East Tennessee State University
Digital Commons @ East Tennessee State University

ETSU Faculty Works

Faculty Works

Rewriting Disciplines: STEM Students' Longitudinal Approaches to Writing in (and across) the Disciplines

Anna Ruggles Gere
University of Michigan

Anna V. Knutson
East Tennessee State University, knutson@etsu.edu

Ryan McCarty
University of Michigan

Follow this and additional works at: https://dc.etsu.edu/etsu-works

Part of the Language and Literacy Education Commons

Citation Information

Rewriting Disciplines: STEM Students' Longitudinal Approaches to Writing in (and across) the Disciplines

Rewriting Disciplines: STEM Students' Longitudinal Approaches to Writing in (and across) the Disciplines

Anne Ruggles Gere, University of Michigan, Anna V. Knutson, East Tennessee State University, and Ryan McCarty, University of Michigan

Abstract: Drawing on three cases from a larger (N=169) longitudinal study of student writing development, this article shows how STEM students "rewrote" disciplines to suit their writerly purposes as they moved through their undergraduate years. Students made it clear that the institutional dimensions of disciplines, visible in administrative units or departments that control resources and records, remained visible in their mental landscapes, but they had a much more flexible view of the epistemological dimensions of disciplines. Rather than entering a field as novices aiming to emulate the writing of its experts, they drew on the intellectual resources of multiple disciplines in order to carry out their own projects. The goals and choices of these students suggest that the term new disciplinarity has implications for the ways WID is conceptualized. As theorized by Markovitch and Shinn (2011, 2012), new disciplinarity posits elasticity as a central feature of disciplines, calls the spaces between disciplines borderlands, and affirms the dynamic nature of projects and borderlands with the term temporality. As such, new disciplinarity offers terms and a theoretical framework that conceptualize the intellectual negotiations of students.

Much of the literature on the development of student writers and on WAC/WID includes the assumption that writing development is inextricably bound to the growth of expertise in a given discipline. Marilyn Sternglass (1977) narrates the writerly development of Joan and Carl, noting that Joan was "appropriately prepared to function in the discipline of psychology" (p. 174), and she observes that courses in communications taught Carl how to make his writing "fair and objective" and to understand its "power in influencing public opinion" (p. 180). Lee Ann Carroll (2002) notes that "Many disciplines… deliberately teach literacy practices" and references students who cite research-methods courses in specific fields as "places where they became more explicitly aware of the interplay between theory, research methods, and genre conventions" (p. 93). Similarly, Anne Beaufort (2007) offers a model of writing expertise grounded in disciplinary discourse community knowledge, highlighting both subject matter knowledge and genre knowledge. Chris Thaiss and Terry Zawacki (2006) posit three stages of development in which students progress from generalized rules to awareness of inconsistency to understanding of differences as "components of an articulated, nuanced idea of the discipline" (p. 110). A central WAC premise is the idea "that writing is highly situated and tied to a field's discourse and ways of knowing, and therefore Writing in the Disciplines (WID) is most effectively guided by those with expertise in that discipline" (Statement, 2014, p. 1).

At our university, the connection between disciplinary expertise and writing development was institutionalized in the upper level writing requirement. Established in 1978, the requirement was originally described as "junior/senior writing courses offered and required primarily in students' areas of concentration… designed to teach [students] the literacy required for effective learning and

---

communication in their disciplines" (Stock, 1983, pp. 195, 197). As the requirement became more established, its mission was articulated as follows: "To help LSA students recognize and master the writing conventions of their chosen discipline, so that, upon graduation, they are able to understand and communicate effectively the central concepts, approaches, and materials of their discipline" (Gere, Swofford, Silver, and Pugh, 2015, p. 246), thus reaffirming the relationship between disciplinary knowledge and writing ability. However, a recent study of this requirement revealed that 50% of students surveyed completed their upper-level writing requirement outside of their major, and that a particularly small number of students in the natural sciences fulfilled the requirement in their home disciplines, relying instead on courses in the humanities (Gere et al.). The fact that departments in the natural sciences didn't offer enough upper-level writing courses to accommodate all their majors offered one explanation for students' choices, but interviews and focus groups suggested that students made choices about writing courses for complicated and often highly individual reasons.

Our interest in learning more about how students understand discipline-focused writing and learning contributed to a larger five-year study (2011-2016) of 169 undergraduates, including 60 who minored in writing and 109 students who did not minor in writing but were academically and demographically similar to the sample drawn from the writing minor. Our data includes a full set of institutional and demographic information for each student; entry and exit surveys; entry and exit interviews; approximately 5,000 pieces of student writing; and electronic portfolios for writing minors composed at the beginning of their time in the writing minor (gateway eportfolios) and at the end of their undergraduate career (capstone eportfolios).

