



CHAPTER 12

# “The Earth Is Flat” and Other Thresholds

A Critically Reflective Cross-disciplinary Conversation in the Post-truth Era

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*“There must be something librarians can do to help these students find better sources.”*

—Gabe Ording, director of the Center for Integrative Studies in General Sciences (CISGS)

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Gabe, the director of the Center for Integrative Studies in General Sciences (CISGS), had just tossed a student’s paper onto the table. In response to an assignment from an introductory science course, one of the options by which to fulfill general education requirements at Michigan State University, the student had attempted to argue in their paper that the earth was flat. The student’s citations included popular figures associated with the modern resurgent “flat-earth” movement, including a rapper and sports figure. In addition to the paper, the student had written an email to Gabe insisting that “flat-earth theory” be taught within

the general sciences curriculum at MSU. When Gabe urged them to identify scientifically reputable sources, the student offered a singular popular press article from 1904, as well as materials from the website the Flat Earth Wiki and the *Annals of Improbable Research*.<sup>1</sup>

I (Sara) was not surprised, neither by the student's approach nor Gabe's desire for a solution. My job title is Librarian for Interdisciplinary Teaching and Learning Initiatives—a long name for an information literacy librarian. With over ten years under my belt working primarily with students in first-year writing, I'd been tasked with developing a new liaison assignment to our general education programs at MSU and had contacted Gabe to set up a meeting to discuss the needs of CISGS. What encouraged me was the glimmer of an opportunity. Beyond the ludicrous claim and the student's impressive chutzpah, this situation provided a chance to explore more deeply some vitally important issues surrounding information literacy, scientific literacy, and the current political climate.

"What's your biggest concern with this student's work?" I asked Gabe. He thought about it for a minute and replied, "These aren't scientific sources, and this is not a scientific argument."

Evidence, I thought. Authority is constructed and contextual. "So ... what counts as evidence and is considered an authoritative source in a scientific context? For example: these sources would be great to use in a sociological study on why people choose to believe the earth is flat, but not in the context of scientifically determining the shape of the earth."

"Yes," he replied, with renewed interest. "So the issue that's here is what is scientific evidence? How is science made?"

"Information creation as a process...," I said. At this point, we jumped into a lengthy discussion about the nature of information literacy, which culminated with the question "What is the most important thing that you want students to take away from their general education science courses in relationship to information?"

As a result of this conversation, we came away with the idea to collaboratively create an information literacy learning object to address issues of scientific evidence, which grew into a project that involved lab coordinators, CISGS's assessment coordinator, our environmental sciences librarian, and a second teaching and learning librarian. During this collaboration, this fundamental question—"What is the most important thing that you want students to take away?"—seemed to continually arise and to drive, undergird, and sustain our work together. These science courses might be the last science classes many students would ever have. What was essential for students to leave with: as active citizens of the US and the world, as consumers and creators of information, and as people who would make choices informed by science, not only in the voting booth, but in their own lives and in the lives of their families?

# Introduction: How Is Political Polarization Affecting Information Literacy in the Sciences?

The appearance of “flat-earth theory” in the context of a university science class brought into sharp focus the degree to which the current polarized political climate has emboldened the resurgence of reactionary approaches to scientific topics that typically remain in the realm of conspiracy theory. The concept of political polarization calls to mind entrenchment in diverging and extreme positions, severe partisanship, distrust of mainstream or opposing views, and defensive, reactionary approaches that tend to isolate positions even further. In the context of the sciences, such approaches shine a bright spotlight on core issues of the nature of scientific evidence; how scientists collect and use evidence to create knowledge; the role of questioning, conversation, authority, and uncertainty in the sciences; and the ways in which scientific knowledge is communicated to the general population. Closely related to those disciplinary values, and unearthed by looking more deeply at the reactions of individuals to politically charged scientific topics, are underlying issues of personal growth, developmental processes, identifying cognitive biases, grappling with deeply held beliefs, and affective dimensions of learning.

The nuances of the ACRL *Framework for Information Literacy for Higher Education* (the *Framework*) position the document as an effective tool for probing the underlying issues surrounding information and knowledge creation, issues that are apparent in polarized approaches to scientific topics.<sup>2</sup> This chapter focuses on the conversations surrounding a collaborative project between scientists and librarians at MSU and the three most significant ways that the *Framework* impacted our work: aiding our collaborative process, identifying key disciplinary values, and examining student learning outcomes. These three dimensions related to one another in complex ways throughout our collaboration. We have attempted to best capture those nuances and interactions here through the medium of our conversations. The voices of those involved provide fascinating insight into the process of working across disciplines in the context of a fraught political climate, with information literacy as a central component for navigating through these waters.

## Procedures

This chapter provides a record of conversational highlights among the group of scientists and librarians, gathered from reflections on our collaborative process and the themes that emerged from it—in effect, a group self-reflection. To gather

the material for this chapter, two librarians (Sara and Eric) obtained participants' consent, conducted loosely structured interviews with eight total project participants—one other librarian, three lab coordinators, the assessment director, and the CISGS director (see appendix 12A for interview questions). After the interviews were completed, we drew out prominent themes and turned these into a second set of questions, which we posed to the eight participants as a whole in a focus group setting (see appendix 12B). As a result of the focus group's conversation, Sara obtained written consent and conducted an additional interview with a former student who had previously volunteered to share his thoughts related to politics and the science classroom. We developed a coding scheme for the interviews based on major themes that emerged, coded the interviews, and placed the coded quotations into the sections that make up this chapter. Our approach to this chapter is to highlight the participants' voices in hopes that they provide insight into the complex process of defining a collaborative and interdisciplinary approach to highlight information literacy within our science curricula. Pseudonyms have been used in this chapter when referring to some participants upon their request.

