An Astronomer Out of Water: How Disciplinary Background Shapes Instructors' Approaches to Science Writing Instruction[1]

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Abstract: Within cross-curricular literacy (CCL) initiatives at colleges and universities, there still remain challenges in preparing and supporting instructors from different disciplinary backgrounds. This small, exploratory study investigates the ways that literacy experiences and disciplinary backgrounds shape the teaching practice of five science writing instructors, three with English/Writing Studies backgrounds, and two with science backgrounds. Findings show that, for instructors in our discipline-linked program, disciplinary background shapes their course goals, their need for cross-disciplinary mentoring, and their levels of confidence in teaching science writing. Reflections for CCL leaders conclude the article.

Introduction

Recent cross-curricular literacy (CCL[2]) research has shown that faculty reflection and theoretical understanding of ideas like threshold concepts, genre, and process theories of writing support their teaching of writing (Basgier & Simpson, 2020; Flash, 2016; Middendorf & Pace, 2004). Promoting such faculty development work can contribute to positive campus cultures of writing, and can chip away at the nefarious old beliefs among disciplinary faculty that it's "not my job" to teach writing, and that "the English Department needs to do *its* job" by teaching students to "just learn how to write a sentence" (those last were actual words spoken to us once by a colleague in a natural science field). Research-driven and decently-compensated faculty development helps to melt away the "strange resistances" that CCL professionals have observed over the years (Donahue, 2002; Salem & Jones, 2010) among faculty who "generally don't think of themselves as teachers of writing" (Anson, 2015, p. 204).

Supporting faculty as they develop nuanced frameworks for teaching writing remains challenging, however, at the many institutions that are not resourced with CCL administrators or initiatives, or whose administrators are juggling CCL work with heavy teaching and service loads. One particular dilemma remains a hard nut to crack: having learned to write by immersion leads to challenges for instructors who have disciplinary expertise, but who have not ever consciously learned to recognize the ways communication practices reflect knowledge production uniquely in their field (Anson, 2015; Tarabochia, 2013; Wilder & Wolfe, 2009). Conversely, instructors who do have writing studies backgrounds tend not to have expertise in other disciplines, which makes teaching content knowledge in CCL courses a challenge for obvious reasons, especially if they are teaching writing in highly technical fields. This unintended myopia can lead to tendencies, among both disciplinary faculty and writing specialists, to universalize "good writing" and compartmentalize it from

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discipline-specific knowledge (Carter, 2007), to project onto communication practices in one discipline the values of another (Wolfe, Olson, & Wilder, 2014), or to project discipline-specific writing practices as universal (Thaiss & Zawacki, 2006).

Where do our conceptions of successful disciplinary writing come from in the first place? If our disciplinary backgrounds shape our conceptions of good writing, then in what ways do they shape our teaching of writing? How can writing programs with instructors from a wide range of disciplines help support those instructors as they negotiate their teaching and writing identities? Our study is an inquiry into the concerns outlined above; it attempts to understand how the backgrounds of five writing instructors in one program shape their teaching by identifying how their literacy experiences, disciplinary training, and positionality serve as catalysts for, or influences on, their teaching practices.

Research Context

The Program for Writing Across Campus (PWAC[3]), a disciplinary writing program at the University of Washington, Seattle, attempts to leverage the expertise of experienced writing faculty as well as instructors from a range of disciplines in order to mitigate against the commonly held "assumption that a writing course outside the disciplines could somehow improve students' writing in the disciplines" (Carter, 2007, p. 386). PWAC offers full, 5-credit courses linked with large lecture courses across disciplines, ranging from Astronomy to Drama to Nutrition. Students enroll in both the writing and linked lecture course concurrently, and the writing course offers students the opportunity to read, think, and write about lecture course concepts in a more in-depth and integrated way than is available through the lecture course alone.

Historically, the program linked primarily with lectures in the Humanities and Social Sciences, and PWAC instructors often had rich relationships with linked lecture instructors: PWAC instructors could determine from lecturers what kinds of learning challenges students faced, and build writing assignment sequences accordingly. In turn, linked lecturers had a writing specialist available for consultation if they wanted to beef up writing in their own courses. As the program began to forge links with STEM fields in the last decade, relationships between PWAC instructors and lecturers dwindled for practical and probably cultural reasons (having to do with the perceived separateness of learning about writing and learning about science). At one point, one of the STEM departments with whom PWAC linked most often requested that PWAC instructors not reach out to the lecture faculty at all, relegating all logistical communications to program administrators (and all but eliminating intellectual collaboration).

PWAC course learning goals are developed at the discretion of the instructor, based on their understanding of program values (learned during orientation), the lecture course they link with, and their own intellectual investments and priorities. Program founders' justification for an absence of prescribed learning goals had been that each linked course relationship was unique, and top-down outcomes were therefore not appropriate.[4]

Because PWAC hires some instructors from the disciplines with which we partner, and some from the pool of graduate instructors in our own department (English), instructors represent a rich variety of disciplinary expertise. During mentor group meetings (required as ongoing professional support for all program instructors) for science writing courses, we found ourselves—one of us a faculty facilitator and the other a graduate student instructor—surrounded by colleagues from a shifting variety of disciplinary backgrounds. Some had or were pursuing degrees in English, and some hailed from natural science fields like Biology, Epidemiology, and Astronomy. In our discussions, it appeared that we did not always understand writing-related and scientific concepts in the same ways; nor did we always share the same values about mechanics, language standards, or technical

accuracy. We believed (and continue to believe) that the confluence of disciplinary expertise was of immense value to our program, but we wanted to better come to terms with the factors that shaped these relationships, how those variables showed up in our science writing classrooms, and what they might mean for CCL programs writ large.