Because of our interest in deepening our understanding of writing in the natural sciences and/or Science, Technology, Engineering, and Math (STEM) disciplines, for the purposes of this study we identified STEM students among our participants. Since we sought not only to explore students' writing but also to illuminate their theorization of their learning and writing through interview data and reflective writing, we decided to look closely at STEM students who had also minored in writing. For this student population, we not only had interview data, but we also had rich reflective texts narrating their progress as students and writers. From the STEM majors among the writing minors in our study, we selected three participants. In each case, the student attempted to theorize relationships between writing in STEM and in other contexts, including the writing minor. The details of each case differ because the students saw their projects differently and adopted varying strategies, but they all share the goal of integrating STEM writing with writing in the humanities.

In one case, the student struggled to integrate writing from across the curriculum into a larger universal, though he ultimately gave up this project to conform to the institutional demands for writing in his discipline. In another case, the student developed a sense of her writing as a trajectory from the facts of scientific research to research-based polemics in advocacy writing, and ultimately to creative fiction that somewhat blurred disciplinary boundaries by drawing on what the student considered to be "valid" research. The third student developed an original and sustainable integration of writing from STEM, humanities, and non-academic contexts, viewing his project as a meshing of epistemologies and forms from across all three domains. In so doing, all of these students worked in the borderlands, a term drawn from Marcovich and Shinn (2011, 2012) to describe spaces between disciplines where projects are carried out. The sections that follow provide an in-depth look at these three cases, showing how each student worked across multiple disciplines and helping to address our central question: How do students in STEM fields negotiate, across multiple years, the complexities of relationships among disciplines, and how do these negotiations inform our understanding of disciplines and, ultimately, of WID?

Three Case Studies: The Lived Experiences of Undergraduate STEM Writers

Drawing on participants' writing from the archive collected by our study as well as the works that they chose to showcase in their eportfolios, alongside their perspectives on their learning and writing development communicated through interview data and reflections written for their eportfolios in the writing minor, we traced the nuanced and complex ways that undergraduate STEM majors understood their development as learners and writers within and beyond their respective academic disciplines. In order to demonstrate how many students existed at times on the borderlands between seemingly stable disciplinary affiliations, we offer the following case studies of three students: Zach,[1] a pre-med student majoring in ecology and evolutionary biology who struggled with synthesizing STEM writing with other types of writing; Erica, a double-major in Spanish and cellular and molecular biology, also pre-med, who blurred boundaries between STEM and other disciplines by writing about scientific topics in other contexts and genres; and finally, Jonah, who switched from pre-med with a major in evolutionary anthropology, becoming an English major late in his undergraduate career—this change, however, did not create a break or boundary in his understanding of writing from disciplines. Of the three cases, Jonah demonstrated the most sophisticated strategies for reconciling types of writing from multiple disciplines.

Across the three cases, we found that although our assumptions about STEM writers and their views on writing were occasionally reaffirmed, the participants overall tended to surprise us by contradicting our preconceptions or by providing unique and unexpected twists on older ideas. On one hand, we saw STEM writers who conformed to traditional ideas about writing in science. On the other hand, we saw our participants complicating commonly-held views like these:

- The relationship between STEM and humanities writing characterized as facts vs. opinion or artifice;
- STEM writing as "clear and concise";
- STEM writing as inherently "different" from other types of writing.

In other words, these students approached writing in the STEM fields in ways that we did not expect at all, illustrating a much more agentive approach to writing. These findings suggested that, while students were concerned with developing abilities to write for audiences within their disciplines, they were not always willing to forego the kinds of broader meaning-making that they associated with a more rounded presentation of their ideas. The participants in this study ultimately surprised us by demonstrating that:

- STEM writing is related to other disciplinary forms;
- STEM students are more aware of the value of writing in their discipline than we might assume.

Zach: "An undergraduate writer seeking to synthesize science and meaning"

At first glance, Zach seemed to maintain a clear dichotomy between STEM and non-STEM writing, just as we had assumed we would see in STEM writers in general. For him there was a definite delineation between "scientific" and what he termed "interpretive" writing, as he literally divided them in separate boxes in the structure of his eportfolio for the capstone course in the writing minor (see Image 1). Even his choice of terms suggested rigid differences not only in departments or schools, but in epistemological approaches to writing. His STEM writing—an introductory-level biology essay on deforestation, an upper-level ecology and evolutionary biology "research project" on the human immune system, and a presentation on fungal diversity completed as part of an intensive summer program at the university's Biostation (a field research station where undergraduates can take classes, often described as "summer camp for science") is scientific, exemplifying distinct disciplinary notions of observation and reporting, with a notable under-emphasis on argument or broader implications, which he described as "streamlined"

in the upper-level text as compared to the broader implications he tried to suggest in earlier STEM writing. On the other hand, his non-STEM writing—which he terms "interpretive" writing—including work from English for his first-year composition course and a philosophy course on religion, is inherently different, focused on explanation of a broader concept of what he called "meaning," separate from the observational focus of scientific writing.