## General Education at Michigan State University

Michigan State University is a large, public, liberal-arts-based institution and has taken a relatively unique approach to general education. Most typically, general education has been delivered through a distribution model, in which students majoring in any discipline complete their general education requirements (e.g., science, social science, arts and humanities) by taking disciplinary courses along with students majoring in that field of study. However, twenty-five years ago, MSU adopted an integrative studies model, in which the common core of the general education requirements is delivered through three Centers of Integrative Studies (Arts and Humanities, Social Science, and General Science). In this integrative studies model, coursework can be better crafted to serve different students across different disciplines. For example, at MSU, English majors complete their biology or physical science requirements by taking an Integrative Science in Biology (ISB) or in Physical Science (ISP) course. This being the case, STEM majors are not typically enrolled in these ISB and ISP courses, and it is widely said that “these are the science classes for the non-science majors.” We anticipate that these will be the very last science courses that these students will ever take. This being the case, it is crucial that we ensure that our courses have a lasting scientific impact on these non-STEM students.

Over the course of the past two years, CISGS has adopted a new mission and has been engaged in curricular reform efforts. Our mission is to foster and enhance scientific literacy (SL) for all MSU undergraduate students, and our curriculum is intended to allow students to engage with scientific issues of societal concern,

support students’ understanding about scientific knowledge and its applications to solving complex real-world problems, enable students to take responsibility and make critical decisions about science-related topics that affect their lives as individuals and members of a community, and develop students’ critical-thinking skills needed to make informed decisions about scientific claims. This notion of “critical analysis of scientific claims” is an essential skill that our students need and is perfectly aligned with the libraries’ focus on integrating information literacy into the wider university curriculum. The very integrative nature of our MSU general education science curriculum has both facilitated and is now benefitting from the partnership developed between CISGS and the MSU Libraries.

## Process: The *Framework* as a Practical Tool for Facilitating and Enhancing Collaborative Work

The *Framework* proved a key factor in facilitating a multidimensional conversation that began between Sara and Gabe in their initial meeting and quickly expanded to a larger group of scientists and librarians. The *Framework* lent a concreteness to concepts, established a common vocabulary on which to build our conversations, and provided tools for thinking about ways of unearthing key values and outcomes for students.

As a result of the initial meeting discussing the flat-earth paper, the decision was made to create a learning module or object that addressed the idea of evidence in the context of scientific information literacy. This module would be scalable for large groups of students and deliverable within the lab sections of larger courses. In order to think more deeply about what this module should look like, Sara and Gabe decided to involve a larger group of people—three CISGS faculty (Amanda, Oz, and David) who are both lab coordinators and teach large lecture courses, the CISGS Director for Program Evaluation and Assessment of Student Learning (Claudia), the environmental sciences librarian (Eric), and a second information literacy librarian (Elizabeth). We met together for the first time in the beginning of the fall semester of 2016.

As the scientists in this group were new to formal information literacy terminology and scope, Sara prepared a short introduction to the ACRL *Framework* to establish a foundation for the conversation during the group’s first meeting. The introduction included a few brief notes on the move from standards to frames; the definition of information literacy as set forth in the *Framework*, which particularly emphasizes IL as a “set of integrated abilities” rather than a list of skills;

and a brief rundown of the six frames: Authority Is Constructed and Contextual, Information Creation as a Process, Information Has Value, Research as Inquiry, Scholarship as Conversation, and Searching as Strategic Exploration.<sup>3</sup> Reflecting on the experience of presenting the *Framework* in this context, Sara indicates

I wanted people to be thinking more conceptually and not just starting from the point of “Oh, let’s make a video or let’s do a class.” I wanted to broaden the discussion before I narrowed it. I think we succeeded in doing that! ... One of my goals coming into this project was I wanted to be able to create the most effective and most nuanced response to this group’s needs that was possible.... I really wanted to get to the root of the issues for scientists and for students who are non-science majors.... I really wanted to put the process before the product.

The *Framework* impacted the group as not just a conversation starter, but more like a “conversation-exploder,” which was fueled by concern over ever more prominent politically polarizing overtones in the instructors’ teaching experiences. As the goal of introducing the *Framework* was to propel the group to think beyond already imagined products or solutions, the scientists, when presented with the concepts and vocabulary in the *Framework*, were prompted to think about the varied ways that information literacy already showed up in the courses that they taught. Each participant seemed to resonate with a different frame according to issues that they had encountered in their own experiences with students. *Framework* terminology and concepts helped the participants to articulate and connect information literacy to a range of issues: “fake news,” identifying and understanding scholarly sources, misleading data visualizations, and the nature of evidence and scientific consensus, to name a few.

Sara cited the *Framework* as a clarifying force, as well as one that enabled the group to dive more deeply into ideas related to the lab coordinators’ perceived needs in order to identify specific concepts and learning outcomes.

**Sara (information literacy librarian):** I think the *Framework* was really accurate in naming some of these more nebulous concepts that we worked toward.... We’re already talking about context, we’re already talking about “Information Creation as a Process,” ...how does scientific information get made, and what were the people [making the information] missing? The *Framework* [helped] us come to the conclusion that the issue at heart here was the issue of “what is scientific evidence?”

A result of our “exploding” conversation was that the exploration of information literacy concepts lengthened the time that we spent developing the module’s learning outcomes and the module itself. We met monthly for the fall semester, and our meetings consisted of progressively more involved conversations about what exactly it was that the instructors wanted students to come away with and what the most pressing issues were surrounding scientific and information literacy.