The Study

This small, exploratory case study investigates the ways that science writing instructors' disciplinary backgrounds shape their approaches to writing instruction. In particular, we wanted to understand how our participants learned/were taught to write in their fields, and how or whether those experiences carried over in meaningful ways into their teaching. Investigating the experiences and perspectives of writing instructors in the sciences seemed especially salient because scientists are often trained in contexts that avoid discussion of writing and rhetoric (with the exception, perhaps, of conventions and form), and writing faculty are rarely trained scientists.

The program has a corps of permanent faculty (of which Megan is one), and a rotating staff of graduate student instructors (of which Julie was one) who have homes in the English department (either the Literature & Culture track or the Language & Rhetoric track), or in another disciplinary department on campus. All incoming PWAC instructors participate in a fall orientation their first year, and for most of the instructors with non-English disciplinary backgrounds this orientation is their first training in writing pedagogy. Graduate student instructors housed in the English department, however, have all formerly taught in the Program in Writing and Rhetoric (PWR[5]), the department's other (and much larger) writing program, where first-year writing and other general composition courses are taught. All former PWR instructors undergo an intensive orientation and graduate level writing pedagogy course, and bring that background to PWAC.

Given the variety of people intersecting within this program—full-time writing faculty, graduate instructors based in English (on either the literature or rhet/comp track), graduate instructors and linked lecturers based in other disciplines, and students with a wide range of intended majors—the program offers a rich site for studying the ways that writing is understood, valued, and taught differently across disciplinary domains. The five participants in this study were recruited based on one similarity: they all taught science writing in our discipline-linked writing program. Beyond that, their disciplinary backgrounds and academic trajectories vary quite widely.

Table 1: List of Participants

Participant Name[6]	**Time Taught in the Program (at the time of interview)**	**Degrees & Disciplinary Background**
Ivo	30+ years	B.A. in English Literature PhD in English Dissertation on Ezra Pound
David O.	11 years	B.A. in Psychology; B.S. in Mathematics; B.S. in Astronomy M.S. & PhD in Astronomy Dissertation on the chemistry of stellar atmospheres

Gabriel	3 years	B.A. in English; B.A. in Russian Studies PhD in English, Literature & Culture track (completed after participation in this study) Dissertation a "revisionist genealogy of liberalism, and its intersection with liberal ideals of freedom, and material practices of sexual violence"
Rose	2 years	B.A. in English, emphasis in linguistics; minors in Spanish & German M.A. in TESOL PhD in English, Language & Rhetoric track (completed after participation in this study) Dissertation on literacy development across languages and modalities and cultures
Jocelyn	2 years	BA in history and philosophy, emphasis on environmental ethics and human rights theory M.S. in atmospheric sciences; studied atmospheric teleconnections Began a PhD in atmospheric sciences, but changed tracks to an "Interdisciplinary Individual PhD" program (in progress) on data sonification: rendering atmospheric science data sets into sound.

Each participant was interviewed for about an hour, following the same semi-structured protocol (see Appendix). We posed questions about participants' disciplinary training and areas of scholarly interest and expertise, followed by questions about participants' memories of literacy development, and of learning to write. We also asked participants about what kinds of writing they assign, what science writing-related learning outcomes they prioritize, and whether or not they feel confident teaching science writing. We recorded and transcribed all interviews, and conducted a thematic analysis according to the framework described by Braun and Clark (2006), wherein themes are identified through an iterative process of generating, refining, reviewing, and codifying.

Framework and Emerging Themes

This study is theorized on the foundational assumption that there is an integral relationship between teachers' content knowledge and their approaches to teaching. Questions Lee Shulman posed in 1986 remain relevant here: "What are the sources of teacher knowledge? ...How is new knowledge acquired, old knowledge retrieved, and both combined to make a new knowledge base?" (p. 8). A teacher's disciplinary background is a quilt of their own learning experiences, epistemological and methodological orientations (Middendorf & Pace, 2004; Southerland, Gess-Newsome, & Johnston, 2003), beliefs about literacy and communication (Brown, Reveles, & Kelly, 2005), and other strands besides. These strands comprise what might be called a "teacher identity," which has been defined variously, but for this study a positional understanding of teacher identity is useful (Moje & Luke, 2009). Particularly for teachers of disciplinary writing, their positions relative to contexts are important because these contexts shift as their teaching shifts, putting them in new relation to disciplinary fields, to students, to mentors, to experts, to texts and writing occasions, to institutional hierarchies. As Moje and Luke write, "identities are produced in and through not only activity and movement in and across spaces but also in the ways people are cast in or called to particular positions in interaction, time, and spaces and how they take up or resist those positions" (p. 430, 2009).

The metaphor for teaching identity as positional makes sense especially for CCL instructors who, like our program instructors, find themselves cast in new positions regularly: the graduate student instructor taking up the mantle of institutional authority (as instructor of record), the disciplinary expert taking up the position of writing instructor, the writing instructor taking up disciplinary expertise, the instructor of any PWAC course enacting/modeling a position of writer of particular genres. Such a framing "recognizes the subject as called into being, invited to stand in certain positions, to take up particular identities" (Moje & Luke, 2009, p. 431), and as Falconer (2019) has noted, discourse can have a positioning function such that it becomes a "marker of disciplinary identity" (p. 10). This study seeks to understand how participants stand in the spaces of their science writing courses, based on their intellectual, disciplinary, and discursive histories.

So that we might uncover some of the bidirectional relationships between participants' textual and literate practices and their identifications and positionings as teachers (McCarthey & Moje, 2002; see also Falconer, 2019), we explored participants' intellectual and literacy backgrounds at the same time that we explored their approaches to teaching science writing. While attempting to pinpoint how these histories catalyze their teaching of science writing in our program, a number of key themes emerged (some of which we anticipated based on our theorizing and line of questioning, and some we did not anticipate) that indicated especially meaningful relationships between participants' backgrounds and instructional practices. These include the following:

- Instructors' learning goals: Outcomes prioritized specifically for science writing, including
    - Genre knowledge
    - Writing as a process
    - Accuracy of particular scientific concepts vs. Broader stakes of science
- Instructors' own teachers and mentors
- Personal experience with writing
- Confidence and anxiety about teaching science writing
- Positioning students as content experts

In the following sections we map out these themes as they emerged from the analysis of our interviews.

