

GUIDING QUESTIONS BEFORE YOU BEGIN READING

- In what ways does having accurate and reliable data improve progress toward your personal or professional goals? Can you think of a personal example?

- What is the benefit to you of reflection? When you think about past experiences, how does the process of *reflection*, beyond *just recalling* those experiences, benefit you?
- How do you talk to your students about how they create evidence of learning? What are the ways that students demonstrate to you that they have learned?

INTRODUCTION: WARY STUDENTS AND THE REFLECTIVE PROCESS

Often, one of the first questions on the first day of class in a data analysis course for communicators in our mass communications program centers around how *difficult* the class might be. After all, the course is ostensibly about data and numbers and these students come to the program to be *writers*. They want to pursue the story, not the numbers. They are well aware of the trope that *writers don't do math*. Even *some* math might be problematic, so a class called “Data Storytelling” awakens the terror inside all of us.

Even readers not familiar with how to construct a data story have seen data storytelling in action. For instance, as police use of force has become increasingly scrutinized in the United States, *The Washington Post* has published a searchable database of police shooting incidents since 2015 (<https://www.washingtonpost.com/graphics/investigations/police-shootings-database/>). Each election cycle since 2008, FiveThirtyEight.com (ABC News, 2020, 2022) has attempted to forecast the winner of American elections—check out examples from 2020 and 2022 (<https://projects.fivethirtyeight.com/>). The attention this model received, especially for presidential elections, has spawned several other popular forecasts.¹ In public health communication, the Coronavirus Resource Center at Johns Hopkins University published and regularly updated the COVID-19 Dashboard for nearly two years during the Coronavirus Pandemic (<https://coronavirus.jhu.edu/map.html>). The dashboard became an essential tool for researchers and the public alike to understand the spread of the disease.

Data storytelling combines evidence in the form of data with compelling visuals and a narrative to communicate insights (Ojo & Heravi, 2018). Data literacy (characterized well by Javier Calzada Prado and Miguel Ángel Marzal,

1 These include *The Economist's* pre-election forecasts (<https://projects.economist.com/us-2020-forecast/president>), *Politico's* 2020 election forecast (<https://www.politico.com/2020-election/race-forecasts-and-predictions/president/>), CNN's 2020 Electoral College outlook (<https://www.cnn.com/2020/11/02/politics/electoral-college-outlook/index.html>), and CBS' Battle-ground Tracker (<https://www.cbsnews.com/2022-us-battleground-tracker/>).

2013) is in demand in the various communication fields. *The New York Times* has called data journalism an “essential part” and “an increasingly common” aspect of their news content (Baquet et al., 2022). So, even for our students who may not think that data storytelling is a compelling career choice will come to realize that data storytelling is all around them.

The instructors of this newly developed course at a large midwestern university in Fall 2021 were fully expecting students to be wary of the course material and concept. Data Storytelling had only recently been added to the mass communication curriculum and was designed from inception to be a hybrid learning course with both online, any time learning and in-person, real-time learning components. The online, any time learning components included short videos featuring professional communicators who use data in their jobs and videos produced by the instructors focused on specific components of what is termed “the Data Project Lifecycle” (Bobkowski & Etheridge, 2023).

This lifecycle argues that data literacy can be improved by instruction that builds first from collection of data to then cleaning and transforming data to, finally, analysis of data and communication of results. Students answered questions about the videos in the online, any time learning content for weekly course credit. In the in-person, real-time learning component, students practiced the data storytelling skills such as data collection, data cleaning, data analysis, or communicating using data to reinforce the online, any time learning material. Each semester, the instructor developed a single class-wide (across the multiple sections) shared dataset on a single topic to use for examples and for student projects. Previous shared datasets have included state-wide high school characteristics, traffic data near the university, college basketball teams and postseason tournaments, Titanic survivor records, or recent Olympics results.

Students who were accepted to the school—offering a single major with concentrations in journalism media arts, or marketing communications—were required to take this new course. Development of the class was motivated by internal research conducted on the school’s curriculum and course offerings. Recent graduates had told a study group of faculty and staff reviewing the curriculum that they would have liked to have had more opportunities to improve skills in data storytelling as students. Likewise, professional communicators in positions to hire recent college graduates said they were looking for candidates with a demonstrated ability to incorporate data into their writing and production across platforms. As we established earlier in this chapter, data literacy and numeracy—the ability to tell stories that emerge from data—are skills in high demand in many communication fields. This increased focus on data in this mass communications program paralleled an initiative campus-wide, especially in the social sciences, to grow data literacy course offerings. Data storytelling was

a part of an interdisciplinary data science certificate organized by faculty from the computer science and psychology departments.

The faculty and staff study group indicated that the skills developed in a data storytelling course were important in two key areas of professional communication. First, a comfort with writing with and about numbers has shifted from a useful to an essential skill. Surveys have shown that many communication programs—in social science-focused media studies as well as more humanities-focused writing studies and applied communication—lack a strong offering in contemporary data literacy practices (Bobkowski & Etheridge, 2023). To be sure, journalism and other writing programs long ago developed “computer-assisted” writing courses. These students learned that simply including numbers in content created without accurately reflecting the meaning behind those facts and figures (what is defined here as *literacy*), can give the audience a false sense of objectivity and misrepresent a true accounting. Mass communicators ply their trade on a foundation of trust. Viewers, readers, listeners, and audiences of all kinds must believe and understand that content creators have taken the time and effort to understand the context, climate, and environment in which a story unfolds. In a digital world this slate of course offerings needs to increase.

Second, those hiring managers queried by the curriculum study group said that professional writers in modern communication careers *were expected* to be able to read and interpret digital and social analytics data that help content creators understand what audiences want from that content. Courses on content creation do not consider the growing need for an understanding of digital audience metrics, engagement data, and analytics (Dunwoody & Griffith, 2013; Gotlieb et al., 2017; Martin, 2017; McLaughlin et al., 2020). Using data to support development of content can display the content creator’s authority on a topic but only when used accurately and transparently. The sense of data-driven decision-making needs to be cultivated in our fields.