Eventually, the group agreed to develop a pilot exercise that asked students to compare and contrast a story about a scientific study from the popular media with the actual study referenced. The lab instructors ultimately agreed that working from the place where students often encounter scientific claims—popular media—presented an engaging opportunity for incorporating analytical, information literacy–based questions into their practice. This approach was informed by the frame “Information Creation as a Process.” In addition, Sara visited the classrooms of four of the instructors (Oz, David, Gabe, and Claudia) during the following semester to pilot a workshop approach for information literacy instruction.

The module and the class sessions that resulted from this process are worth discussing in depth and have served as a catalyst for further research, collaboration, and partnerships between the libraries and CISGS. However, since this chapter is intended to focus on the role of the *Framework* through our conversations, they are referenced here simply as the context for those conversations.

## Disciplinary Values: The *Framework* as Clarifier and Connector

During the process of discussing and creating the module, the presence of a politically charged topic provided an impetus and a sense of urgency for the group to move deeper than what might typically be associated with the task of curricular material or learning object development. This momentum prompted us to reflect upon and clarify ways that information literacy and scientific literacy intersect within the context of disciplinary values. Members of the group identified similar yet nuanced values regarding science and information literacy, centering around the process of how scientific information and knowledge come into existence. Among the values discussed were the nature and function of evidence in creating scientific knowledge; habits of mind such as curiosity, inquiry, and analytical thinking; notions of “proof” and uncertainty and how they relate to scientific consensus; the nature of evidence; and the role of scholarly conversation in the sciences.

These conversations often referenced an observed problem or “stuck place” involving student learning—such as the insistence of the original student that there was “scientific evidence” that the earth was flat, or the unwillingness of some



students to engage with politically charged topics such as evolution or climate change. Participants reflected on instances from their own teaching in which they had been personally impacted by observing students encounter these types of roadblocks. The *Framework* provided a lens for analyzing instructors' personal feelings of frustration and concern and served as a constructive tool for identifying the disciplinary values at the root of these roadblocks.

**Claudia (CISGS assessment coordinator):** “Research as Inquiry” and “Scholarship as Conversation” are points from the *Framework* that are central to scientific literacy because we try to have our students understand that even though they are not going to become scientists or studying to become scientists, it is important that they understand what is the process of science, and of course the research and scholarship at the center of it.

**Gabe (CISGS director):** I think that we need for our students to think about information—where it’s coming from, who is putting it forward, that it’s a dialogue, an ongoing process—the interpretation of information which is being supplied to us, being contextual, and we have to pay attention to who is the author of the information and who are they trying to speak to and persuade.

The focus of the disciplinary values that surfaced surprised Sara, who had the most experience with the *Framework* out of the members of the group. Since the conversation had begun with a discussion about the value of appropriate evidence, she had anticipated that the frame “Authority Is Constructed and Contextual” would be primary in the design of the curricular materials. Through the conversations, it emerged that the scientists were deeply concerned with the values surrounding how scientific knowledge is created and communicated, and the frame “Information Creation as a Process” came to prominence instead in the focus for the module.

## Connecting and Contrasting Disciplinary Values and Politics

Several themes that surfaced in these replies led us into a closer examination of the political dimensions of scientific information. Themes included the fluid, changing nature of science; the rhetorics of popular media in presenting scientific information; and the less visible processes such as funding, lobbying, and construction of authority that undergird the creation of scientific knowledge.



Through our discussions, we identified several ways in which we had noticed political polarization specifically affecting scientific information and information literacy practice. Sara and Amanda both mentioned the direct impact of politics and political appointees on current sources of scientific information:

**Amanda (lab coordinator):** Whether it’s dismantling the national parks, or [the EPA’s] corruption and ... removing all the climate data from government websites, it’s very upsetting.

**Sara (information literacy librarian):** Things that are happening to scientific information because of politics are key. The documents that are being removed from government websites, the information that’s being changed and taken down on government websites, the uncertainty of the availability and reliability of government information on science topics is looming.

In this vein, several participants voiced concern about the misleading nature of certain information coupled with concerns about authority and trust:

**Eric (environmental sciences librarian):** Looking at the way the people in the political realm were able to twist information and twist the truth and claim fake news about everything.... A lot of people are so invested in their political ideologies that they are willing to overlook all scientific evidence (and nonscientific evidence as well), and there’s so much political power and economic power behind perpetuating false ideas: denying climate change and things like that.

**David (lab coordinator):** The “death of the expert....” Fewer and fewer people are seeking out advice and information directly from experts.... There’s a sort of a misguided perception that if you read information that an expert put forward that you are as knowledgeable as the expert.... So that is contributing to a misguided sense of “I know as much as this person who has dedicated their life to it because I can read and understand what they just wrote.” [And] it doesn’t help that there are experts that have been shown to be misleading and not trustworthy and include bias in the reporting of their results.

# Getting Personal: Politics, Disciplinary Values, and Their Connection with Personal Motivation in Teaching

The idea of politics—or more specifically, the relationship between politics and teaching science—was an underlying but not explicitly stated theme of the conversations that took place surrounding the creation of our materials—the “elephant in the room,” so to speak. It was apparent from our conversations that the polarized political climate was personally worrisome to the majority of the participants. Although the nature of the political climate touched upon deeply held personal and disciplinary values, there seemed to be reticence to overtly connecting personal values with political and disciplinary values in a teaching context. In order to explore this connection more directly, the authors developed an additional series of questions (appendix 12B) about politics and political polarization in relation to teaching, scientific literacy, and information literacy that explored these connections more directly. The interviewees came together in a focus group setting to discuss these additional questions.