Image 1: Zach's Capstone Eportfolio Organization
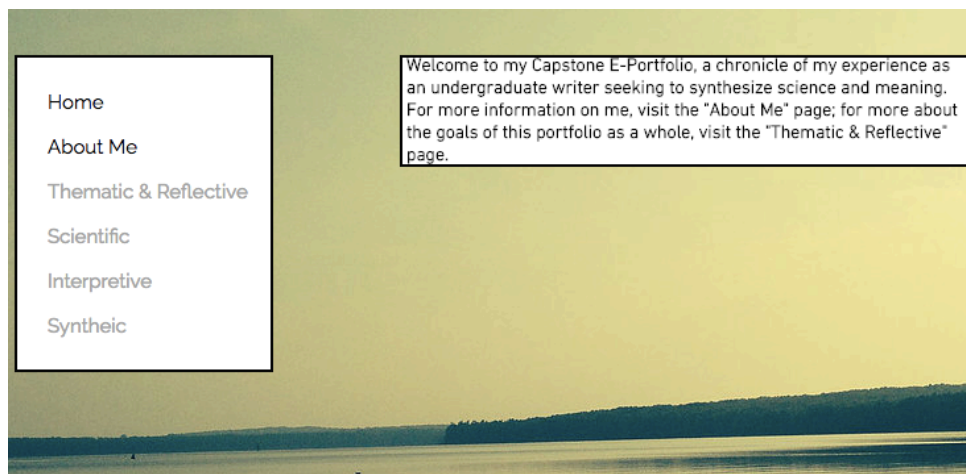
Though he had a sense that these two views could work together, he still maintained a sense of difference between them, insisting that scientific and interpretive approaches can and should be simultaneously leveraged in an attempt to fully understand and convey "meaning," a quality that, in his view, is both empirical and personal, with rigorous methodology that does not hamper the writer's ability to move the discussion of implications to a more general series of appeals. So, for Zach, writing development was a process of learning to write in ways that were both acceptable in academic contexts and responsive to his desire to engage with this broader meaning. He chronicled this often-rocky process in his "Writer's Evolution Essay," a reflective writing assignment for the capstone course in the writing minor. This essay began with examples of his first unsuccessful attempts to integrate meaning into a piece of STEM writing for a 100-level course, in which an assignment asked for "a journalistic analysis of a current environmental issue facing the world." Zach noted in this reflective essay that he "took care to accurately chronicle the rising atmospheric carbon levels in a relatively impartial way prior to the conclusion," then highlighted in red the pieces of his conclusion that were identified as inappropriate for the context, and argued that these phrases are some of the best examples of his early experiments with writing broader implications:

> While the fiscal risks pointed out by Republicans are certainly nothing to scoff at, [a greater misery than 11% unemployment will befall the globe if immediate steps are not taken to halt or reverse the effects of carbon emissions.] While the prospect of being jobless may seem the worst possible fate for any American, the thought of future generations not being able to breathe the earth's air without aid should be much more frightening. If the price of cleaning up the way the world produces energy is economic uncertainty, the common man must be willing to sacrifice for a short amount of time in order to allow for the world to break its dependence on oil by allowing the renewable industries to take root.

While some of these phrases might be ill-considered in hindsight, bordering sometimes on the hyperbolic as they do, Zach spoke of them in terms of their applicability to broader audiences who might appreciate

the connection of empirical work to more meaningful implications, suggesting that the spirit of scientific inquiry excited him so that he "simply couldn't help injecting a deeper moral implication at the very end to leave a quizzical taste in the mouths of [his] readers." For Zach, these moments of non-STEM moralizing make an otherwise monologic text into a more complete expression, with a wider scope than the one imagined by the instructor.

Ultimately, Zach regretfully conceded to the process of revising his language to excise the "meaning" he identified. In his narrative of writing development, he learned to write in a register that satisfied his instructors, propelling him through a successful undergraduate career with a 3.9 GPA and acceptance into medical school. However, he did not see these successes as indicators of development in the kinds of writing that he valued. In his exit interview, he reflected:

> I guess the main lesson about development in my portfolio would have to be more with that separation that I talked about—how maybe at the start of a college career when you're writing about science, there's a tendency to not be able to separate it from deeper meaning or non-scientific explanations. Then as an education gets more streamlined for the sciences—you lose that abstract point of view when you're writing about these things.

It is important to note that he described his development as a writer in the STEM fields here as a process of streamlining and loss, a sense that he tried to push back against in his final capstone project, a text that walks the line between science communication and a philosophical tract on "the search for complement as an alternative to conflict" between science and faith.

To the extent that he was able to blend two kinds of writing—one highlighting STEM's objectivity and another the personal voice of reflective writing—he successfully bridged the separation that he describes as the biggest obstacle to his overall intellectual and writerly development. However, these two registers are notably compartmentalized, existing in distinct paragraphs or sections and rarely meshing as they did in the earlier writing he highlights in his Writer's Evolution essay, suggesting that he had effectively learned and perhaps internalized strictly-divided notions of disciplinarity.

In one section of his capstone project for the writing minor, the division of registers is clearly linked to the purpose of the paragraphs. Zach moved from a less-scientific register when connecting concepts to readers' own experiences to a more distant STEM register when discussing the generalizable aspects of the topic at hand:

> So you may unequivocally believe that you are seeing everything around you at any time, many key pieces of information—infrared or ultraviolet light, for example—are slipping through the cracks. To contextualize this further, image [sic] how different your perception of your identity would be if you couldn't see in color. How strongly would you feel attached to the University of Michigan if you couldn't proclaim to "bleed maize & blue"?