Learning Goals

Some of the first things we set out to understand in this study, and which form an a priori theme, are the instructors' learning goals for a linked science writing course. How does being a scientist or a rhetorician (or scholar of literary studies) shape what they want students to learn? What do they prioritize and what they de-emphasize?

We asked a number of related questions, including what kinds of writing they assign and why, what are the indicators of good science writing in their students' work, and what they focus on in their feedback. Whenever and wherever possible, we identified relationships between these goals and the respondents' academic/scholarly backgrounds.

We began by asking instructors to rank in order of importance a set of learning goals that we developed in advance, based on some of the metrics we routinely discussed in our mentor group meetings. Participants thought through their rankings aloud with us, and we enclose some of those reflections below. In the ranked choice exercise, we found that their priorities differed very little, irrespective of disciplinary background, with four out of five claiming adherence to genre as the number one goal, and four out of five claiming that mechanical correctness was their lowest priority.

What we make of these similarities, particularly given the nuanced divergences that were revealed through further discussion, is that a short, ranked-choice assessment of teaching values is likely a less valuable metric than in-depth discussion.

Table 2: Ranked Learning Goals

	Adherence to the structure of the assigned genre (e.g., "essay")	**Effective use of evidence**	**Deep understanding and explication of scientific concepts**	**Advancement of new scientific ideas or research[7]**	**Mechanical correctness and polished style**
David O. (Astronomy)	1 (tie)	3	1 (tie)	5	4
Jocelyn (Atmospheric Sciences)	1	2 (tie)	2 (tie)	4	5
Rose (English: Lang. & Rhet.)	1	2	3	4	5
Gabriel (English: Lit. & Culture)	1	2	3	4	5
Ivo (English: Lit. & Culture)	4	2	1	3	5

The few cases where rankings differed are instructive. In one case, the scientists ranked "deep understanding and explication of scientific concepts" highly (first, for David O., and second, for Jocelyn), whereas Rose and Gabriel ranked it third. As David O. told us, "I want them to clearly explain what's going on-- and I'd like them to get to deep understanding. It's pretty obvious when they don't get to deep understanding, it hinders their writing, but this is a key point of what we're trying to do…" However, of that same value Gabriel, a literary studies scholar, said,

> I don't feel like I'm capable of assessing this… I also don't feel equipped—like, this is the key word here, "deep understanding"—I'm not going to be able to identify deep understanding because most of the time when I'm asking them to engage the scientific concepts they're learning, I'm asking them to summarize it to me. I would put this higher on the list [if I had more scientific expertise]. I would say it's very valuable for them to have a deep understanding of scientific concepts and to be able to represent that understanding in the writing they're producing. So that would probably be second, maybe even first. But I feel like that's where I reach my limit.

Without a background in science, Gabriel has to position himself in relation to his students differently than David O. does. While Gabriel relies on his students to "summarize" scientific concepts accurately in their writing, on the other hand David O. finds it "pretty obvious" when his students lack understanding. These responses affirm the huge variation in "mental operations" across disciplines (Middendorf & Pace, 2004, p. 3), and indicate that long-internalized disciplinary knowledge (or absence thereof) has direct consequences for teaching.

We do not judge this perceived limitation. Nor do we concede that technically accurate and good science writing are synonymous. We ourselves are science writing instructors with backgrounds in writing studies, and probably regularly fail to catch inaccurately described science from our students. In fact, we note that Gabriel compensates for his lack of scientific expertise by adjusting his courses' learning goals, and emphasizing concepts that he is better able to support (i.e., teaching genre, and the responsible use of evidence). Without trying to oversell it, we see some pedagogical potential in non-expert instructors' ability to more explicitly target "bottlenecks to learning" precisely because their own disciplinary understanding has not become tacit over time (Middendorf & Pace, p. 2). We will go into the possible affordances of instructors' lack of expertise at greater length later.

One unexpected consistency was the near-unanimous de-emphasis on mechanical correctness, a topic discussed regularly over the years in mentor group meetings. All participants were familiar with the department's de-prioritization of mechanical correctness, and all writing course instructors undergo (or in Ivo's case, lead, since he directed the program at one point) at least one teacher training in which teaching mechanics and grading for error are discouraged. Gabriel referred to departmental training explicitly when he said:

> We are so inculcated by [orientation] to not treat this at all. What I've found though is that [mechanics] matters in almost every discipline but our own, and they all imagine that we care about it the most, right, so there's a kind of weird double blindness.

This comment shows awareness that not penalizing error is a pedagogical convention specific to writing studies. Beyond that, the comment implies that external forces like teacher trainings can override or come into tension with whatever disciplinary knowledge had already been in place for some instructors. For example, it seems possible that David O.'s hesitation about wholly ignoring error correction comes from an awareness that such standards are more stringent in other disciplines, as this comment shows:

> I don't worry TOO much about mechanical correctness and polished style, although I also think it's unfair to completely push that down, particularly given our large international student population… And if I don't help them with some of these mechanical issues, then they're going to get stigmatized in future classes, other instructors might be less forgiving and more concerned about mechanical correctness.