The focus group was asked, “Would you say that increasing political polarization was a driving factor for you personally in working on this project? Why or why not? How has the climate affected you in relationship to your teaching?”

**Claudia (CISGS assessment coordinator):** Yes and no. Yes—I find it impossible to be in this day and age and not be affected in some way by the political climate and polarization that we have. In all my years here I’ve never experienced anything like this. No ... to me it’s more this scientific literacy ... to convey to my students the importance of science and the generation of knowledge through science, scientific endeavors.... But definitely it’s impossible to detach science from politics and political views.

**Gabe (CISGS director):** So I can’t say that political polarization drove me to do this, but I’m recognizing that ... information literacy is essential in this day and age of political polarization. We do need folks to recognize bias—their own, other people’s biases, the possibility for confirmation bias. If you’ve been led to believe by

your political party that climate change is a hoax ... “It’s a chilly day today, see? Global warming is bullshit!” That kind of mentality.

It is notable that the librarians were much more likely to identify political polarization as an explicit motivation for their work than the scientists, who were more measured in their responses. Possible reasons for their caution could be that the scientists have experienced more direct challenges from students related to political topics than the librarians or that they could want to focus on the science content itself rather than related political issues, as David (lab coordinator) indicated:

I’m somewhat safeguarded in that I’m teaching environmental science, even though politics play a huge role in anything, including environmental science. But I get to not talk about that for a couple hours every day. If there’s something significant, I do talk about it, but yet I still feel obligated to talk about it from an objective position.

Although both the scientists and librarians saw critical thinking as essential to their teaching and politics as impacting their subject areas, the librarians seemed to more readily cite political polarization as fundamentally and personally tied to the work that they do. It is possible that librarians in primarily one-shot teaching scenarios are less frequently exposed to student and peer concerns about perceived political differences or that the material that librarians work with has more overt political overtones. This question is ripe for further exploration. When asked the same question—was increasing political polarization a driving factor for you personally in working on this project—librarians responded in the following ways:

**Elizabeth (information literacy librarian):** Yes, and I think I didn’t know that until I was through the project.... I think I didn’t even realize ... this passion for information literacy and critical thinking has grown exponentially since the election.

**Eric (environmental sciences librarian):** Yes.... Especially in the lead-up to the election, when there are obvious falsehoods being repeated on the campaign trail, in the news, and all across social media—and you know what we know now about how social media was really weaponized and not even closely related to anything in the realm of reality a lot of times.

**Sara (information literacy librarian):** I would say that it absolutely was.... Political polarization has just exacerbated this [motivation], but my mission is really to be able to get people to look at themselves. To be able to reflect on their own interactions with information, and look at it from a more objective viewpoint, and really be honest with themselves and think about their own reactions, their own biases. Because I think that when you don't do that, then we have the political situation that we have today.

## Does Politics Have a Place in the Science Classroom?

Some of our most intense conversation centered around the issue of what role politics should or should not play in the science classroom, with several opinions emerging on this front. In many ways, introducing the focus on how information is created into the equation brought the issue of the political realm closer to the forefront—closely examining the ways in which information is produced necessarily includes political dimensions—whether involving research funding sources, interest group agendas, personal bias, or other considerations. While none of the participants indicated that they felt it would be appropriate to have a full-blown political discussion in either a science or an information literacy classroom, there was a wide variety of thought on the issue. Potential areas of intersection between politics, disciplinary values, and information in the classroom that emerged from our conversations included learning materials, classroom environment and pedagogical approaches, the academic environment for instructors, and goals for students.

Sara and Amanda discussed the practical recognition of the role politics plays in the information that students will encounter and how the implications of that political dimension provide a direct and necessary connection to the material.

**Sara (information literacy librarian):** We [might not] explicitly discuss politics or political situations in the science classroom, but ... [for example], looking at some opposing viewpoints, both of them coming out of lobbying groups—an industry group and a consumer rights group—we are able to see that yes, politics is involved in this issue.... Just knowing the fact that there are political forces behind these science issues and behind the science information I think is extremely important.

**Amanda (lab coordinator):** If ... the EPA [continues to be dismantled], I think things will become a little bit more dire and confrontational. I think I personally would have less of a problem being confrontational about it and talking to my students about it if it continues much longer.

Three participants specifically mentioned issues of safety—in the context of either a safe place for students, or protection for themselves or their colleagues, or both—in relation to politics in the classroom. Elizabeth (information literacy librarian) expressed concern that the polarized political climate could create hostile environment for students:

I feel like it it's not our job to ignore political issues ... but I do feel like it's our job to make it more of a safe space, so that students can explore what they're thinking out loud. When you introduce the current political climate to that, because it's so damn polarizing, I think it shuts down students. I think they're not there yet, they're not ready to hold their own in those situations. They need to practice and learn.

Gabe (CISGS director) addressed the balance between avoiding politically charged topics with the necessity of recognizing the political dimensions of those topics:

I've heard some faculty talk about how they'll actually avoid teaching certain things because they're just too political. Evolution ... climate change.... But given that I'm teaching a science class, I verbalize to my students—we have to recognize that this is a topic on which there's a great deal of debate going on. My purposes, though, are to help you understand the scientific process.

Amanda (lab coordinator) expressed concern for herself as an early career faculty member and for her younger colleagues in relation to the vocal, public discussion of politics in the classroom. It would be interesting to explore the relationship of academic culture to political discussion in the classroom further.