Clearly designed to help readers relate the preceding discussion of perception and the light spectrum to personal experience, phrasing in the imperative second person and using an appeal to university team pride, this paragraph provided one of the most extreme examples of Zach's sense of engaging fuller "meaning" by meshing scientific registers with other less-academic registers. However, he seemed to have learned not to blend too heavily, because it is not until the next paragraph that a more recognizable STEM register resurfaces:

> This exemplary model of perception can be reasonably applied to explain the sensation of self-awareness as well, since both are based on similar initial inputs (environmental cues received by sensory neurons) and outputs (an integrated representation of our current status relative to

the world around us). Relatedly, although one's conception of their identity may seem holistic and unshakeable, it is reasonable to assume that there are potential aspects of self-awareness that the brain simply doesn't have the capacity to code for.

The move to the third person is strong in wordings like "one's conception" and "it is reasonable to assume," only breaking down in his reference to "the world around us," though this occurred in the explanatory parenthetical aside, which might explain his confiding tone. This pattern persisted throughout his project. When relating disciplinary information to broader contexts, one register dominated. When introducing new disciplinary concepts or analyzing the work that concepts do, he reverted to the other. This suggests that perhaps he has been thoroughly trained to reduce his earlier elastic ability to weave science and meaning together, as suggested by his reflection above on streamlining and the loss that comes with specialization.

Indeed, looking back on his time in the writing minor and his work trying to synthesize science and meaning, Zach seemed to close the book on this kind of borderlands writing. He recognized its value and pushed back against the strict disciplinary divisions between STEM and humanities, but felt compelled for professional reasons to conform to what he found to be a monologic discourse. He emphasized the extent to which broader meaning-centered writing must be left behind in his exit interview when discussing his capstone project and eportfolio: "I felt like that could be my last chance to do this kind of thing. I really focused on trying to capture what I was feeling at the time and make it a way that I could look back at writing someday and think of it as I was doing it then—if that makes sense."

For Zach, then, the borderlands projects that he found most meaningful were extremely bounded in time. The incorporation of resources from across his academic experiences was valuable, but not long-lasting; he noted that it would be valuable to look back on these projects, though there is little sense that he felt like there would be any chance (or reason) to resurrect them in the future. Zach's dismissal of these meaning-making practices suggests that he recognizes a key difference in the goals of writing in college classes: a difference that might correspond to a similar divide between WAC and WID conceptions of writing. As Monroe (2003) notes in his critique of the strict divides that have grown up between the two: "While WAC emphasizes the commonality, portability, and communicability of writing practices, WID emphasizes disciplinary differences, diversity, and heterogeneity" (4). That Zach ultimately feels as if he must choose the more siloed discourses of a single discipline might reflect a pragmatic position that is a direct challenge to more elastic views of disciplinarity.

Erica: "A Scientist's Progression Towards Creative Writing"

In her interviews and capstone eportfolio, Erica, a pre-med student who double-majored in Spanish and cellular and molecular biology while minoring in writing, told a story of tentative synthesis. Her narrative of her own writing development in college was characterized by a marked tension between humanities and STEM writing, which ultimately revealed blurred disciplinary boundaries in the form of the somewhat uneasy coexistence of a STEM topic (addiction) within what she categorized as a humanities genre (fiction), in her writing minor capstone project. Although she tended to view STEM writing and other types of writing as being inherently dissimilar, her choice to write about STEM topics in other disciplinary genres revealed a more nuanced understanding of disciplinarity that seemed to occupy a borderlands position. Additionally, Erica challenged some stereotypical views of STEM writing by valuing it much more highly than humanities writing: she viewed her research lab as a critical site of writing development, largely due to the opportunity it provided her to collaborate with experienced researchers in her field. In Erica's view, to succeed in her chosen STEM field, medicine, required writing ability, which is why she chose to minor in writing. Thus, while Erica viewed science and humanities writing as inherently different, she did view scientific writing as essential to fulfilling her professional goals.

In her interviews, she consistently made a clear distinction between STEM writing, which she enjoyed and felt comfortable doing, and humanities writing, which she hated. She described STEM writing as "very straightforward: short sentences, to the point, and it's very organized—just introduction, methods, background, conclusion, that sort of thing. That's what I mostly do." In this quote, Erica confirmed one commonly held preconception about STEM writing, which is that it is clear and concise, as well as her own sense of affiliation and comfort with that type of writing: STEM writing is "what [she] mostly do[es]."

In contrast, she described humanities writing as inherently different, stating, "It is…very different language used in the writing for science. Different format.… Just APA versus MLA type of stuff. But yeah, very different." Here, Erica confirmed another preconception about STEM writing: in her interviews, Erica seemed quite invested in reinforcing the boundary between humanities writing and STEM writing, describing the types of writing as "different" three times in this brief quote. Additionally, her description of humanities writing was much more negative: "These five-paragraph typical essays that you write at the beginning of college, I dreaded it. I hated doing that. I would rather study science for two weeks than write one of those papers." In these comments Erica appeared to exemplify the student who sees writing as discipline-focused: the two types of writing, in her view, were "very different."