However, as noted above, instructors in Data Storytelling knew that students in the mass communication program were budding writers in part because of their passion for *the story*. Whether they were inspired by a love of communication or following a path into mass communication driven by an uncomfortableness with scientific information grounded in hard facts, the hard truth was that *data and statistics knowledge* was not found to be inspirational to budding scribes.

To achieve a level of confidence whereby students could write effectively both with and about numbers, instructors felt it was important to demonstrate the accessibility of numbers as support for the kinds of content they were used to creating in previous courses. To do this, they identified key moments in the course where students could demonstrate to themselves that they were learning the material through assignments that allowed students to reflect on

their data literacy and demonstrate connections between the course content and their lived experience.

In this chapter, we discuss one example of how instructors seized on the feeling of reticence among students in the Data Storytelling course and used metacognitive approaches to ameliorate this fear, helping students build confidence in their learning, and demonstrate how identifying personal experiences and connecting them to skills and concepts students were learning could benefit them in their future careers or even personally. By providing opportunities for students to recognize moments where they have already encountered data, the assignment and discussion outlined below build students' self-confidence, which has a demonstrated ability to improve learning outcomes (Steele, 2011). To develop this better practice, we draw from The Conference on College Composition and Communication Committee for Best Practices in Online Writing Instruction's (2013) *Principles for the Postsecondary Teaching of Writing* as well as the *Framework for Success in Postsecondary Writing's* (Behm et al., 2017) adaption of Arthur Costa and Bena Kallick's *habits of mind* (2000).

DON'T CALL IT "REFLECTION"

We recognize that "reflection" can sometimes—especially among students—be identified as simply thinking about the process or thinking about the experience. Reflection can mean students writing about their thoughts and feelings throughout a course or activity. Students can keep a journal or record video entries about their experience throughout a course. Reflective components can additionally complement major projects. Ashleah Wimberly and colleagues (Chapter 4, this collection), for instance, highlight a reflective "rhetorical rationale" assignment that students complete alongside their memorial/monument redesign project. This component tasks students with reflecting on the choices they made and how those choices align to their rhetorical goals for the assignment. These kinds of activities are important to the learning process.

In practice, however, we have found that students do not always take reflective practices as seriously as they might other assignments. As college instructors, we have additionally found that assessment of these kinds of activities can be difficult. Students' pre-conceived notions of reflective practice can structure their responses to "reflection activities." Because of this, we are wary to call the types of activities we discuss in this chapter "reflection" in the assignment descriptions, framing our activities simply as "thinking about a time where data did or could have benefitted you." Students may then reflect on experiences without thinking about the activity as a performative "reflection assignment." In doing so, we hope that students will more easily see the connections we are

trying to create—to make data, an often new and different concept, one that is more familiar and comfortable.

In this chapter, our *better practice* highlights activities that allow students to recognize what they *have* learned in the course *by connecting ideas in the material to personal experiences or goals*. Specifically, we want students to *know* that they can incorporate numbers—from demographic data to survey results to sports statistics to crime rates to social media analytics and more—into their communication approaches because these activities have already laid the groundwork to allow them to see where data literacy might benefit them. In this course, we used structured reflective learning activities to address students' discomfort with numbers, highlighting ways that numbers already exist in students' lives.

Writing studies—and communication studies more broadly—have a rich history of reflective writing both as a means of writing practice and an assessment tool (Huot, 1996; Irvin, 2020). Reflective learning practice in mass communication writing instruction has clear benefits to retention of knowledge, demonstration of learning, and reinforcement of the educational experience (Burns, 2004). Reflective thinking in some form has been advanced in professional and educational settings for nearly a century (Dewey, 1933; Rogers, 2001; Schön, 1983). Donald Schön (1983) identifies reflection as “the dialectical process by which we develop and achieve, first, specific goals for learning; second, strategies for reaching those goals; and third, means of determining whether or not we have met those goals or other goals” (p. 6). Likewise, the Conference on College Composition and Communication's Committee for Best Practices in Online Writing Instruction explicitly recommends the use of “the inherently archival nature of the online environment” to “encourage students to rhetorically and metacognitively analyze their own learning/writing processes and progress” (2013, p. 14).

Kathleen Blake Yancey (2016) defines reflection as “tightly focused on the mental activities of the composer in the process of composing” through three reflective practices: “reflection-in-action,” “constructive reflection,” and “reflection-in-presentation” (pp. 3-4). We draw from Yancey's rich characterization of reflection to demonstrate how students can connect to the course material through constructive reflection, or reflecting on how text is interrelated with identity, and reflection-in-action, or reflecting upon relationships between the writer and the text.

In doing so, we also recognize the important contribution of Jesse Borgman and Casey McArdle's (2019) Personal, Accessible, Responsive, and Strategic approach (PARS) to online writing instruction by focusing on the student experience as they work to understand the role of data in storytelling (*strategic*) and showing students the human aspects of learning by empathizing with their concerns and providing instructional scaffolding to support their learning (*personal*).

Additionally, the *Framework for Success in Postsecondary Writing* (Behm et al., 2017) advances the idea that *metacognition* can be achieved through prompting students to examine processes they use to think and write and connecting choices they have made in previous work to improve subsequent projects. These are all important learning approaches that have shown to improve outcomes.

Moreover, data literacy requires a rhetorical understanding of data communication, including 1) the audience, 2) the situation, 3) the available data, and 4) the medium. Reflective writing allows students to practice rhetorical analysis with data literacy, thus encouraging them to look beyond assumptions of objectivity in quantitative data. Numbers, just like words, can tell a story. The students' role is to interrogate that story to ensure the data used in storytelling is represented as accurately and completely as possible.