Genre Knowledge

With the exception of Ivo, who has been teaching in the program longer than any of the other participants, all instructors said that teaching genre knowledge was fundamental to their course, though they seemed to describe (and understand) the concept variously. Though they both center genre in their courses, the two science instructors described it more in terms of conventions, as we see from this comment by David O., which emphasizes form, first of publications, and then the students' own "review-style research" papers:

> I'm really focusing more on genre as an arc, as a guiding narrative for the whole class. There are different types of science writing. Some of which are simpler and easier to access than others, from very basic *New York Times* style sort of things, to *Nature*, *Science*, that sort of stuff… By the end of [the course], we're faking a research paper. They're still not ready for research, but they can do, you know, review-style research. They can go look up some articles, collate information, pose a question, analyze their thoughts a bit...

Whereas David O. implies that students demonstrate genre knowledge through acts of formal mimicry, Gabriel describes genre in more complex terms, grounding the concept in behavior, methods, and engagement:

> ...it's challenging and also valuable to constantly mark how disciplinary methodologies that you're working with differ from another set of disciplinary *methodologies*, especially when you're in interdisciplines like gender studies or environmental studies, or whatever. The only way to ground yourself in those fields is by *figuring out what you're doing* and how it's different from *what other people are doing*. In terms of, not just the kinds of genres that you're producing, but *the methods that you're using* to produce them-- the sort of modes of engagement, the objects that you analyze, or that are given a critical legitimacy, identifying the audience you're speaking to-- all of those things are the basics that we start with, you know, in the [PWR] teacher training. But we start there for a reason, I'm realizing [laughing]. It's hard to identify all of those things, so once you can do that, it *helps you navigate the field*—or fields—much better. (emphasis added)

As he indicates here, Gabriel's primary exposure to genre-based teaching is through the writing pedagogy course that all incoming English graduate students must take, and which studies genre theory. Rose was our only participant pursuing a PhD in composition and rhetoric, and her dissertation chair is a renowned scholar of rhetorical genre theory. Rose spoke about genre in terms that explicitly reflect the scholarship, and she explained that both the Systemic Functional Linguistics (SFL) and rhetorical schools of thought influence her thinking. She was also able to distinguish herself from more simplistic conceptions of genre as defined by form and convention. As she told us about her pursuit of genre knowledge in her teaching:

> [I'm] not necessarily [focusing my teaching on] the structure of the assigned genre, but I think again that gets to the focus on the rhetorical appropriateness, or the effectiveness of what they're doing. So you know the genre usually is a way of achieving the purpose, it's kind of that social action. So being able to identify in what ways they're being effective for their audience is most important for me.

These responses accord with Basgier and Simpson's (2020) findings that faculty encounter genre in their own teaching with varying degrees of interest and difficulty. They write:

> While the situated nature of learning is certainly an obstacle for many faculty members teaching with writing, so, too, is the notion that genre is more than a formal container or set of conventions, but rather a dynamic construct that emerges and is recreated at the nexus of specific, recurring, material situations; larger cultural contexts; and a network of intersecting genres.

Given how explicitly the English studies participant Gabriel referred to the teacher training, and given Rose's specialization in rhet/comp, it is perhaps unsurprising that participants with that explicit training in genre are able to treat the concept in more complex ways with their students. These

findings help inform our inquiry about whether and how disciplinary backgrounds influence approaches to teaching, and indicate that teacher training and mentorship should explicitly differentiate across various forms of knowledge, both from writing studies and the disciplines being taught.

Writing as a Process

Writing as a process was expressed quite explicitly as a teaching value by English participants. Rose assigns reflection papers concurrent with the drafting process to enforce metacognition, and Ivo emphasized that "I just really believe in pretty inductive, pretty incremental practice" when it comes to developing a piece of writing. Gabriel ties his own writing practice to his pedagogical emphasis on process: "So yeah, I want them to think of writing as a process… Basically the only way I've gotten better at writing is by constantly doing it. And that's part of my rationale. In some ways I think framing writing as a process comes out of my personal experience." In some ways it is to be expected that these instructors frame writing as a process more explicitly than the instructors with science backgrounds. However, aside from citing their own personal experience with the writing process, none of the English instructors referred to learning about or being influenced by process frameworks in composition theory. We expect that long enough immersion in writing-centered fields has made process a core value for these instructors. Conversely, the science experts did not explicitly name process as a learning goal.

Accuracy of Particular Scientific Concepts vs. Broader Stakes of Science

One of the scientists we interviewed, David O., placed a very high value on scientific accuracy, which none of the other participants prioritized. To him, technical understanding of the material is a basic prerequisite to effective communication:

> Clarity. Foremost: accuracy. It's one thing we talk about a lot, particularly in the beginning. The need to know your material, understand your material because—and I emphasize this, maybe to my pain at some point in the future—at times like these one might say, being truthful is more important than ever. And being able to communicate scientific information accurately is the overarching thing that must happen… if you don't understand the thing you're trying to write about, it's very difficult to do it well.

We assume David O.'s scientific training inculcated in him such a value for precise content knowledge, and though he did not explicitly cite his own disciplinary background as an influence on this value, David O. did at a later point in our interview express satisfaction in his ability to support students' interaction with and communication of scientific content. This comment also highlights David O.'s priorities when it comes to teaching genre; though genre knowledge is one of his stated learning goals, genre is a means to an end—accurate scientific knowledge—whereas, for Gabriel, genre knowledge was itself the end.

We wonder if the particular discipline of science is relevant here as well. Jocelyn, the atmospheric scientist, did want students to learn some basic data literacy when it came to interpreting atmospheric datasets, but at no point did she emphasize accuracy in such emphatic terms. In fact, her main content knowledge goal boiled down to one broad, but key, scientific principle:

> I just think it's really important that people feel comfortable saying, "You put carbon dioxide and heat-trapping gases in the atmosphere, and they stay in the atmosphere for hundreds of years, they don't come out immediately like other forms of air pollution, and

> they trap heat in the atmosphere, and they dissolve in the ocean and become acidic." Like, that's it!