While at first glance it may seem as though Erica saw no connection between the two types of writing, it is intriguing that she seemed to view them both as being extremely formulaic. In interviews, Erica referred to STEM writing as "a plug and chug system…like a Mad Lib, but for science." Similarly, she viewed humanities writing as being formulaic and repetitive: of humanities writing, she stated, "Writing a paper about the symbolism of this and the symbolism of this and the symbolism of this, it…becomes almost the same paper. You could almost copy and paste it, just change the words, a couple of the examples around." In other words, while Erica seemed committed to reinforcing the boundary between humanities writing and STEM writing, she also viewed them as both prioritizing formulaic, rigid genres.

Another surprising finding from Erica was that she viewed her goals as a scientist and her goals as an academic writer as being inextricably bound: this was illustrated by the fact that she viewed the lab as a critical site of writing development, and that her primary motivation for minoring in writing was for her professional development as a scientist. When asked about her writing development as a STEM major, she stated, "Really, my lab is where I learned how to do it all." And when asked why she had minored in writing despite her apparent discomfort with her early writing classes, Erica said, "It was my lab.… I kind of realized that my very narrow-minded thought process of not needing to be a strong writer in the medical field was just not accurate. That's kind of what led me back." In other words, the writing tasks and processes that she encountered while writing in the lab not only challenged her as a writer, but they inspired her to seek out further writing instruction by declaring the writing minor.

The boundaries that Erica seemed to have established in her interviews between STEM and humanities writing started to break down and blur, however, when we analyzed Erica's capstone eportfolio (Image 2). In her eportfolio, Erica framed her story of writing development—at least in the context of the minor in writing—as a trajectory from STEM writing to creative writing; the subtitle of her capstone eportfolio narrated her project as "A scientist's progression towards creative writing."

However, Erica's trajectory from science writing to creative writing represents a change in genre, but not in content: all of the key pieces that she described when narrating her writing development dealt with drug addiction, a topic that she had studied academically as a STEM student and professionally through her work at a rehabilitation facility. Her stated goals for her writing minor capstone project, a work of fiction about drug addiction, were to "tak[e] the topic of addiction and creat[e] an informed piece of fiction with heavy academic and field-based research components," which, in many ways, she did. Of the piece, she said, "I had never written creative writing before. I had written a few papers on drug addiction. They were progressing in that direction, less fact-based… Then it was less of a scientific, factually-based paper… Then I just felt like creative writing was the next piece."

Image 2: Erica's Capstone Eportfolio Home Page
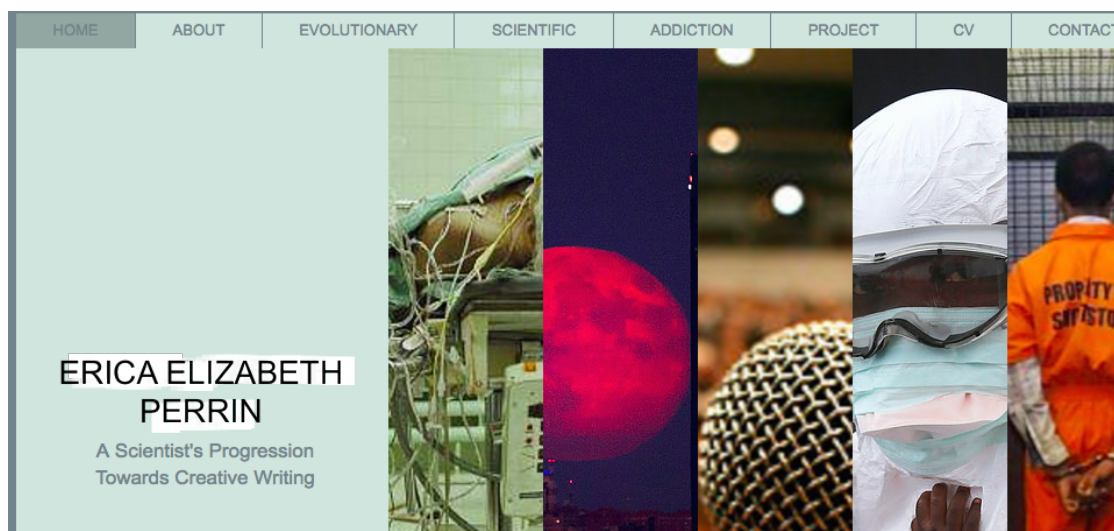
Despite Erica's goal to create fiction grounded in research, the status of "reality" or "truth" in her understanding of her own writing development was quite complicated. In keeping with more stereotypical views of disciplinary writing styles, Erica seemed to associate STEM writing with truth and humanities or creative writing with artifice. Of STEM writing, she said,

> Well, it's just…factually-based, most of it. You research a topic. You pull from a lot of different sources. You can come up with novel ideas, but it's meant to be able to be read with ease. It's not something that you get to have an opinion about. It has to be supported. There isn't a lot of room for stylistic manipulation at all. It's cut and dry. That's what I'm used to.