CULTIVATING THE “HABITS OF MIND”

To provide a grounded framework for developing students' data literacy through reflective practices, we incorporate Costa and Kallick's (2000) *habits of mind*, what these scholars call “a disposition toward behaving intelligently when confronted with problems,” to create practical and actionable tasks that achieve the stated goals of metacognitive, strategic, and personal learning. We present a scenario where students can demonstrate mastery of data literacy in both concept and operation. The habits of mind framework for solving problems include emotional responses such as finding humor in a situation (Habit #14) or more rational responses such as managing impulsivity (Habit #2).

Recognizing that students were coming into the course with high anxiety about the subject matter drew us to highlight how important students' disposition and individual problem solving would be in confronting the course material. For our purposes, we think of data literate habits of mind as responding mindfully and personally when asked to process and explain sets of data. Communicators are often tasked with addressing tasks with personal distance and objective thought. These practices are important. However, for students to internalize learning they must attach it to personal experiences, goals, feelings, or outcomes. This is where the habits of mind are advantageous.

Quite simply, this framework gives educators 16 mindsets for creating an environment where students can be confident they have learned. In the following sections, we highlight one example assignment that uses reflective practices to identify connections between habits of mind and data literacy. For important context, we also describe the class discussion that led into the assignment. Later, we describe how this lesson could be adapted to in-person, real-time; online, real-time; or fully online, any time learning.

COURSE CONTEXT AND LESSON

DATA LITERACY THROUGH OUR EXPERIENCES

To demonstrate how data literacy and reflective learning were interconnected in this data storytelling course, this section of the chapter discusses one key moment early in the course where students were given the opportunity to identify relationships between data and their personal experiences. This reflective moment centers around the conceptual and operational definitions of data, which are important ideas in the first several weeks of the course. After presenting the assignment, we will then describe what occurred in the classroom that led into the assignment, followed by additional context about the structure and design of the hybrid learning course.

This assignment was developed in part as a result of the instructor's observation of reticence among students early in the in-person, real-time learning component of the course. He quipped on that first day of class that a common sentiment among writers—both professional and amateur, across disciplines and fields—was that they *became* writers because there wouldn't be any math in their jobs. Heads nodded among the students. One student nervously asked how challenging the course was going to be for students who were uncomfortable with numbers. Another added that they were thinking about switching majors after seeing what this course was about. The instructor anticipated these types of questions. However, the connection between establishing a foundation of previous knowledge among the students and connecting that knowledge to the concepts in the course was not as apparent as it would become until an important opportunity to assuage their fears and make the learning more relevant arose.

He explained on that first day that data storytelling required a *comfort* with data but not an *expertise* in data. Data storytelling centered around *understanding* how and when numbers, facts, and figures improve a story and help the writer tell better stories. This was reinforced by professional communicators who were in a position to hire recent graduates. They wanted early career professionals with “spreadsheet wherewithal,” (Bobkowski & Etheridge, 2023) not necessarily a cadre of coders and statisticians. Developing advanced knowledge of statistics and data manipulation would be an option for students who were interested in taking additional courses on the topic through an interdisciplinary data science program, but this course focused primarily on *data literacy*, or simply knowing when was a good time to use numbers, where to find them, and how to incorporate them seamlessly into a story.

A few days later, as a way to address these overlapping concerns, the instructors developed an assignment using the Transparency in Learning and Teaching (TILT) framework (Winkelmes, 2013; Winkelmes et al., 2016). This activity is scaffolded to position students to respond clearly and concisely with artifacts that allow them to demonstrate both conceptual and operational definitions of

data. In development of this sample assignment, we focused specifically on question and problem posing (Habit #7), applying past knowledge to new situations (Habit #8), and gathering data through all senses (Habit #10) from Costa and Kallick’s habits of mind (2000). More than simply “reflecting” on a past experience, this assignment asks students to explore how skills in the course could have benefitted them in the past and could benefit them in the future.

We provide students with a prompt we use to assess skills they should be bringing with them from previous coursework as well as new concepts we are introducing. We provide reminders about skills they have learned in previous courses (a story includes necessary context, such as who, what, where, when, and why) and ask them to demonstrate their ability to communicate with those skills. We use personal experience as a backdrop for asking students to explore new concepts in data literacy.

ASSIGNMENT: WHERE CAN DATA BE FOUND IN YOUR LIFE?

Purpose

One of the objectives of this course is to “Understand the essential role of data in journalism and strategic communication workflows.” In previous courses, you have seen how generating topics for your news stories, news releases, videos, and audio projects from experiences and observations is an essential part of your future career. In this assignment, you should draw on a personal experience to show how data can enhance a story. Don’t worry about newsworthiness or news value for this assignment. Just think about a time in your life where *more* data would have benefitted a personal situation and write about it. Include where you might get those data and what characteristics of those data would be necessary to tell a better story.

Skills

The purpose of this assignment is to help you practice identifying sources of data and to think critically about where valid data could be found to enhance your storytelling. For this assignment, you should demonstrate how datasets have *observations* (defined as the individual events that occur and are captured in the rows of the dataset) and *characteristics* (defined as the aspects of each case that are different). For example, your transcript shows all of the classes you have taken (cases) and their characteristics such as semester taken, class number, course title, and grade. Formatting your transcript as a dataset allows you to more easily calculate your grade-point average.

Knowledge

This assignment will also help you to become familiar with the following important data storytelling concepts:

- Identifying valuable narratives in mass communication
- Sourcing data (for example, kaggle.com or github.com)
- Cases and variables in data
- Using evidence to support narratives

Task

In this assignment, you should:

1. identify a story from your own life that might be expanded or improved by supporting data and write about that experience in as much detail as possible (about 200 words), and
2. in a separate paragraph (about 200 words), describe the data that might improve or support that story. Identify sources of these data. Describe why you think these data are valid. Then, describe the cases and characteristics of these data. Be sure to include what characteristics you might analyze to include in the story from your own life.

