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## Part 1: Creating Scientist-Citizens through a Writing Minor

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## Part 1: Creating Scientist-Citizens through a Writing Minor

Melissa L. Carrion and Ed Nagelhout

Many contemporary scientific and medical “controversies”—from challenges regarding the role of humans in causing climate change to questions about the safety of vaccines or the efficacy of masks in preventing the spread of COVID-19—persist despite overwhelming scientific consensus to the contrary (Ceccarelli). Public skepticism surrounding these issues has very real and deleterious effects, from halting meaningful policy change to jeopardizing public health. While research suggests that increased scientific literacy among the public can alleviate some difficulties inherent in this phenomenon, citizen-science, defined broadly as “public participation in scientific projects” (Heigl et al. 8089), has been shown to supplement increased public scientific literacy, which positively impacts trust in science more broadly: lay citizens play a central role in this activity.

As such, attempts to help scientists engage effectively in this process are a crucial, yet often overlooked, component of the citizen-science effort. Since scientists are still primarily trained to communicate findings in lab reports or in professional publications to a specific and well-informed audience, there has been far less attention to date paid to the pedagogical development of what Pamela Pietrucci and Leah Ceccarelli call *scientist-citizens*—those who “take up a rhetorical ethos that not only displays technical expertise but also demonstrates virtue, goodwill, and good judgment to communicate their specialized knowledge with people who do not already share it” (102). Understandably, attempts to help expert scientists engage effectively in this process are an important component of this effort. As Pietrucci and Ceccarelli write, “There are times when a solution to the tragedy of the expert-lay divide lies not in democratizing science or scientizing the public but in bringing scientists out of their isolation in the technical sphere so that they can embrace their rhetorical duty as citizens” (106).

While existing research has examined and offered suggestions for scientists who choose to engage with the public and citizen-science efforts (e.g., DeVasto and Creighton; Fischhoff), there remains, as Pietrucci and Ceccarelli note, “alienation of scientists from their responsibilities as agents in a broader civic culture” (99). This means, to us, that in order to harness the potential of the citizen-science model, educators need to cultivate its corollary—scientific citizenship. However, while these are values that are increasingly embraced in the broader public and civic culture, there has been less concerted effort to embed these values early and consistently throughout science education efforts. Responding to this gap, we describe our interdisciplinary science writing minor as a replicable, programmatic model for fostering scientific citizenship among STEM students. We outline ways that the program design provides students with explicit training in rhetoric and scientific writing for public audiences, fosters collaboration among faculty, and provides the flexibility needed to preempt the logistical and bureaucratic challenges that can often thwart such efforts.

Indeed, from epidemiologists with blogs to social media groups moderated by credentialed experts to outreach efforts from governmental agencies, recent years have seen a proliferation of scientists and health professionals engaging directly with the public in an increasing variety of ways, both formal and informal. These include efforts to

involve lay publics in citizen-science, which can take many forms from crowdfunding to citizens who help collect data to participatory models where community members play a central role in determining study designs, intervention, and evaluation (Wiggins and Wilbanks). Research suggests that citizen-science can help to expand the public's scientific knowledge and understanding, facilitate effective science communication and greater understanding of the scientific process, and increase faith in scientific institutions more generally (Bonney et al.). Academic-based efforts to promote citizen-science engagement offer, therefore, an important avenue to combat broader trends toward science skepticism and anti-science attitudes.

While scholars have a fairly well-developed idea of what citizen-science looks like, we don't have an equally deep or robust image of the effective *scientist-citizen*. We have even less research and guidance regarding how to foster effective scientific citizenship from a curricular perspective; specifically, how to integrate effective training in scientific citizenship for STEM students in higher education settings. Those efforts that do exist tend to focus on either direct integration into STEM courses (i.e., asking STEM faculty to include lessons on effective communication alongside disciplinary content) or stand-alone science communication programs, both of which can pose logistical challenges for students, faculty, and administrators. We argue that effective strategies for fostering scientific citizenship must necessarily involve both faculty in scientific disciplines as well as those who can offer substantive instruction in rhetoric and writing more generally. We offer our interdisciplinary science writing minor as one model for how to develop sustainable pedagogical and curricular interventions to ensure STEM students receive adequate training in not only the content of their disciplines, but also in strategies to engage effectively with lay publics as a means to understand and embrace their potential as *scientist-citizens*.