In contrast, she described creative writing as such: "You can say whatever you want in a creative writing piece. It doesn't have to be backed up. The biggest thing that's different for me is writing opinions. That's something I don't do ever in writing is writing what your opinion is." However, these views were complicated, of course, by the fact that the creative writing pieces that she composed for her capstone eportfolio were supported by knowledge—truth, if you will—that she had obtained through her research and her experience working with addicts. Even the visual presentation of her eportfolio, in which she incorporated images from a photojournalist project documenting the lives of addicts, relied on true accounts of addiction to, in her words, "put a face and a story with the names."

While the writing itself challenged many stereotypes about disciplinary writing, Erica's own perspectives on humanities and STEM writing seemed to fall back on more predictable preconceptions. In this way, she presented a fascinating example of the ways students who work in the borderlands between disciplines may not always be able to describe the integration they are attempting to accomplish, thus raising questions about the role of metacognitive awareness in writing development in and across the disciplines.

Jonah: "English (and More Specifically, Writing) is a Science"

Our third case, Jonah, presented interesting divergences from Zach and Erica, not only in his decision to take a B.S. in English rather than completing his pre-med studies in evolutionary anthropology, but in his general sense of comfort in straddling the structures and epistemologies that are purported to divide disciplines. Though he began his time in the writing minor convinced that he was "a pre-med student with a writer's brain," suggesting the normal dichotomies in which medical students aren't writers and

people with writerly brains aren't going to medical school, by the time he was ready to graduate he had come to see these categories as much more porous and interrelated, with rich possibilities for working on borderland projects that span multiple disciplines, styles, and epistemologies.

Like Zach and Erica, his understanding of how to taxonomize his experiences with writing across his college career was well-illustrated in the organizational scheme of his Capstone eportfolio for the writing minor (see Image 3). He explained his choice of a molecular structure as a layout, saying: "Mostly I wanted it to reflect the fact that I'm getting a bachelor of science in English. I wanted it because it shaped me, I think, and it has affected how I view things. Even if it's not necessarily reflected in my writing, I think it has affected me. I wanted that to show."

Image 3: Jonah's Capstone Eportfolio Writing Sample Organization
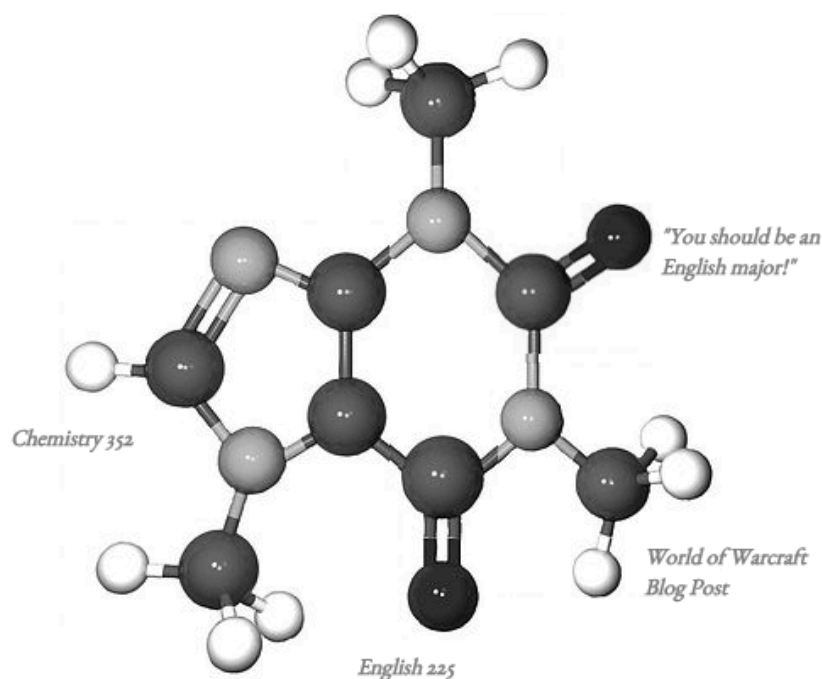
Recognizing that his writing repertoire drew on experiences in courses in very different disciplines, Jonah drew a picture of himself as a writer who excelled at finding connections where others might not see them. He noted that each course and its respective writing sample "represent different aspects of [his] growth as a writer," suggesting that, like a molecule, each part contributes to a larger and more complex whole. Therefore, like Zach and Erica, Jonah understood his writing to be bound up in disciplines and the rhetorical requirements of other specific contexts, but he was much more comfortable moving across these boundaries, crafting projects that were well-suited to the expectations of his audience, though drawing on resources from far afield.