We have discussed how data should have cases (observations in rows) and variables (characteristics of those observations in columns). Another example: If you wanted to know what percentage of people in class wear glasses, you would need a list of the people in the class (cases) and whether they wear glasses or not (a variable). In what you submit for this assignment, highlight how many cases you think your data might have and what characteristics your data might have.

Example scenario: Let's say you tried to convince your parents over the summer to let you spend a semester studying abroad. First in this scenario, write a paragraph on where you wanted to go, when you wanted to do it, why you thought it would be a good experience, and what you said to your parents. Then, identify where you might find good data to support your argument. You might try a Google search for information about study abroad programs and learning outcomes. You might see if the KU International Affairs office has data showing why study abroad programs are beneficial. In that second paragraph, describe what the data might look like. You're not citing facts and figures about study abroad here; you're trying to imagine how someone might measure if students who study abroad do better in their future jobs or earn more or that they express a higher satisfaction in life.

Criteria for Success

This assignment will be assessed in three ways and is worth 15 points (5 points for each part; 5 = fully present down to 0 = not present).

- All three parts below will be assessed in part on professional use of grammar, punctuation, spelling, and tone.

- Part I: Did your experience include enough detail that someone who was not there could understand it fully? Make sure you include the Who, What, Where, When, Why, and How of the story.
- Part II: Do you identify possible data sources to support this experience? Do you discuss how you know the sources of data are valid and reliable?
- Part III: Do you identify the cases and characteristics of the data? Did you connect those variables to the experience you outlined in the first part?

BETTER PRACTICE IN ACTION

While a planned assignment such as this example is constructed with the ideal outcome in mind, as educators we know that meeting students where they are is a critical skill. In this section of the chapter, we highlight the experience of one instructor as he introduced the conceptual and operational definitions of “data” and then described this assignment to students.

In this vignette, the Week 2 in-person, real-time learning session of the course opened with a discussion of the terms that comprise the name of the course. The assignment above was then distributed and discussed. At the start of the class session, students were asked to define for themselves the terms “data” and “storytelling.” They were given five minutes to write down a definition for each term. They were then told to share their definitions with someone sitting close to them in the classroom. After students thought about their definition and shared it with a partner, the instructor asked if students would like to share what they wrote with the entire class. Giving students time to think about a concept and then share it in a small group can help students build confidence in their responses (Azlina, 2010). This confidence can then help facilitate a more robust discussion as students grapple with ideas that are being introduced to them for the first time. The process is sometimes called “Think. Pair. Share.”

The instructor returned the discussion to the entire class after the small-group period and opened the floor to volunteers who might describe their definition of “storytelling.” In the activity outlined above, “storytelling” serves as a foundation upon which data sits and is a skill students should be more comfortable with. This can serve as a stronger starting point in the whole-class discussion. Students providing a clinical definition of storytelling itself was not as important as the activity of asking students to recall previous experiences with storytelling and then formulate what they know goes into a storytelling narrative.

In mass communication coursework, students are exposed to the idea that a good story must focus on the experiences of individual actors in the story.

The anecdote drives the narrative. For journalists, the “rule of three,” where three sources make a story, guides the foundation of reliability and veracity. For strategic communicators, the personal experience of an employee, a customer, a fan, or a member of an organization can be highlighted to support the organization’s goals. Conceptually, data in mass communication builds on this idea of a “source” by recognizing that the aggregate experiences of hundreds or thousands of individual sources can serve to elaborate on the anecdotal experiences featured in a story. By having students define the term “storytelling,” the instructor was giving students a launching pad to think about what they know of sources. Data storytelling is, in essence, the same kinds of sourcing practices they performed in previous classes, but with hundreds or thousands of sources, rather than one, two, or three.

When students were asked to share their definition of “storytelling,” the classroom went silent. Silence is valuable to a discussion because it gives students time to collect their thoughts. Silence is also uncomfortable and eventually the discomfort will build to a point where a student jumps in to speak. (In the online, any time learning environment and to a certain extent in the online, real-time learning environment, the “silence” tool is not one available to the instructor. We offer some suggestions for how to address that issue later in this chapter.) After some prolonged silent awkwardness, one student said a story was an experience that a person wished to share with others. Another then said that storytelling was the act of communicating. A third added that she was not sure how to define it but offered to give an example. Early in the semester, students and the instructor were still getting to know each other, so supportive statements that facilitate discussion wherever it may go can be valuable.

“Examples are important ways to communicate definition,” the instructor said. “So what’s your example?” This student described a situation where she was nearly hit by a car earlier that day on campus, adding the location and time of the incident. This example was in-fact a clear story with contextual details that allow a writer to build a narrative. To drive the discussion toward “data storytelling,” the instructor asked the class if that intersection was particularly dangerous. Students did not know. Then the instructor asked if students knew what the worst intersection was on campus. Students did not know. The opportunity to discuss the conceptual and operational definitions of data presented itself and so the instructor shifted to that line of thinking.

He told the class to hold on to what they have written about “data” and “storytelling.” They were going to work with this student’s example to explore possibilities of data storytelling. All stories need a source. Students were familiar with the idea of a source of information. In previous courses, they had discussed how to identify and scrutinize individual sources in news content. As stated

above, conceptually, data can be thought of as the aggregation of many sources. The instructor told the class that the student's experience at the intersection that day was one source and a valuable story. Data to enhance this story could simply be the collection of many individual experiences at that intersection. When considering even broader scopes, the data could be the collective experiences of individuals at many intersections across campus, the city, the state, or the country.