**Amanda (lab coordinator):** Honestly I tend to just avoid [politics] especially with... my graduate TA's who are younger, and I do not want them to have to worry about saying something political and getting into a confronta-

tion, and so I really tried to step back from that in this class.... Honestly it's more protective for me.... I really wish I could talk about it in the classroom.

Several participants explicitly stated that the goal of the courses was not to change students' existing views, but to encourage them to learn and explore different processes of thinking and reasoning. Along these lines, participants also emphasized creating a welcoming and positive environment for students when dealing with potentially polarizing issues.

**Amanda (lab coordinator):** One thing that I consider is that political affiliation is a big part of a lot of people's identity, how they see themselves, and the groups that they identify with, and so I always worry about discrimination. I don't want to ever bring up politics because I don't want a Republican student to feel like they have less of a place in my classroom than a Democrat. And so that's where I would tiptoe around it. And that's why I like teaching science because I can just share information, I don't have to put a political spin on it.

**Gabe (CISGS director):** We have these non-science majors in our science classes, for perhaps one last shot. As a result, we can't afford to ostracize them or have them feel uncomfortable. We need them to feel that they are part of this learning community, so I want to be cautious to not come across as being one-sided.

Finally, the group was able to tie disciplinary values together with scientific literacy and information literacy in the hope that the combination of the three could provide tools or methods to address political issues from a nonpartisan stance or to address extreme polarization. This combination was cited by both the librarians and the scientists as an approach that could directly help move students to a place of criticality regarding their interactions with the politically charged world around them.

**Elizabeth (information literacy librarian):** ... If students have a healthy dose of scientific information literacy—the underpinnings of that testing hypothesis, understanding methods, seeing what the data really says, learning to think for yourself, and learning to analyze those things for yourself—I think [this] only make[s] engagement in politics better.

**Gabe (CISGS director):** I like to believe that if we could enhance everyone’s scientific information literacy that political polarization would be reduced. I have to believe that if people can approach information thoughtfully with an open mind [and] a logical progression of thought, and allow themselves to identify sound logical evidence-based argumentation and recognize when that’s not taking place, that they would be able to avoid these striking polarized viewpoints.

These ideas became further complicated by discussion that arose regarding student identity, issues of uncertainty, and intellectual development, which are discussed in more depth in the following section.

## Outcomes: The *Framework* and Student Learning

Disciplinary values viewed through the lens of the *Framework* provided a way to identify and discuss some deep concerns related to student learning. The information literacy concepts and language found in the frames provided a path to identifying ways to drill deeper into some of these values. The task of identifying and agreeing upon student learning outcomes—particularly the task of deciding which specific concepts and skills were most important across different lab sections—was aided by the *Framework*, in the tasks of both expanding the options for outcomes and narrowing them down.

The role political polarization played in considering and identifying learning outcomes was at times below the surface, but was noticeable in the abundance of ideas that came out as a result of our discussions on what it was that we wanted the students to specifically learn as a result of the learning module and from information literacy efforts more generally. The instance of the flat-earth paper combined with the language in the *Framework* (new to the scientists) served as a catalyst for uncovering deeper issues of disconnection or gaps in learning. Unsurprisingly, each participant had slightly different ideas about their ideal or most pressing learning outcomes regarding scientific information literacy for students in their courses, but each of these ideas carried an undercurrent of connection to political issues.

The task of creating a learning object that was scalable across several lab sessions—our original goal—necessitated the development of learning outcomes that were connected to the programmatic outcomes for CISGS students, namely developing students’ critical-thinking skills needed to make informed decisions about scientific claims. Due to the expanding nature of our conversations, this



part of the discussion actually took the longest to work through. This discussion highlighted—mainly for the scientists—the sheer magnitude of skills, practices, concepts, and habits of mind tied to information literacy. When faced with the task of developing a learning outcome for our modules, we spent several meetings attempting to narrow our focus. After exploring several potential themes related to examining scientific claims, including identifying and reading scientific journal articles, interpreting data representations, evaluating sources, and dealing with “fake news,” we decided that the learning object would focus on science in the media and specifically on the task of comparing and contrasting media coverage of a scientific study with the published study itself. The module was designed to foreground an in-depth class discussion, and the explicitly stated outcome was “Students will compare and contrast a scientific study and its popular news coverage in order to interpret media depictions of scientific research.”

When considering outcomes for the learning object, a key issue for this group was the non-STEM major status of students enrolled in CISGS courses. Initially, information literacy skills, such as the ability to read and analyze the construction of a scientific paper, were discussed as important outcomes, but the fact that these students would likely not go on to be scientists was an important factor in identifying what were the essential skills, concepts, and habits of mind with which the instructors wanted their students to leave the course. The fact that this was the very last science course that many of these students would take provided the impetus for articulating and streamlining specific learning outcomes. The consensus of the group was that we wanted students to begin the exercise with an example of information related to science that they were likely to encounter in the context of everyday life.

The wide variety of potential learning outcomes for the module prompted us in our interviews to pose the question “What do you personally feel is the most important concept for students to take away from your class related to scientific information? Why do you think this matters to you personally?” In the responses to this question, the undercurrent of concern for the current political situation was apparent in mentions of misinformation, decision-making, and the role of science in service of societal good. The types of learning goals stated varied and included affective, skill-based, and conceptual goals. Claudia (CISGS assessment coordinator) focused on understanding the nature of evidence in science and the role of science in service to humanity:

The process of science... how life sciences generate knowledge—how does knowledge come to be and how does that get into their hands for them to use to benefit humanity ...I really want them to understand what is evidence, where to get it, what’s reliable, what’s not, what is factual, what is not factual from the perspective of sci-

ence, generating knowledge through science.... That’s the most important thing, so that they understand how important that is in their everyday life. It’s not just “science is for scientists”—no, we live with science, and we live because of science.