Again, the final project that Jonah developed for the writing minor provided him with a platform to highlight his ability to enact such fluid movement. Building on the success of a blog post he had previously written about World of Warcraft, an immense online gaming franchise, Jonah constructed a multimodal introduction to the game's community, providing explanations of everything from basic icons to the behaviors of players who had mastered the game. He suggested a link between the development of a gaming community, with individuals and pieces adding up to create a world, and his sense of his writing development in which, "Each section is a part of a greater whole; each page, each essay, each project tells a

more whole story of me as a writer. Individually, they are small—they are atoms. Together, they are a much bigger—they are an entity, my being."

However, such a statement of integrated writing is much less complex than his discussions of the decisions he made in each text. When asked about the purpose of the World of Warcraft project, Jonah suggested that, while he was most interested in discussing the community aspects of gaming, he spent most of his time thinking about how best to convey information clearly to novices, especially given the complex structure of gameplay and player-centered feedback. He described one page this way:

> It's a scientific approach. If you're playing the game, and you're doing something right or wrong, people will actually put things on a website, and analyze them, and rank you compared to other players. This is a lot of the time where I would take that scientific approach where I would try to say as much as I can about numbers and facts, without going too far above people's heads, but also without dumbing it down too much.

His sense that the writing in this project was "scientific" might not occur to a reader at first: it is often phrased in the first person, with moments of reflection on the game that border on sentimentality. However, Jonah seemed to recognize a transfer of something much more nuanced than surface-level style. What he saw as STEM-inflected writing is writing that maintains a particular type of analytic logic, with an explanatory purpose that broke up complexities to understand them more fully.

In his discussion of a piece of writing from a chemistry course, Jonah describes this purpose in familiar terms, saying that in "sciences, there was analysis, but a lot of it was summary. Even when you did have analysis it was very straightforward." This particular writing sample, "Examining Ricin and Its Vaccine Derivatives, RiVax and RTA1-33/44-198," did indeed spend a good deal of time summarizing, that is, explaining what was chemically important about these derivatives. Sentences were direct, frequently fronting the subject ("RiVax, the first of the two isoforms, is still under clinical development"; "Ricin's toxicity comes from its depurination of adenosine in ribosomal RNA at the key sequence known as the sarcin-ricin loop") and often defined basic concepts as a process of building up to more specific knowledge: "The other isoform, RTA1-33/44-198 (also known as RVEc), is the smallest of the three isoforms and varies to a much greater degree than the others. It is made of a much shorter version of the A chain, and incorporates a new disulfide linkage to stabilize the molecule."

Significantly, when compared to the ways that writing functions in Jonah's WoW project, there are overlaps that reinforced his sense that he was incorporating elements from his "science writing." This is clear in an excerpt in which Jonah describes one type of player role (the DPS):

> DPS stands for "damage per second" and players in this role are the main source of damage against enemies. Throughout a fight, DPS players need to prioritize any number of targets and avoid as much damage as possible. While healers will certainly help, DPS are the most prone to boss mechanics that will cause too much damage to heal through.

As in the excerpt from his chemistry writing, the explanatory mode of this excerpt impels Jonah to define, gloss, and move toward nuance, a logic that he associates explicitly with the kinds of writing he learned to do in his chemistry and other STEM courses, but that he considers a resource that he can draw on for other projects outside of his disciplinary STEM writing contexts.

Thus, like Zach and Erica, Jonah's understanding of STEM writing entailed an informative mode that privileged clarity above all other considerations, but he also broke from the former insofar as he insisted that writing features from STEM disciplines can be deployed in large-scale authentic projects that require a range of rhetorical moves to engage with a range of purposes and audience needs.

Implications

Analysis of these three cases demonstrated complex negotiations across disciplinary boundaries as students "rewrote" disciplines to suit their own writerly purposes. As a result, our thinking about the meaning of "discipline" was called into question, particularly the epistemological dimension of that term. Students in this study made it clear that the institutional dimension of disciplines visible in administrative units or departments that controlled records and resources were still part of their mental landscapes; however, students' ways of thinking about their various projects showed considerable flexibility about intellectual boundaries between these various institutional locations. As we have discussed above, Zach attempted to integrate or create a more unified whole of his writing in science with his writing in areas where he saw interpretation and the search for what he termed "meaning" as more prominent. Even though he ultimately felt that he had to step away from this project of integration and conform to the discourses of medical school, he affirmed his attempt to blend writing from two different disciplines. Erica, who saw her development as a scientist integrally linked to her development as a writer, crossed boundaries by adopting multiple genres as she moved from discourses of science to writing to advocate for aspects of science and convey scientific knowledge via creative writing. In her conviction that she needed to develop as a writer in order to become a better scientist, she positioned herself in the borderlands between the activities of both disciplines. For Jonah, growth in rhetorical awareness was a goal that extended across all of his studies, and his was the most "successful" integration in that he did not feel the need to step away from the borderlands. In part his focus on rhetorical awareness may have shifted his integration of STEM and humanities writing to a higher, more theoretical, and therefore sustainable level. Jonah's continued integration of scientific and humanities writing may also result from his interest in World of Warcraft, an extracurricular activity that led to his first job after graduation. The ongoing project of WoW became a borderlands space where he could continue to integrate writing from two disciplinary areas.