The instructor then asked students, drawing on their personal experiences, to identify the variables that would be considered to evaluate the "worst" intersection on campus. The class brainstormed that car-to-car accidents, car-to-person accidents, car-to-bike accidents would have to be considered. Then the instructor prompted the students to consider the degree of severity in the evaluation. For instance, an accident causing a fatality would be worse than an accident-causing injury but not fatality, right? Of course. Then students were asked to identify where these data may be gathered. Students were given time in class to identify possible sources for these data. The goal of this activity was to demonstrate how narrative or storytelling ("I almost got hit by a car") could be an opportunity to explore how data or evidence ("How many people are hit at this intersection a year?") might help provide important context to that story.

This discussion builds from Habit #7 in Costa and Kallick's habits of mind (2000) model: question and problem posing. Students were asked to reflect on how they knew something to be true—the danger level of an intersection—and what evidence they needed to demonstrate that truth—how many people have been hit at the intersection or how many accidents there have been at the intersection. This behavior could most closely align with what Yancey (2016) termed "constructive reflection" or the act of "developing a cumulative . . . identity" (p. 14). As Yancey noted, constructive reflection and reflection-in-action are closely aligned. In this experience, we think about the role of reflection in classroom discussion as "constructing" the knowledge that will be demonstrated in the practice activity.

Through personal and strategic approaches to this discussion (Borgman & McArdle, 2019), the instructor was drawing students closer to an operational definition of data with this line of questioning. Data has two important components: cases and characteristics. The characteristics are often called variables and cases are sometimes called observations. In this course, students would be asked to functionally place the cases in the rows of a spreadsheet and characteristics of the cases in the columns to create a dataset. By the end of the course, students should be comfortable with the terms "cases," "observations," "variables," and "characteristics."

He asked students to think about how they would find out how many accidents occurred at an intersection. "Police reports," said one student, drawing

from previous coursework about sourcing. The instructor nodded and asked “what if a car goes through an intersection but does not get into an accident. Could that be an important measure of the level of danger at the intersection?” The conversation continued, eventually establishing that “danger” might be designated as the number of *accidents per cars that go through the intersection*. In this scenario, cases would be the number of cars going through an intersection and the characteristics of each case would be to determine if the car gets into an accident or not. This was the first introduction in the class to “rates,” which would be a valuable tool to compare differences in cases. In social media analytics, professional communicators want to know the volume of engagement with content as well as the rate at which people engage (reactions per number of followers). Thus, “rates” would also be a term with which students should be comfortable by the end of the course. “So both the number of accidents at an intersection as well as the number of accidents per cars going through the intersection are important,” the instructor said, summarizing and concluding the discussion.

At this point, the instructor told students that repeating this activity they had done together in class would be one of their assignments for the week. They were to think of a story or experience in their lives that might be made better by data and then think about the cases and characteristics of that data. The instructor could then assess the degree to which students had a grasp on “data,” both conceptually and operationally. As students reflected on their past experiences, they were expected to apply new knowledge to a past situation (an adaption of Habit #8). Additionally, they were prompted to pose questions (Habit #7) about where the data to support their story might originate and think about how they might gather data through all senses (Habit #10).

Whether they knew it or not—or welcomed it or not—they were becoming data storytellers.

EXAMPLES FROM STUDENTS

In this section, we summarize two strong examples that students submitted for this assignment. The first example is practical and applicable to the student’s professional goal to be a social media manager. The second example is from a student who is a fan of college baseball and enjoys making predictions about games and the season as a whole.

The student who wanted to be a social media manager discussed an internship where she was a part of a team developing a strategy to build sales online. She wrote that the company analyzed their online traffic, but it appeared that most of the evidence used to determine where their efforts would be best applied was anecdotal or based on where other organizations in the industry were

putting their attention. The student believed that this approach would not capture a new audience because much of the in-house discussion focused on the company's website. In the second section of the assignment, she discussed how the company had access to data such as "time spent" on the website as well as "click-throughs" and "engagement" on social media, yet they were not considering what they could learn from this data. She wrote that cases could be "social media posts" or "time spent" on each page of the website.

The second student wrote a more personal narrative about being interested in college baseball from a young age. He learned about players on different teams and followed them as they went from college to professional leagues. He wrote that he would like to develop a dataset to determine what qualities made a college player a good "major leaguer." He proposed using baseball players who had played in college and were now in the major leagues as cases in the dataset. He proposed characteristics such as height, weight, position, and college statistics to include.

The feedback the instructor wrote on the first submission centered around the broadness of the scope of the idea. Social media users behave differently than website users. The student may want to consider how to differentiate between the two. By narrowing the scope of the analysis, the cases and characteristics needed to complete an analysis would become clear. The instructor's previous experience indicated that time spent narrowing students' scope on a topic early is valuable in the end. In the second example, the instructor wrote that the student should think more about the concept of a "good" baseball player. What statistics might be more illustrative of "goodness?" Further, what defines "good?" This could be different over time, but it could also be different by position. The student may want to consider analyzing data only of position players or pitchers. He may also want to consider differences over decades. Further, the instructor encouraged the student to avoid superlatives that reduced the analysis to a binary. Is a player "good" or "bad?" Well, there are many factors that go into it. Instead, reframe the question, such as: "Does high fielding percentage in college lead to high fielding percentage in the pros?"

COURSE DESIGN

As a component of a professionally focused mass communication program, the hybrid learning environment of this data storytelling class was designed to mimic what students might find in a technology-laden working world such as a newsroom or an advertising agency. The hybrid learning design of the course was structured to provide both online, any time and in-person, real-time learning situations, similar to what might exist in many of those workplaces.

The course was capped at 30 students and met in a classroom with mobile desks and chairs to allow for small groups to coalesce in different formations and sizes. Attendance was not recorded in the in-person, real-time learning sessions in an attempt to give students the maximum flexibility during and after the COVID-19 pandemic. However, students were still expected to demonstrate knowledge of the material delivered each week.