Indeed, one of Jocelyn's biggest learning goals was that students "felt connected, importantly, that they weren't just writing for the academy, that this class wasn't disconnected from their lives and from society." Whereas accuracy and truth heavily animates David O.'s teaching, the stakes of science take on a more personal valence for Jocelyn. She even asked her students to compose a piece of "cli-fi," or climate fiction, a piece of writing that is loosely informed by scientific data but is then pushed to a place of creative speculation. Returning again to genre, Jocelyn was less concerned about the rhetorical attributes of cli-fi (audience, typified style, etc.) than she was about helping students identify, through self-expression, a personal stake in climate change. Like David O., genre serves an instrumental scientific purpose for Jocelyn, whereas for Rose and Gabriel, genre knowledge was the goal.

Atmospheric science, with climate change as its central current focus, is concerned with communicating urgent global stakes to lay publics (particularly skeptical ones). In contrast, the astronomy course with which David O.'s writing course is linked (and which David O. himself often teaches when he is not teaching writing), focuses on content that is abstract and is often theorized in mathematical terms: the evolution of galaxies, quasars, stars, our solar system. Immediate human stakes are low; precision is primary.

While learning goals are a somewhat amorphous category with subcategories that overlap and diverge, we see our participants' goals for their students' learning to be one of the most important manifestations of their disciplinary and intellectual backgrounds. It is also an area into which WPAs can help disciplinary writing instructors externalize their own knowledge, whether scientific or rhetorical, as Flash (2016) has done with disciplinary faculty teaching Writing Enriched Courses at the University of Minnesota. For our own program, these findings reinforce the importance of helping instructors not only to identify their goals for student learning, but also to align their own priorities with program- or course-specific learning goals.

Instructors' Own Teachers and Mentors

When it came to pedagogical development, participants tended to seek out support and mentorship from folks in other fields—typically those from fields from which they did not come. Rose, the PhC in rhet/comp, forged a productive relationship with another instructor in the program, a doctoral student and botanist housed in the Biology Department. They were brought together through the program orientation and pedagogy course, and then in the mentor group. They went on to present together on science writing at our campus's annual graduate student-organized literacy conference.

Similarly, Ivo, long-time faculty in English, developed a rich teaching relationship with an instructor in the Biology Department, who taught in PWAC for a time, and who helped develop the program's science writing courses. As Ivo describes it, the relationship was mutually beneficial, with the biology faculty bringing in ideas about using primary science literature, and Ivo and other program faculty teaching him in turn about writing pedagogy.

The inverse happened for David O., the astronomer. When he first started teaching in the program he spent a lot of time with the program's founding director, who was a scholar in CCL Studies. He told us that working both with her and another program faculty member was

> where I spent more professional, focused energy time really thinking about rhetorical issues, writing issues. How to offer guidance and instruction to people. What are common

> problems. What are common solutions. It was really those first few years [working with writing faculty] that strengthened [my teaching].

The two science instructors were clear that their disciplinary training in science did not prepare them to teach writing, or even really to teach. Jocelyn told us,

> Uh, it was not my disciplinary and professional training. It wasn't! We don't get any training in teaching in atmospheric sciences, which is where I spent most of my graduate [studies]—the last three years now I've been in the interdisciplinary PhD program but I've had no pedagogical training through graduate school.

A noteworthy contrasting response was from Gabriel, who regularly cited the teacher training he underwent in the department's Program in Writing and Rhetoric (PWR), and the mentor group he participated in, in PWAC. Because all grad students in English spend five or more years teaching in the PWR prior to teaching in PWAC, they undergo a more exhaustive week-long orientation, followed by a full graduate course in the theory and practice of teaching composition. He cited the PWR and PWAC trainings multiple times as having an influence on his approaches to teaching genre, using rubrics, and not penalizing mechanical error.

While these findings confirm the importance of high-quality formal orientations and courses, we also observe the integral importance of mentoring relationships, which can be informal, incidental, and also bi-directional. Additionally, some of the most fruitful mentoring relationships appear to take place across disciplinary lines. Tarabochia (2017) offers a framework for productive CCL discussion among writing specialists and disciplinary faculty, which "respects locations of expertise and inspires communicative decisions based on how individuals are positioned in relation to one another" (p. 152). As WPAs sponsoring pedagogical development for those teaching disciplinary writing, we may better support our instructors by serving as matchmakers—putting folks with various disciplinary backgrounds in touch with each other so they can capitalize on each other's knowledge and experience.

Personal Experience with Writing

We asked participants about their own relationships with writing in order to understand how or whether their own writing practices shape their teaching practice. It turns out there is influence in both directions, but the participants with English backgrounds articulated more clearly the ways that their writing and their teaching interrelate.

Ivo drew parallels between his experience writing in other contexts and his confidence teaching writing in other contexts. He had learned, for example, how to conduct ethnographic field work through an immersive, trial-by-fire process while he was a TA at the School of Social Work (during his graduate studies in the Department of English). He describes his acculturation to the genre of ethnography, and his gradual development of authority:

> I'd be at the table all the time with people who I couldn't claim to have anything like the preparation they'd had to steer the enterprise as a whole but I could certainly do the things they asked me to do, and I got a little better at them all the time, and, um, I could edit work they were working on, I could appraise drafts of what they were working on, so there was a way in which you were an integral part…

Ivo's experience with fieldwork and subsequent development of writing skills and habits of mind in a discipline outside his own may have contributed to his comfort and flexibility in teaching writing

in other contexts. Similarly to Ivo, Gabriel relates his own writing practice to his teaching, but less in terms of his versatility in switching contexts, as Ivo did, and more in terms of the sheer repetition of the practice (despite the number of disciplines he has worked in): "Basically the only way I've gotten better at writing is by constantly doing it. And that's part of my rationale. In some ways I think framing writing as a process comes out of my personal experience." Rose, on the other hand, told us that for her, it's the other way around: it's her teaching that informs her writing:

> One of the most significant things for me actually was teaching the [first year composition] class. And every class that I've taught has helped me develop as a writer, because as I'm pointing things out that are salient for the students I'm also realizing, Oh yes! I could be doing this too, or maybe I'm doing this and wasn't thinking that this was something I could further develop. Like even something as basic as identifying rhetorical appeals, and how you're using them. Or using the "Create a Research Space" model from John Swales, which is something that I knew from TESOL, but hadn't really thought to apply myself.