Elizabeth, Amanda, and David focused on the traits of critical thinking, skepticism, and decision-making as general outcomes, but with the same undercurrent of helping students to navigate a politically fraught climate:

**Elizabeth (information literacy librarian):** I think it’s really important for students to ... become healthy skeptics. Specifically in the sciences, I think that it’s important they understand that there are things that have been proven.... Be skeptical, [but there’s] a point you have to accept what they’re saying and being comfortable with accepting things that you don’t really understand is ok, too.... They come out these healthy skeptical people.

**Amanda (lab coordinator):** The biggest thing for me is just the message of “be critical.” Be critical of what you’re told, messages that you’re given, think about where they’re coming from and what are the motivations behind them.

**David (lab coordinator):** If one of my goals for students is to make well-informed decisions based on gathering information, avoiding relying on inference—particularly others’ inferences—I think I would be contributing significantly to a more well-rounded community.... This one is right up there with a significant part of their development as thinkers, as informed citizens.... But if I had to pare down to one thing, I would have to point out to all of my students that there is misleading information masquerading as proper ... [for them to] use evidence-based information—data-supported information—to make the most informed decision that they can when they want to.

Sara and Gabe both emphasized more affective outcomes—“habits of mind,” as Gabe says, and both refer to the ability to self-reflect on one’s relationship to information. These outcomes in many ways expand beyond the disciplinary

boundaries of science to impact a person's self-knowledge—their understanding of themselves as both individuals and as part of a responsible community.

**Gabe (CISGS director):** If we can alter our mind-set such that our habit of mind is to pause and wonder: what is the source of information, who is the source of information, what are the potential biases, why might they be trying to persuade you one way or another? Habit of mind is the most essential thing—so that we recognize the importance of slowing down and just asking ourselves [those] questions ... because we can't "know all the knowledge."

**Sara (information literacy librarian):** What I want students to get out of any information literacy is the ability to step back and look critically at their own processes and their own dealings with information, look inward, and be able to identify the way that information is affecting them personally ... a self-awareness of how they interact with information ... to really be able to take a step back and examine their reactions and feelings about it, think about it from the point of view of scientific evidence, think about it from the point of view of cultural factors, think about it from the point of view their own biases and their own reactions to it.

The theme of self-reflection was mentioned specifically in other discussions about learning outcomes, which indicated a way of looking at skills and concepts together. The undercurrent of political polarization was again apparent in these responses as the ideas of slowing down, thinking, and mental flexibility stand in direct contrast to the reactive nature of extreme polarization. Claudia (CISGS assessment coordinator) mentioned reflection in the context of the learning process:

[It's] important for our students to really understand, think about, and reflect upon and contextualize everything they do in their everyday life.... Having to reflect on: "What was important about this article? Did it change my mind?" Because it's not something that they can just go copy and paste, it's something that they have to think about.... Often during the cognition process, reflection is where you really structure what you've learned.

Gabe and Elizabeth both mentioned mental habits as outcomes—flexibility and ways of thinking—that are often in contrast to skills-based outcomes that may have guided students’ previous experiences.

**Elizabeth (information literacy librarian):** I love this phrase: “the mental flexibility to pursue alternative avenues.”<sup>4</sup> That is sometimes lacking, but I don’t think it’s inherently the students’ fault. I think it’s their previous educational experience that hasn’t taught them mental flexibility yet or they’re not there yet.

**Gabe (CISGS director):** You are working really hard to help students develop this habit of mind.... It’s not to memorize scientific formulas or mathematics, it’s to change the way we think about the natural world and information being conveyed.

This focus on reflection and other affective and cognitive dimensions eventually assisted us in crafting the outcomes and structure of our materials.

## What Are Learning Outcomes for Scientific Information Literacy?

Another theme that emerged during the focus group portion that reflects a fraught relationship with the rigid, uncompromising nature of polarization was the idea of uncertainty. This idea was first mentioned in the context of students learning to be comfortable with a degree of uncertainty as opposed to always having a black-and-white conclusion. It was discussed that this phenomenon may relate to students’ intellectual development (see Perry’s Scheme).<sup>5</sup> Uncertainty was also discussed as an essential part of knowledge making in science—there can be consensus, but the fact that there is never uncontested “proof” does not reduce the value of that consensus.

Oz (lab coordinator) mentioned his experience of the idea of uncertainty used as a tactic to reify an anti-science position:

[I often encounter] uncertainty used as a limitation or “failing” of science. For example, the following quote from the NASA website: “97 percent or more of actively publishing climate scientists agree: climate-warming

trends over the past century are extremely likely due to human activities” is used to imply a lack of consensus in the scientific community (i.e., there are 3% who disagree).

Sara and Eric made ties between uncertainty, students’ comfort levels, and personal identities.

**Sara (information literacy librarian):** [I see] students encountering conflicting information and not knowing what to do with that conflict. This is related to development—being able to hold conflicting ideas in tension and look at them objectively... And I think because of political polarization, we have so much knee-jerk reaction ... if people feel a certain way about something, they see something that confirms what they think, and it just pushes that confirmation deeper without having to step back and really take a hard look at it. I wish that people would not regress and reify their positions, but that they would actually ask the questions. But I don’t want to fault people for that because it’s really hard, affectively, to do that. And so if you’re not at place yet where you really have the skills and the confidence to take a step back and look at things from a different viewpoint, then you’re just going to kind of revert back to your own cognitive bias.