In this section of the chapter, we further explore the structure of the course, the learning outcomes and other assignments. The course was designed to be delivered in a hybrid learning format with one weekly in-person, real-time learning laboratory session for structured discussions of and elaboration on the online, any time learning course material made available through the course management system at the start of each week. Students watched a series of brief (five- to ten-minute) instructional videos each week on portions of the Data Project Lifecycle model (Bobkowski & Etheridge, 2023) as well as three- to five-minute practical-focused videos that featured an interview with alumni of the program who use data in their professions. After watching and taking notes on these videos, students responded to a prompt for a small amount of points (10–20 each week out of a total of 900).

Following the Data Project Lifecycle model, the first five weeks of the course examined the capabilities and uses of spreadsheeting software such as Microsoft Excel, including sorting and filtering data, using functions to transform data, and generating pivot tables for analysis of the data. Data manipulation skills in this course were limited primarily to data validation, generating ratios, creating tables for displaying data, and visualizing data. The course's narrow scope aligned with the argument that all professional communicators should be comfortable performing basic calculations using spreadsheets but would not be expected to write code unless it was expressly a part of the job for which they were hired.

The middle portion of the course explored visualization of data using self-guided instructional tutorials for the online, any time learning portion and deeper, more robust discussions about the purpose of visualizations such as The Pudding's Heat Records (<https://pudding.cool/projects/heat-records/>) and USAFacts.org's analysis of rent increases during the Coronavirus pandemic (<https://usafacts.org/articles/where-are-rents-rising-post-covid-19/>) were held in the in-person, real-time learning portion. The Financial Times' Visual Vocabulary (2021) is a useful tool to discuss effective ways to communicate data graphically (<https://www.ft.com/content/c7bb24c9-964d-479f-ba24-03a2b2df6e85>). The final third of the class was reserved for students to develop and produce their own data stories, including drafting, revising, and refining the content with regular feedback from the instructor.

Additional assignments after each of the first two thirds of the course were designed to provide opportunities for summative assessment. After the first five weeks, students were tasked with identifying a professionally written data story

from one of a list of “data-driven” online outlets and write a “biography” of the data, assessing the degree to which the author of the piece transparently described the source and transformation of the data as well as the conclusions that came from that manipulation. This assignment was repeated at the end of the semester to allow students to demonstrate growth throughout the course. After 10 weeks of the course, students were to submit a demonstration of how they self-directly learned a visualization tool such as Flourish (<https://flourish.studio/>) or Tableau (<https://www.tableau.com/>) they identified as being beneficial to Data Storytelling. Self-directed learning was also highlighted by graduates and hiring managers as an important skill in professional communication.

As a final summative project in the course, students were expected to produce a data story by the end of the semester for inclusion in their professional portfolios. Course designers allowed students to develop summative projects that demonstrated data storytelling fitting their individual educational goals. In the course, students found a topic that interested them and either generated their own data or manipulated secondary data related to their subject to tell a compelling story. Students were encouraged to find a topic related to the shared dataset—on a topic selected by the instructor and data curated jointly by students in the class—but were not required to do so.

Some examples: Students who were working towards a career in sports communication could create final projects analyzing coaches’ salaries across college sports in the semester where the shared dataset topic was college athletics. In the semester where a state-wide high school database was the topic of the shared dataset, students interested in teaching as a career could use it to identify post-graduate destinations. Outside of the shared dataset, a student interested in international studies could find and analyze data on military spending by country. A student interested in fashion could develop a dataset on features of different fashion house websites. The final project analysis might be delivered in the form of static or interactive infographics, timelines, maps, charts, or graphs, among other types of data visualization.

With a few adjustments, we believe the course content could be transitioned to fully in-person, real-time learning; online, real-time learning; or online, any time learning environments because of this project-based assignment model the instructors developed. For example, the online, any time learning videos produced by instructors could be converted to live lecture/discussion sessions for in-person, real-time learning or online, real-time learning. The in-person, real-time learning sessions of Data Storytelling could be converted to more scaffolded low-stakes practice activities guided by written or audio instruction for fully online any time learning. Additional suggestions for modality shifts are included at the end of this chapter.

REFLECTING ON REFLECTING IN DATA SCIENCE

Instructors in this data storytelling course anticipated the reticence writing students would express towards data science and designed reflective learning activities to help students connect with the material and see how data could enhance their writing skills. In this section of the chapter, we discuss why the assignment highlighted above was important to the goals of the course. Then we explore how the assignment might be adapted to other modalities. Finally, we consider how multimedia might be incorporated into this assignment.

By making the experience of learning personal (Borgman & McArdle, 2019), the assignment allowed students to reflect on how data could impact their lives, yet the assignment was not positioned to students as a “reflective learning” which could bias students to respond in a way they have been conditioned to think of as “reflection.” Like Borgman and McArdle, we believe that it is important not simply to reflect on learning, but to do so with strategic purpose and a connection to the course goals and learning outcomes. We and the instructors of the Data Storytelling course, one of whom is an author of this chapter, understand that professional storytelling is often inspired by personal experience or observation. The assignment outlined in this chapter required students to perform an activity many of them will hopefully continue to do throughout their career—approaching an experience with wonderment (Habit #12, Costa & Kallick, 2000) to examine the extent to which it might be a broader trend or phenomenon. After deeper exploration, perhaps the student who was nearly hit by a car would find that the data indicate the intersection where that event occurred is relatively safe compared to others on campus. Perhaps that intersection is a death trap. With a strong understanding of numeracy and data literacy, students can use their senses (Habit #10) to apply past knowledge to new situations (Habit #8).

Reflective learning has been a significant tool used by teachers for more than 100 years (Dewey, 1933; Rogers, 2001; Schön, 1983). This featured assignment as well as others in this hybrid learning course demonstrate how reflection can build data literacy skills. With only one in-person, real-time learning session weekly, the hybridity of the course required structuring assignments and discussions that could be recalled after a full week of other classes, part-time jobs, club meetings, and other tasks. We believe that the personal experience aspect can help address that obstacle.