To meet the needs for educating *scientist-citizens*, we developed an interdisciplinary science writing minor as part of a larger multi-layered and multi-disciplinary program that included a technical writing minor and a professional writing minor in the English department at the University of Nevada, Las Vegas. Our goal was to design a replicable, programmatic model for fostering scientific citizenship among STEM students by providing explicit training in rhetoric and scientific writing for public audiences. We also sought to foster collaboration among writing faculty and science faculty, as well as build in flexibility needed to preempt the logistical challenges that can often obstruct such efforts, especially from an administrative perspective.

Our theoretical framework builds fundamentally from the acknowledgment that professional practices related to effective technical communication are a science unto themselves. That is, research suggests that one major contributor to science skepticism relates to the tendency toward the Dunning-Kruger effect, or what some scholars have termed the "beginner's bubble" (Sanchez and Dunning): the propensity of individuals with limited exposure to a new topic to feel they have gained expertise to rival actual experts. To expect STEM faculty—in isolation—to be able to teach and prepare students in effective rhetorical and writing practices is committing the same error. On the contrary, we should acknowledge that effective science communication practices—while they might be situated within disciplines and departments, like English, which are historically tethered to the Humanities—are nonetheless areas grounded in a kind of scien-

tific expertise. These practices are likewise informed by education, research, and practice that is not replicated quickly or easily. Efforts toward fostering the kinds of communication necessary for scientific citizenship are thus best supported, in a university setting, by faculty trained in these disciplines. In line with this approach, our interdisciplinary minors provide STEM faculty with the expert support that supplements their own disciplinary training in essential ways.

This theoretical orientation is related to a broader pedagogical benefit. Best practices in learning sciences suggest that effective and sustained learning occurs through a process in which students are introduced to a new topic/skill, given an opportunity to connect it to their prior learning and experience, offered a clear explanation and space for discussion, and finally encouraged to apply it in a real life scenario with opportunities for reflection. This latter component can and should be integrated into STEM disciplinary courses, along with requisite reflection, where students can practice communicating the real research- and lab-based findings generated via their STEM coursework in modes authentic to the discourse practices expected in their majors and future professional fields. However, to enable STEM faculty and students to focus their energy and efforts in this direction, students must have the opportunity to develop foundational writing skills and practice—in areas like audience analysis and communication design—that can be transferred across disciplines.

To offer a more specific background, our efforts to create a science writing minor began in 2019 when the English department began a larger curriculum reform initiative. Since we had already failed six times over the previous decade to secure approval for a legitimate professional and/or technical writing concentration in the department, we altered our approach to building a robust program in science, technical, and professional writing by focusing on minors. Concentrating our efforts on creating writing minors offered numerous advantages. In particular, a minor at our university requires only 18 credits and, more importantly, UNLV policy allows students to “double-dip”—or count a single course toward multiple requirements—which meant that we could allow students to use up to two courses in their major to count toward the minor. This ensured that the pursuit of a minor would not impede a student’s progress toward graduation, even in a major with few elective options.

Structurally, our science writing minor requires 18 credit hours. These include four courses, or 1 credits, from those offered in the English department, and two courses, or six credits, designated by the college, department, or program in the sciences. Writing courses foster effective expert/public communication by training STEM students in specific rhetorical strategies that attend to issues of audience, translation, persuasion, and disciplinary discourse practices necessary to support the effective rhetorical training of future scientists, as well as explicit training in specific rhetorical strategies for scientists (e.g., Luzón) and “trans-scientific genres” (Mehlenbacher 1). These courses include many already existing in English, like document design, electronic documents and publication, and advanced professional communication, as well as some new courses, like a dedicated science writing course, that we have recently developed. As previously discussed, this combination of practice in discipline-specific discourse strategies and more transferable rhetorical principles helps future scientists to understand the relationships between

the expertise and skills they offer within a specific scientific community and the tensions and responsibilities that exist in translating that expertise to more general audiences.