Whereas the English instructors seemed to be well attuned to the ramifications their own writing development has had for their teaching (and vice versa), both scientists refrained from drawing those parallels. Not only did the scientists not make explicit connections between their writing and their teaching, each in their own way even put a little distance between the two. This is particularly interesting given that David O. and Jocelyn were the only participants we interviewed who have actually published scientific writing. Yet David O. does not seem to leverage his own extensive experience as a science writer. He told us, "During my graduate and postdoc career, I wrote a *lot*," (emphasis in original), but now,

> Most of the writing I do, like 75-80% of the writing I do is email correspondence, varying from "I got your assignment, thanks" to five-page-long screeds about something that's going on. And then yeah, the other 20% or so are written reports for some administrative unit. Whether it's the astronomy department or central admin or something of that nature. I haven't written a paper for astrophysics since 2014.

David O.'s comment calls to mind the ways that different kinds of writing practice instantiate our academic identities, whether that is "practicing scientist," "teacher," "administrator," or something else. The majority of the writing he does—emails and administrative reports—does not seem to serve his knowledge in and for teaching science writing. As Anson (2015) and others have discussed, teaching writing in a disciplinary context involves different kinds of knowledge, including knowledge of discipline-specific communication and knowledge of writing pedagogies, and not all of these strands always exist (or intersect) at the level of conscious awareness. What is less clear is the degree to which workplace writing (like emails and administrative reports) serves as a strand in these overlapping forms of knowledge for teaching writing. Lea and Stierer (2009) have explored the ways that workplace writing helps to reify faculty's identities as academics, but it is very possible that for David O. and others like him, workplace writing does not shape his pedagogical practice in a direct or discernible way.

Jocelyn also disidentifies with the writing in her field, but for different reasons, and it does show up in her teaching, as she reports:

> I had such a negative reaction to scientific writing because it felt way too siloed. And I saw the need for scientists to get so much better at talking in plain language about what they know, and spending so much time writing in these journals that very few people

> read. And that's fine for furthering the science, but I felt I didn't want to spend any more of my time writing for specialists… I have a real low tolerance for a lot of jargon in academic writing. I just don't think that's useful right now. Also that was part of the reason that I pivoted to doing a different kind of research. And that informed—way informed how I approach teaching [my writing class] too.

When contrasting the responses from the English participants with the scientists, we see a difference in the perceived functions of writing—in their lives and in their teaching. Among Ivo, Gabriel, and Rose, the writing to learn function is notable. The incremental (a word Ivo used at another point in our interview) nature of development over years of writing practice seems to be something the English participants have internalized, and are willing to model, though more research is necessary to understand how this shows up in their actual teaching.

It's harder to categorize the ways the scientists' own writing practice informs their teaching. Cremin and Baker (2010) have pointed to the difficulty many teachers have with modeling their own writing processes "if they lack self-assurance and positive writing identities" (p. 9). This combined with Yore, Hand, and Prain's (2002) findings that scientists overwhelmingly view nontraditional (e.g. public-facing) science writing as unscientific and illegitimate, makes us wonder where David O. fits in here. His dismissive attitude about his own writing ("I haven't written a paper for astrophysics since 2014") indicates that his identification as a writer is not something he draws on as a teaching tool. Our own work with graduate students and faculty in the sciences has shown us that they tend to receive very little explicit training in writing, and even less in process-based frameworks, though Jocelyn did point out that more and more science communication trainings for scientists have been cropping up in recent years.

Given that Eodice, Geller, and Lerner have also observed that there is a connection between the "teacher as writer" and the student's writing experience (2017, p. 16), further research is needed that explores disciplinary writing faculty's own histories with and relationships to writing, and how these relationships play out in the classroom. Such investigations might especially focus on teaching faculty who have pursued other avenues of professional advancement than traditional scholarship, like David O., whose rise through the ranks of faculty governance has shifted his writing practice away from science and toward administrative writing; and like Jocelyn, whose distaste for specialized science writing pushed her out of a science PhD altogether.

Confidence and Anxiety

As we have mentioned, all participants spoke about the ways that their disciplinary expertise did or did not prepare them to teach writing. For some of the participants this showed up in the form of confidence and/or anxiety about teaching science writing. For several of them, both emotions were present in different degrees, depending on the moment. Participants' expressions of confidence or anxiety were often tethered explicitly to their training (or lack thereof) and their experiences with mentorship early on in their teaching. David O. told us, for example,

> So I think I feel really confident about it *now*, but certainly at the beginning it was really tricky. And I think this relates to the disciplinary thing because I was like, I've never taught anybody how to write… I felt like an astronomer well out of water for a long time. Again, bless [the former program director] for continuing to believe and letting me grow into it a little bit.

Yet, when it comes to supporting students working with actual astronomical concepts, David O.'s response was decidedly sure-footed: "Oh you're interested in black holes? You want to learn more

about black holes? Knock yourself out… I can help. I know enough about the background that I can be supportive of you, so I think of that as a real strength." Jocelyn expressed a similar satisfaction with her ability to distinguish for her students more authoritative climate data sets from less authoritative ones. Conversely, Gabriel told us of his own perceived failings as a teacher of content knowledge:

> I mean, I wish I could help them a little bit with the content because it would be an ideal—the link[ed writing course] would be an ideal space to help them master the content. Which is why I think people who have disciplinary training in biology make better instructors in some ways because they can respond to the inaccuracies in the content.