The assignment is adaptable to other modalities. For example, the in-person, real-time learning discussion detailed in this chapter could be conducted over video conferencing software in an online, real-time learning or through a discussion board in an online, any time learning course. In the any time environment, instructors could ask students to write a story in the first week of class

they believe could be enhanced by data and other students could annotate their thoughts about how data might be applied to the scenario using digital tools in the following week to develop community in online environments. We appreciate that technology affords us the ability to use different interactive tools across modalities. The chat function of video conferencing software would be a useful tool in an online, real-time learning class but could even be used in a similar fashion in an in-person, real-time learning course to allow students to brainstorm without the pressure of performing in front of a class of peers.

As communication instructors, we also recognize that multimedia is a significant focus in professional programs such as ours. With that in mind, we propose that students could be asked to submit a video detailing their reflective activity or an audio file such as a voice memo recorded on a smartphone or computer. Alternatively, students could be asked to take pictures of a situation that could be enhanced by data and then write about what data could enhance the scene in the photo. These modifications to the assignment could reinforce that professional communicators use a variety of platforms and techniques to communicate.

CONCLUSION

Effective data storytelling demands that practitioners know the capabilities as well as limitations of data, understand the ethical issues and implications of data collection, and possess the logic skills to balance the limitations and issues with the capabilities and implications. Data literacy requires a knowledge of software tools available for collecting, transforming, and analyzing data. This chapter highlighted one opportunity in a course to draw on reflective learning practices in a hybrid learning environment to demonstrate the utility of data storytelling and data literacy to students, many of whom felt unprepared for the course material.

We see data literacy as crucial for future communication professionals and believe that data storytelling should be incorporated into any writing curriculum. Data literacy can contribute to skills in argumentation when data is used to support a point of view. It can also be beneficial in social science as scaling of sources from a handful to dozens, hundreds, or thousands can lead to a deeper understanding of social trends and behaviors. Further, programs that emphasize data provide students with skills to recognize how and when to respond to audience wants through analysis of digital analytics data, increasing reach, profitability, and effectiveness.

This is the way of the world now. Quantitative information processing is essential in “the increasingly mathematical complexity of our society” (Paulos, 1996, p. 3).

In this course, the instructors challenged the contention that writers are necessarily bad at math, while still recognizing that numeracy as a skill presents challenges that other forms of information gathering typical for writers in communications fields may not (Dragga & Voss, 2001). These lessons are translatable across modalities. We believe that students who reflect on their learning and the application of past knowledge to current situations can build confidence and eventually strong numeracy skills. We demonstrated how this can happen through a sample assignment and structured class discussion about the conceptual and operational definitions of “data” and “storytelling.” This assignment and discussion are inspired by Costa and Kallick’s (2000) framework for developing habits of mind in a life-long learner and draw from Borgman and McArdle’s (2019) *personal* and *strategic* activities in online writing instruction. These practices are important to development of metacognitive skills, in which students can grow by analyzing their own work (Conference on College Composition and Communication Committee for Best Practices in Online Writing Instruction, 2013).

And while our students may still identify first as writers through words and second as data storytellers with numbers, we contend that the opportunities provided through this assignment (and course as a whole) will certainly get them to reflect on the role of data in the information they provide, the arguments they make, and the stories that they tell.

MOVING BETTER PRACTICES ACROSS MODALITIES

- **In-Person, Real-Time Learning:** Metacognition and learning through reflection occurs slowly over time. Yet, this assignment began first as an in-person discussion and could be effective as simply that. Students can be prompted to write about their experiences for a brief period of time (five minutes) and then share those thoughts in small groups. Rather than students suggesting ways their own stories could be improved with data, the instruction could prompt students to suggest opportunities to other group members.
- **Online, Real-Time Learning:** Likewise, in real-time online environments, tools such as video conference breakout rooms can put students in small groups outside of the intimidating ear of the instructor. This gives students some free will to test ideas with their peers before stating it in a large group setting.
- **Online, Any Time Learning:** Students in writing programs benefit from repeated and frequent opportunities to write. In an asynchronous environment, students could be asked to submit work from a previous class or other experience and other students could then be

tasked with using collaborative editing tools such as Google Docs or Microsoft Word Online to comment on opportunities to add data.

- **Hybrid Learning:** As currently structured, this better practice, originates from a real-time discussion where the class is able to openly exchange ideas and suggestions, critique their own work as well as others, and receive formative feedback live from the instructor. Yet, this activity has a crucial reflective element as highlighted in this chapter. Instructors should think about their goals when adapting this activity to their own classrooms. When the goal is to build camaraderie and collaboration, instructors may choose to emphasize the discussion. When the goal is to build metacognitive skills, instructors may choose to emphasize the written response. This activity works well when both are present, but these portions can function independently.

REFERENCES

- ABC News. (2020, November 3) *2020 FiveThirtyEight Election Forecast*. FiveThirtyEight. <https://projects.fivethirtyeight.com/2020-election-forecast/>
- ABC News. (2022, November 8) *2022 FiveThirtyEight Election Forecast*. FiveThirtyEight. <https://projects.fivethirtyeight.com/2022-election-forecast/>
- Azlina, N. N. (2010). CETLs: Supporting collaborative activities among students and teachers through the use of think-pair-share techniques. *International Journal of Computer Science Issues*, 7(5), 18-29.
- Baquet, D., Kahn, J., & Duenes, S. (2022, March 22). Expanding our data journalism ambitions. *The New York Times Company*. <https://www.nytc.com/press/expanding-our-data-journalism-ambitions/>
- Behm, N. N., Rankins-Robertson, S., & Roen, D. (Eds.). (2017). *The framework for success in postsecondary writing: Scholarship and applications*. Parlor Press.
- Bobkowski, P. S., & Etheridge, C. E. (2023). Spreadsheets, software, storytelling, visualization, lifelong learning: Essential data skills for journalism and strategic communication students. *Science Communication*, 45(1), 95-116. <https://doi.org/10.1177/10755470221147887>
- Borgman, J. & McArdle, C. (2019). *Personal, accessible, responsive, strategic: Resources and strategies for online writing instructors*. The WAC Clearinghouse; University Press of Colorado. <https://doi.org/10.37514/PRA-B.2019.0322>
- Burns, L. S. (2004). A reflective approach to teaching journalism. *Art, Design & Communication in Higher Education*, 3(1), 5-16. <https://doi.org/10.1386/adch.3.1.5/0>
- CBS News. (2022, October 30). *2022 US Battleground Tracker*. CBS News and YouGov. <https://www.cbsnews.com/2022-us-battleground-tracker/>
- CNN. (2020, November 4). *Electoral College outlook: A remarkably stable race comes to an end*. CNN Politics. <https://www.cnn.com/2020/11/02/politics/electoral-college-outlook/index.html>