For all three of these students, discipline did not mean an academic area that they entered as novices with the goal of learning to emulate the writing of experts therein. Rather, their choices and reflections suggested a much more flexible view of discipline, one that allowed them to draw on the intellectual resources of multiple disciplines in order to carry out the highly individualized projects and goals that they wanted to pursue. We came to see that their undergraduate experiences exemplified a version of new disciplinarity, which resembles "disciplinarity" as articulated by Paul Prior (1998) in that it acknowledges complex configurations of networks, privileges objects of study, and posits genesis in audiences and relationships. New disciplinarity as theorized by Marcovich and Shinn (2011, 2012) acknowledges the ongoing existence of disciplines, in both their institutional/administrative and epistemological aspects, but it posits elasticity as a central feature of disciplines. Elasticity describes these students' capacity to move from one discipline to a space where they can carry out projects—such as writing creatively about the science of substance abuse—of their own devising. New disciplinarity calls the spaces where such projects are enacted borderlands, a term that acknowledges the dynamic spaces that exist outside disciplines but are closely connected to them, spaces where intersections and collaborations, like Jonah's work on WoW, can occur. Temporality, the final term associated with new disciplinarity, affirms the dynamic, ever-changing nature of projects and the borderlands in which they occur and speaks to the limited duration of such projects, an aspect demonstrated by Zach's time-bound project of integrating science and "meaning" as he defined it before he moved away from this project toward the discourses of medicine. These four terms of new disciplinarity—elasticity, project, borderlands, and temporality—provide a way of theorizing the experiences and reflections of the undergraduates in this study.

We believe that the value of the framework of new disciplinarity extends beyond this particular study of undergraduates and has implications for how WID is conceptualized. The currently contested nature of the term—and enactments surrounding—discipline suggest the need for a more flexible way of

conceptualizing the intellectual negotiations of students as well as of scholars and researchers. New disciplinarity offers terms and a theoretical framework that come much closer to actual enactments than does the traditional concept of discipline. Indeed, the very project of WID itself can be described in terms of new disciplinarity. Each course that carries the WID label represents a project that occurs in the borderlands between a given field and writing studies. Elasticity from both areas is essential to the success of the WID course, and the course is bound by the temporality of the semester. Seen from this perspective, the "in" of WID can designate the framework of new disciplinarity in which the lived experiences of student writers and their instructors can be captured more accurately.

References

Beaufort, Anne. (2007). *College writing and beyond: A new framework for university writing instruction*. Boulder: University Press of Colorado.

Carroll, Lee Ann. (2002). *Rehearsing new roles: How college students develop as writers*. Carbondale, IL: Southern Illinois University Press.

Gere, Anne Ruggles, Swofford, Sarah C., Silver, Naomi, & Pugh, Melody. (2015). Interrogating disciplines/disciplinarity in WAC/WID: An institutional study. *College Composition and Communication, 67*(2), 243-266.

Marcovich, Anne & Shinn, Terry. (2012). Regimes of science production and diffusion: Towards a transverse organization of knowledge. *Scientiae Studia, 10*, 33–64.

Marcovich, Anne. & Shinn, Terry. (2011). Where is disciplinarity going? Meeting on the borderland." *Social Science Information, 50,* 582–606.

Monroe, Jonathan. (2003). Writing and the disciplines. *Peer Review, 6*(1), 4-7.

Prior, Paul. (1998). *Writing disciplinarity: A sociohistorical account of literate activity in the academy*. New York: Routledge.

Statement of WAC Principles and Practices. (2014). WAC Clearinghouse.

Sternglass, Marilyn S. (1977). *Time to know them: A longitudinal study of writing and learning at the college level*. Mahweh, NJ: Erlbaum.

Stock, Patricia L. (1983). A comprehensive literacy program: The English composition board. *fforum: a newsletter of the English Composition Board, University of Michigan, 4*(2), 192–200.

Thaiss, Chris, & Zawacki, Terry Myers. (2006). *Engaged writers and dynamic disciplines: Research on the academic writing life*. Portsmouth, NH: Heinemann.

Note

1. This and the other student names mentioned are all pseudonyms.

Contact Information

Anne Ruggles Gere
Gertrude Buck Collegiate Professor
Arthur F. Thurnau Professor
Director, Sweetland Center for Writing
School of Education
University of Michigan
Ann Arbor, MI 48109
Email: argere@umich.edu

Anna V. Knutson
Assistant Professor

Department of Literature and Language
East Tennessee State University
Johnson City, TN 37614
Email: knutson@etsu.edu

Ryan McCarthy
PhD Candidate
Joint Program in English and Education
University of Michigan
Ann Arbor, MI 48109
Email: ryanmcca@mich.edu

Complete APA Citation

Gere, Anne Ruggles, Knutson, Anna V., & McCarthy, Ryan. (2018, November 3). Rewriting disciplines: STEM students' longitudinal approaches to writing in (and across) the disciplines. [Special issue on transdisciplinary and translingual challenges for WAC/WID.] *Across the Disciplines, 15*(3), 63-75. Retrieved from http://wac.colostate.edu/atd/trans_wac/gereetal2018.pdf