His confidence re-emerges when his writing expertise is evoked, though he does acknowledge his need to establish legitimacy as an expert in writing:

> I do feel confident navigating writing, and helping them think about writing. And so it's also kind of a move to legitimate my own authority at the beginning of the quarter. I'm like, I know nothing about science; I have an English degree, you know, or I'm working towards an English degree. But I can tell you that as somebody that has an English degree, I know how to understand writing. And that's what you're here for.

But it would be irresponsible to claim heavy-handedly that all scientists are insecure about writing and confident in their content knowledge, and vice versa for those with English backgrounds. Two of our English participants expressed confidence in teaching science writing, in part as a result of a cultivated attitude about teaching within foreign contexts. Ivo told us that his long tenure in the program (over 30 years) had brought him to a space of "being adaptive, to being opportunistic, to not confusing the expertise that you possess with the expertise that's needed. And it's probably a really good model for going into anyone's discipline, being a little bit respectful and thoughtful and deferential at the same time." Funnily, Ivo said he was much higher on "the anxiety scale" when it came to teaching literature courses, possibly because he was deeply immersed enough in the discipline to know about all he didn't know. For him, teaching writing in biology offered him an occasion to let go, to step aside and let students be content experts, which he found was a more successful and empowering way to teach anyway, a point we return to below.

As a graduate student Rose could not claim as many decades of experience for her source of confidence, but her training in writing studies, and in particular her specialization in translingualism did help: "I've mentioned the genre training, the translingualness [sic], like both of those kind of allow for, and place value on the comfort with ambiguity. And not just in terms of a wishy-washy ambiguity, but like being comfortable with… [as you gather] more context, keep listening to something and it will make more sense."

Ivo's long pedagogical practice with crossing disciplinary boundaries and Rose's theoretical foundation in translingualism (not to mention her extensive experience as a learner of languages and disciplines) offer them confidence in teaching writing in a discipline in which they do not have training or expertise. Instructors who are new to the theory and practice of writing instruction, particularly those from scientific disciplines but those from English as well, may well draw inspiration from exposure to those who are more comfortable in new or ambiguous teaching situations.

Positioning Students as Authorities

A similar theme that we believe relates directly to confidence is our English-trained participants' practice of positioning students as content authorities. Ivo was especially vocal to us (and apparently, to his students) about this, but Rose and Gabriel also signaled that, in the absence of scientific expertise, they deferred to students' scientific knowledge. Their bases for positioning themselves as scientific novices does vary slightly, depending on their pre-existing levels of confidence. On the one hand, Gabriel tells his students up front that "I know nothing about science" but that he does know about writing as "a move to legitimate my own authority," and, we suppose, to mitigate his lack of confidence.

On the other hand, Ivo's lack of content expertise not only does not diminish his confidence, but increases it—because he uses it as a teaching tool. As he told us, "I had a lot of clarity about what I don't know. A ton. … [And] that's a strength." We have heard Ivo speak, both in and out of our interview, of positioning himself as a "master learner," meaning that he leverages his lack of disciplinary expertise to model authentic intellectual curiosity about the knowledge production and genres of a new field. Ivo claimed that program instructors who are non-scientist literacy experts are well positioned to approach disciplinary writing with fresh eyes, posing questions about communication norms and conventions that long-immersed experts would not ask. This positioning aligns with Nowacek and Hughes's (2015) model of the "expert outsider" in their writing center research, and refers to a tutor who may not have subject area expertise, but draws on their "knowledge of writing processes and genres, as well as the affective, institutional, and ideological contexts for writing, to inform their conversations with writers" (p. 181).

The literature on student confidence is abundant (e.g., Reiff & Bawarshi, 2011; Schuldberg et al., 2007; Silver, 2019), but it is quite thin when it comes to instructors, particularly in CCL studies. Given that instructors may not originate from the discipline in which they are teaching writing, a better understanding of the ways that confidence and anxiety play out in their teaching would be beneficial for WPAs and CCL specialists. As we structure teacher training and mentoring in our program, we intend to more explicitly address affective dimensions that may aid instructors in directing feelings about a deficiency of disciplinary/rhetorical expertise into a confident "master learner" position in the classroom. In addition to the benefit of alleviating instructors' anxieties, such modeling is important for students as they learn to enter a discipline with confident curiosity—a particular strength in STEM fields, whose undergraduate major pathways can be rife with competition and feelings of anxiety and inadequacy (Bozinovic et al., 2021; Grunspan et al., 2016).

Reflections and Strategies for WPAs

As we have said, our program hires instructors annually from its own department (English) and from other disciplines. We have permanent faculty who have been teaching for decades, and we also hire graduate student instructors from disciplines outside English who have never taught a writing course. As such, instructors with all levels of expertise and experience find themselves in a room together, intensively at first (during program orientation) and then periodically thereafter (in mentor group meetings). Hiring graduate student instructors enables us to require, as a condition of employment, the kinds of interaction and cross-pollination that is integral to professional development in teaching writing—such requirements may be more challenging, culturally or contractually, with full- or part-time faculty. While we are proud of the support and intellectual cross-pollination we can provide instructors within our English department-based disciplinary writing program, as the findings of this study show, there remain gaps in knowledge and confidence among our instructors. In future program assessment we hope to gain a more nuanced understanding of how these are assets or liabilities for student learning.

In general, CCL faculty development opportunities tend to be meager: they are often voluntary and time-intensive, leaving many instructors to determine on their own how they want to approach teaching a subject they were not trained in or comfortable with. Based on some of the successes and remaining challenges of the PWAC's orientation and mentoring, we describe below some of our intentions for supporting faculty who teach disciplinary writing in our program.