**Eric (environmental sciences librarian):** [Political] issues like this—they’re so tied into the way that people see themselves in their self-identities, and so getting somebody to change their mind is so much harder than actually providing a cohesive argument. You have to get them to change the entire way that they think about the world and themselves, which is hard to do.

David and Gabe made connections between uncertainty and levels of intellectual, educational, and personal development.

**David (lab coordinator):** Upperclassmen might be a little bit more ready to handle it. Underclassmen just might be wanting input—answers, just tell me what it is I need to do.... The uncertainty piece—that’s a big chunk of critical thinking. My underclassmen are still in the frame of “this is how we learned in high school, and you give us

the information, I study, and I give it back to you.” I’d ask my students, “What is it that you just don’t gravitate toward with science?” And a lot of them say, “It’s because there’s never a correct answer.”

**Gabe (CISGS director):** [What] their brains don’t do very well with is scientific uncertainty—I think students want science to be precise and exact, for sure, and never changing. Therefore, if you have a scientific journal article that was written in 1925, it still should hold true. So they don’t recognize that knowledge is evolving, our understanding is changing in the face of new technologies.

Elizabeth (information literacy librarian) provided insight into the nature of polarized politics—that uncertainty is devalued in the current political climate.

The uncertainty piece—I also feel like it’s where they are in life as well.... And I think that there’s a rub with politics there, because you can’t change your mind as a politician. Immediately you’re labelled as a flip-flopper, as wishy-washy, a waffler. You cannot evolve in your thinking—you’re punished for that.

Sara and Claudia connected the idea of uncertainty directly to scientific concepts of “proof” and consensus.

**Sara (information literacy librarian):** Students may think that something has to be “proven scientifically” for it to be true, but that’s not really how science works. You generate a consensus. But with a consensus there’s still a little bit of uncertainty. There’s always the possibility that something else is the case. And that kind of uncertainty I think is sometimes difficult, because people see things in black-and-white—either it’s true or it’s not.

**Claudia (CISGS assessment coordinator):** We never have scientific “proof.” We have lines of evidence, but there is no proof because organic beings change—the biosphere changes, and all the interactions in it. In terms of the intersection with information literacy—to me, the most important intersection is: What is consensus in the scientific world? How do we define that? How consensus

helped us debunk something as dangerous as vaccines and autism? Consensus is what is helping us say that the climate is changing, and it's due to one species on this planet. The *Framework* is very important in terms of defining how scientists build consensus, which is very different from the way the social sciences and political issues define consensus.

The theme of uncertainty was expressed in ways that were intimately connected to how scientific information is created and communicated as well as the larger concepts associated with political polarization: namely, entrenchment in diverging and extreme positions and unwillingness to listen to or consider positions other than one's own. One might even venture to frame polarization as “extreme certainty” in order to contrast it with the ability to deal with uncertainty in a productive way. As strategies for dealing with uncertainty are central to information literacy concepts, personal intellectual and identity development, and the way science works, this concept rose to the forefront for future discussions and research for our group.

## How We Talk About and Approach Politically Charged Information Matters

Our conversations reflected our experiences that scientific information and its creation and dissemination—especially scientific information as presented in popular media—can indeed involve political dimensions in varying degrees; that information and scientific literacies were a strategic way to address and explore these issues; and that consideration of students' levels of personal and intellectual development and issues of self-identity also played a role in addressing areas of information and scientific literacies. The final takeaway of our group discussions was the role that creating positive learning environments can play in addressing political polarization.

Circling back to the original student who had emailed Gabe about flat-earth theory, we noted that Gabe had responded to the student in a positive, engaging manner, offering to meet with them and indicating that he would be willing to look at whatever evidence the student had for their theory. Gabe explained to them that their one scientific journal citation from 1905 was neither current nor sufficient evidence.

**Sara (information literacy librarian):** When Gabe replied to that person, he explained that “No, these sources



don't hold up as scientific evidence, and here's why.” And the student was able to accept that, but if he had just said “That's not science and we're not teaching that here” without any explanation, that would've set off a political battle. I think that transparent discussion about why information should or shouldn't be taught or used in class is going to be extremely important to counter some of the potential for political polarization that goes on. These discussions about how science is made or where the information comes from are key to any kind of middle ground at all between the poles.

To further explore the impact of a positive learning environment in addressing political polarization, after the group's interviews had concluded, Gabe contacted a former student, Chasen, who had recently participated in a focus group about his ISB class. Chasen had indicated that he had come into the class with negative expectations, but had left with a positive experience. After obtaining Chasen's consent to be interviewed, Sara spoke with him to gain additional insight into his experience:

**Sara:** Can you give me a bit more detail on how exactly you expected it would be a negative experience for you?

**Chasen:** I just kind of expected to be ... to almost have my beliefs attacked throughout the entire course. So I don't know, I kind of came into it a little bit defensive, but as it went on I realized that nobody was out to get me, it was just education.

**Sara:** What specific factors in the class made the difference for you in it not being a negative experience?

**Chasen:** Well I think Gabe was a big part of that. He was always open to questions, he was always kind. He never attacked anyone for having a different opinion.... It made it a whole lot easier to get respect back when I was shown respect.