The designated science courses include those with an emphasis in writing and/or disciplinary literacy (i.e., the “ways of knowing” that characterize a field), and offer discipline-specific, authentic writing tasks that help students to apply their rhetorical training to situations they are likely to encounter as professionals when communicating with both their peers and public audiences. These two approaches provide students a range of options for developing more fully as writers and *scientist-citizens*. All courses are offered regularly, ensuring that students will be able to complete the minor in any two-year period, and the courses approved to fulfill the requirements of each minor also dovetail with courses counting toward requirements or electives from the collaborating majors.

Our initial outreach for the science writing minor targeted the College of Science (2,500 majors), the School of Integrated Health Sciences (2,000 majors), the College of Nursing (1,600 majors), and the Psychology department, a major in our own college of Liberal Arts (1,500 majors). This outreach began by scheduling meetings with the Associate Dean of each college or school, as well as with the Chair of Psychology. To prepare for these meetings, we developed a unique set of talking points, a flexible script, a series of prompts, and a one-page FAQ handout. Interestingly, each administrator that we talked with recommended our first follow-up be with the director of their advising center; each advising center director was extremely enthusiastic about the potential for our science writing minor. We have since met with a few department chairs and faculty to further explore options and opportunities.

Our primary goals for each of these meetings were to discuss writing across the following contexts: the value of writing for their students, the ways faculty currently use writing in their courses, and the opportunities to collaborate on and support the incorporation of writing into the student experience more effectively and more efficiently. Since interdisciplinary collaboration among faculty was central to our program design, we wanted to foster “a shared social value of writing” (Arduser 20); we used stakeholder theory to pay particular attention to strategies for creating the reciprocal opportunities that would lead to sustainable partnerships among both individual faculty members and the majors/programs they represent (for more information on this process, see Carrion and Nagelhout).

As our cohort of interdisciplinary minors wends its way through the labyrinth of the academic approval process, we offer Introduction to Science Writing in the coming semester for the first time. Ultimately, our experience with all students in the minors, teaching the writing courses, and collaborating with our disciplinary colleagues will shape our program over time. Initially, we found that a focus on specific colleges allowed us to develop a curricular plan to adapt courses in our catalog and propose new courses, build on our core program principles, create assessment plans that drive interdisciplinary development, and meet the needs of specific science majors. These pragmatic considerations are an important reminder of the various stakeholders and responsibilities that must be balanced in this process: while developing *scientist-citizens* is the goal, we are

not doing so in a vacuum, but rather within a network of complex institutional needs and requirements.

The call for this special issue asked authors to “rethink the work that novice scientists engage with inside the classroom” in order to facilitate effective scientific citizenship. While STEM disciplinary classes and coursework provide one natural platform for this endeavor, we argue that interdisciplinary approaches—and specifically those involving faculty with explicit training and focus in rhetoric, writing, and communication—are required in order to ensure the development of sound and sustainable efforts toward this goal. In line with this assertion, we believe that collaboration among faculty and departments across disciplines is not only beneficial, but necessary—from a theoretical, pedagogical, and pragmatic perspective—and position our interdisciplinary science writing minor as one model for how we can facilitate such collaboration in a manageable and sustainable manner. We suggest our interdisciplinary science writing minor offers a model for how rhetoric and writing faculty can provide this foundation to ensure that STEM faculty can build upon these core skills in discipline-specific ways while not detracting from the ability to cover important disciplinary content.

This logistic consideration relates to what we see as the final benefit of the model we propose, which is its ability to overcome bureaucratic hurdles that can often thwart such efforts, both from a short- and long-term perspective. In particular, our interdisciplinary science writing model was grounded first and foremost in pedagogical considerations of the skills and experiences necessary to help students develop as *scientist-citizens*. But it was also developed with attention to the pragmatic considerations—related to issues of credit hours, progression toward degree, and faculty workload/course coverage—that can prevent an otherwise sound model from moving forward, flourishing, or sustaining over time. In this way, the collaborative approach that our model represents can allow STEM departments and faculty to continue the important work of fostering disciplinary scientific expertise, while also ensuring that students develop the integrated communication skills that will help them to be not simply scientific experts, but also the scientific citizens who can help us to navigate the myriad challenges—scientific, social, and cultural—that we’ll face moving forward.

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