- In program communications about disciplinary writing instruction, whether in web sites or workshops or even department meetings, writing specialists should emphasize key writing principles, but in lay terms. Our participants showed varying degrees of understanding of the word genre, for example, ranging from genre-as-convention to a nuanced awareness that genre is a social activity and textual forms are byproducts of that activity. Helping disciplinary scholars understand that writing is an integral part of (and not separate from) the kinds of knowledge-producing activities they carry out in the field helps externalize knowledge that most people already intuit. Exploring concepts of genre knowledge and threshold concepts are excellent entry points for non-experts, and may create more curricular coherence.
- We will continue to offer bi-directional mentoring opportunities to anyone teaching disciplinary writing. The more disciplinary backgrounds represented, the better, which is why group mentorship can be very fruitful. Our participants showed a tendency to seek out support from folks in different fields (i.e., those with English backgrounds learned from scientists, and vice versa); creating informal spaces where writing instructors can gather and discuss the ways that content and writing knowledge intersect will likely enrich their experience. Given our findings that the scientists and non-scientists had different priorities for learning outcomes, we encourage group facilitators to be intentional in bringing up different outcomes (such as scientific accuracy, or awareness of writing as a process) and asking participants to explore their own values. Positioning all participants as peers who have unique expertise to contribute is important, too, to avoid feelings of resistance or resentment. It is important to leverage—and honor—the different kinds of background knowledge that people bring, whether that is expertise in science or writing pedagogy. Our findings show that we can do this better in the PWAC as well.
- Our biggest opportunity for improvement lies in facilitating exploration of instructors' own experiences and identities as writers. As our study participants demonstrated, not all were able to leverage their own writing experience as a teaching tool or as a basis for empathy. Indeed, some dismissed their own writing practice as wholly separate from their students' writing practices, or separate from the discipline in which they are teaching (e.g., non-scientific administrative writing, or dissertation writing). Dryer (2012) similarly found that GTAs expressed ambivalent, complex relationships to their own writing while simultaneously projecting simplistic, reductive writing identities on their students. He proposes "deroutiniz[ing] the practices that [certain] genres make commonsensical, transparent, or otherwise beneath notice" (p. 442). In other words, when disciplinary experts have been writing a particular genre for many years, they may perceive writing it as a simpler process than it really is for novices. Asking instructors to hark back to their own experiences of learning to write the genres they assign in their classes may help cultivate the kind of "metaknowledge" Anson (2015) characterizes as necessary for teaching disciplinary writing.

We are aware that the above practices can be arduous to implement for institutions that do not employ a CCL director, and that professional development for disciplinary writing instructors often falls to writing faculty who are themselves balancing WPA work with their own teaching and service loads. Time, funding, and will for even occasional, informal mentoring meetings can be hard to come

by. Fortunately there are some excellent compiled resources online, including guides to teaching writing in STEM fields from the CCL Clearinghouse and from Georgetown University. Also, Flash (2016) and Middendorf and Pace (2004) offer helpful heuristics for cross-disciplinary conversations, which we can imagine taking place even during brown bag lunch conversations.

Disciplinary faculty's contribution to writing instruction is essential to student learning and to campus cultures of writing. Participation in the long-haul endeavor of developing student writers cannot happen if disciplinary faculty pull the "it's not my job" card, nor will it happen if writing specialists are not willing to help position disciplinary faculty so that they will be successful writing instructors in their own courses. A key part of this process, as this study has attempted to show, is the necessary reflection involved in understanding how instructors' disciplinarity and their educational and literacy experiences all intersect to shape writing teacher identities and positioning in the classroom. Larger scale, multi-institutional research would reveal a more nuanced understanding of these connections. As WPAs, CCL specialists, and writing faculty, we will help improve writing education at our institutions if we facilitate and nurture such reflection among our disciplinary colleagues. Indeed, we'd do well to do it ourselves.

Appendix: Interview Protocol

What is your disciplinary background?

What are your current disciplinary interests or areas of research?

What are some of your memories of learning to write in your field, in college, in grad school, and beyond?

What kinds of professional writing do you do now?

You just mentioned [x genre]; do you recall learning how to write that genre?

What kinds of writing do you assign (or have you assigned) in your science writing courses?

Why did you choose these assignments?

What do you want students to learn in your science writing courses?

What, to you, are indicators of "good" science writing from your students?

What does your feedback on student writing mostly focus on?

When it comes to your approach to feedback and assessment of student writing, what do you value most?

Please rank these in order of priority:

- Mechanical correctness and polished style
- Deep understanding and explication of scientific concepts
- Adherence to the structure of the assigned genre (e.g., essay)
- Effective use of evidence
- Advancement of new scientific ideas or research

How would you describe your confidence in teaching science writing?

What, in your view, are some of your strengths and weaknesses as a science writing instructor?

What did your disciplinary/professional training best prepare you for as a teacher of science writing?

Is there anything else you'd like to share with us about learning to write, or your experiences as a writer or teacher?

Are you willing to share some of your course materials with us? (writing prompts, rubrics, and feedback on student writing, with student identifiers removed)

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Notes

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[2] Following Tarabochia (2013, 2017) we use the phrase "cross-curricular literacy" (CCL) to encompass the broad and various kinds of work that Writing Across the Curriculum (WAC) and Writing in the Disciplines (WID) programs do.

[3] The program name was changed to Program for Writing Across Campus in 2022. When this study was conducted, the program still had its former name, The Interdisciplinary Writing Program (IWP). For better visibility and accuracy, we use the new name in this article.

[4] The PWAC has since developed high-level, program-wide principles of learning, but these principles were not in place at the time of this study.

[5] Also recently renamed. The program's former name was the Expository Writing Program.

[6] All names are pseudonyms.

[7] Several participants noted that this goal is usually not applicable because students (often in their first and second years) are not typically advanced enough to be conducting/producing original research.

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