In addition, Chasen indicated that he was able to reflect on his own biases, identifying that some of his negative expectations had been set up partly through his own consumption of information sources:

**Sara:** So you think the media was a big influence for you in kind of setting up those negative expectations?

**Chasen:** Yeah. And it's media, and I think universities are generally more liberal, just ... that's just kind of how it's always been, and so that's kind of what shaped my expectations.

Chasen indicated that he had been able to broaden his perspectives during the class, even after coming into it with negative expectations of polarization.

**Sara:** Did anything in particular in the class challenge you in new ways or cause you to look at an issue from a different perspective?

**Chasen:** Oh definitely. So coming into it, I had my own beliefs about everything, and every time we would discuss a new topic that I felt may have challenged my beliefs, it definitely caused me to look further and to see. Some things I would change my perspective on, other things it would just kind of help me see what the other side thinks, and then go deeper into what I believe, but basing what I believe more off of facts and everything rather than just kind of blindly believing. So I guess I just had my beliefs challenged, and it did cause me to do more research.

He also described how he had come to a less politically polarized view of the issue of conservation through the class:

**Chasen:** Because from the media perspective, it always seems like conservatives or Republicans are against conservation and environmentalism, and if you want any sort of environmentalism, you have to vote democratically—or for the Democratic Party. Which I saw in this class that really isn't the case, but that this is something that should have bipartisan support no matter what.

Chasen's input as a learner was helpful for us. Combined with our own experiences as teachers, his experiences added to our conviction that information literacy has an indispensable role to play in the goals of general education in the sciences. The intersections of information literacy and scientific literacy, especially for students who were not STEM majors taking their last science courses,

provided a critical juncture for addressing skills, concepts, and habits of mind in these areas.

## Conclusion: Moving Forward

**Sara (information literacy librarian):** It’s very rewarding for me personally to really have people outside of the library who care so much about information literacy, and really care about students, and are willing to participate and buy into this project as much as they have.... Every person I’ve talked to in Integrative Studies across the board has really seen the importance of information literacy, so I am hoping that it can serve to be a cohesive force and also a central pedagogical focus across these classes.

While these conversations began as informal interactions from a group of people who discovered a shared vision, the group has gone on not just to develop the original learning object, but also to develop a full research agenda that has now grown to include intersections of critical information literacy, scientific literacy, and inclusion. The group is also exploring, on a larger scale, new models for curricular integration and change, exploring alignment with existing frameworks across general education at our own university as well as the potential for addressing curricular change across institutions. If there is any silver lining to the current polarized political climate, it is that it has galvanized efforts between the libraries and CISGS toward information and scientific literacy on our campus and provided impetus and space for in-depth interdisciplinary conversations centered on information literacy and facilitated by the *Framework*. These conversations are directly impacting curricular transformation at our institution, and as a result have the potential to reverberate in the wider spheres of institutional change in liberal arts education. “Flat-earth theory” may not be scientifically valid, but it provides a tremendous opportunity for learning about science if we are willing to work together and meet our students where they are.

# Appendix 12A. Interview Questions

- What were your initial thoughts/feelings about information literacy/the *Framework*?
- How did the *Framework* concepts speak to you? Which ones stood out as related to your work or discipline? Was there anything surprising?
- What do you personally feel is the most important concept for students to take away from your class related to scientific information? Why do you think this matters to you personally?
- What IL/SL related issues present as difficulties with your students, and which bother you the most? Why do you think that is?
- What was the process like for you? Do you feel that it was productive? Would you have approached it differently? What were the positives and negatives of the group discussions?
- What was different for you about working with (librarians or scientists)? (for example: concepts, vocabulary, assumptions, views, etc.?)
- What are some of the difficulties you encountered in working or communicating across disciplines?
- What were some of the benefits of working across disciplines?
- Would you say that increasing political polarization was a driving factor for you personally in working on this project? Why or why not?
- Did these materials help you at all to facilitate discussion of political issues with your students?
- Looking toward the future, how do you see the relationship between scientific information literacy and political polarization playing out?
- What kinds of learning and collaboration around information and scientific literacy would you like to see happen in the future?

## Appendix 12B. Focus Group Questions

- In what ways do you think information literacy or scientific literacy could function as an antidote to political polarization? Do you think there are any ways where it could make the polarization worse?
- Politics and the science classroom: What does this look like? Should these be separate? In what ways do we see politics surfacing? Can information literacy provide a way to approach political issues without having an out-and-out debate or necessarily focusing on politics? What are the different opinions about this?
- What are key issues about the nature of scientific information that intersect with information literacy and have come to the forefront in this political climate (e.g., science takes time, what is consensus, weighing evidence and what it means, making decisions, the idea of “scientific proof”)?
- How and where have we seen students grappling with learning to deal with uncertainty or holding ideas in tension? (Think about student reactions.)
- In what ways has our common teaching and learning focus served as an interdisciplinary connector?

### NOTES

1. “Experimental Evidence,” Flat Earth Society Wiki, accessed June 21, 2018, <http://www.theflatearthsociety.org/tiki/tiki-index.php?page=Experimental+Evidence>; Mark Fonstad, William Pugatch, and Brandon Vogt, “Kansas Is Flatter Than a Pancake,” *Improbable Research* (blog), reprinted from *Annals of Improbable Research* 9, no. 3 (May–June 1993): 16–17, <https://www.improbable.com/airchives/paperair/volume9/v9i3/kansas.html>.
2. Association of College and Research Libraries, *Framework for Information Literacy for Higher Education* (Chicago: Association of College and Research Libraries, 2016), <http://www.ala.org/acrl/standards/ilframework>.
3. Association of College and Research Libraries, *Framework*.
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