- Conference on College Composition and Communication. (2013, March 13). *A position statement of principles and example effective practices for Online Writing Instruction (OWI)*. National Council of Teachers of English. <https://cdn.ncte.org/nctefiles/groups/cccc/owiprinciples.pdf>
- Costa, A. L., & Kallick, B. (2000). *Discovering and exploring habits of mind*. Association for Supervision and Curriculum Development.
- Dewey, J. (1933). *How we think: A restatement of the relation of reflective thinking to the educative process*. D. C. Heath.
- Dragga, S., & Voss, D. (2001). Cruel pies: The inhumanity of technical illustrations. *Technical Communication*, 48(3), 265-274.
- Dunwoody, S., & Griffin, R. J. (2013). Statistical reasoning in journalism education. *Science Communication*, 35(4), 528-538. <https://doi.org/10.1177/1075547012475227>
- The Economist. (2020, November 3). *Forecasting the US 2020 elections*. <https://projects.economist.com/us-2020-forecast/president>
- Financial Times. (2021, March 7). *Charts the work: FT visual vocabulary*. <https://www.ft.com/content/c7bb24c9-964d-479f-ba24-03a2b2df6e85>
- Flourish. (n.d.). *Data visualization & storytelling*. Retrieved January 2, 2024, from <https://flourish.studio>
- GitHub. (n.d.). *GitHub: Let's build from here*. Retrieved January 2, 2024, from <https://github.com>
- Gotlieb, M. R., McLaughlin, B., & Cummins, R. G. (2017). 2015 survey of journalism and mass communication enrollments: Challenges and opportunities for a changing and diversifying field. *Journalism & Mass Communication Educator*, 72(2), 139-153. <https://doi.org/10.1177/1077695817698612>
- Huot, B. (1996). Toward a new theory of writing assessment. *College Composition and Communication*, 47(4), 549-566. <https://doi.org/10.2307/358601>
- Irvin, L. (2020). *Reflection between the drafts*. Peter Lang Publishing.
- Johns Hopkins University of Medicine, Coronavirus Resource Center. (2023, March 10). *COVID-19 map*. <https://coronavirus.jhu.edu/map.html>
- Kaggle. (n.d.). *Kaggle: Your machine learning and data science community*. Retrieved January 2, 2024, from <https://kaggle.com>
- Martin, J. D. (2017). A census of statistics requirements at U.S. journalism programs and a model for a "statistics for journalism" course. *Journalism & Mass Communication Educator*, 72(4), 461-479. <https://doi.org/10.1177/1077695816679054>
- McLaughlin, B., Gotlieb, M. R., & Cummins, R. G. (2020). 2018 survey of journalism & mass communication enrollments. *Journalism & Mass Communication Educator*, 75(1), 131-143. <https://doi.org/10.1177/1077695819900724>
- Ojo, A., & Heravi, B. (2018). Patterns in award winning data storytelling. *Digital Journalism*, 6(6), 693-718. <https://doi.org/10.1080/21670811.2017.1403291>
- Paulos, J. A. (1996). *A mathematician reads the newspaper*. Penguin.
- Politico. (2020, November 2). *Who wins 2020? Presidential election predictions & key races*. <https://www.politico.com/2020-election/race-forecasts-and-predictions/president/>

- Prado, J. C., & Marzal, M. Á. (2013). Incorporating data literacy into information literacy programs: Core competencies and contents. *Libri*, 63(2), 123-134. <https://doi.org/10.1515/libri-2013-0010>
- The Pudding. (n.d.) *Tracking heat records in 400 U.S. cities*. Retrieved January 2, 2024, from <https://pudding.cool/projects/heat-records/>
- Rogers, R. R. (2001). Reflection in higher education: A concept analysis. *Innovative Higher Education*, 26(1), 37-57. <https://doi.org/10.1023/A:1010986404527>
- Schön, D. A. (1983). *The reflective practitioner: How professionals think in action*. Basic Books.
- Steele, C. M. (2011). *Whistling Vivaldi: How stereotypes affect us and what we can do*. W. W. Norton & Company.
- Tableau. (n.d.) *Business intelligence and analytics software*. Retrieved January 2, 2024, from <https://tableau.com>
- The Washington Post. (2023, July 22). *Police shootings database 2015–2023: Search by race, age, department*. <https://www.washingtonpost.com/graphics/investigations/police-shootings-database/>
- USA Facts. (2023, March 23). *Where are rents rising post COVID-19?* <https://usafacts.org/articles/where-are-rents-rising-post-covid-19/>
- Winkelmes, M. (2013) Transparency in teaching: Faculty share data and improve students' learning. *Liberal Education*, 99(2).
- Winkelmes, M., Bernacki, M. L., Butler, J., Zochowski, M., Golanics, J., Weavil, K. H. (2016). A teaching intervention that increases underserved college students' success. *Peer Review*, 18(1/2).
- Yancey, K. B. (2016). *A rhetoric of reflection*. Utah State University Press.