Like Speaking a Blueprint: STEM Writing Tutors' Disciplinary and Writing Identities

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Abstract: This paper argues that undergraduate peer-to-peer instruction in STEM writing provides valuable insights into the relationship between writing and disciplinary identity. Drawing on observation and interview data from a writing center staffed by undergraduate STEM students, I argue that STEM writing tutors construct disciplinary identities by drawing on coursework and extracurricular writing experiences that contribute to rhetorical knowledge. Tutors then leverage this knowledge and experience within tutoring sessions by engaging in explicit genre instruction and disciplinary socialization.

It is a busy evening in the writing center. Raul[1], an aeronautical engineering major, is helping a student, Chris, with a lab report for a technical writing class.

> Chris: I also didn't understand, what does it mean by "synthesize and interpret," what does that mean, how do I put that into a tech report? Do I write down what's the results in more of an explanatory way, or…?
>
> Raul: Yeah, so the idea is that you will essentially have to pull all these different data points and like, connect them into one coherent narrative in your paper, and then from that, you'll also have to be able to interpret the meaning of that data…And so you'll be using evidence from your different sources…to create…um…I use the term narrative, but I guess in this case you're just trying to present an argument to see which antenna would be the best antenna to use.
>
> C: Um, well, in the case study it says, you know what the recommendation is and everything. But I don't really know how to interpret this raw data in a way that will make sense…And I didn't really know what data to use for the argument. So I'm supposed to prove that the dish is better than the dipole.
>
> R: Wow, they're asking you to do some engineering type work, aren't they? [Laughs]

As the session continues, Raul answers more questions about the conventions of lab reports, describing the function of methods, results, and discussion sections as they relate to the genre's overall goals. He also shows Chris how to cite personal communication, like emails, in APA style, and how to create equations in Google Docs using shortcuts rather than inserting symbols by hand.

Throughout the session, Raul volleys between providing technical instruction and communicating genre knowledge, simultaneously occupying the roles of engineering expert and writing tutor to help Chris better

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understand the requirements of his assignment. Tutors like Raul, who come from STEM backgrounds and have been trained in writing center pedagogy, embody the "elasticity" of disciplinary identity (Marcovich & Shinn, 2011), as they maneuver within multiple fields of expertise and draw on multiple ways of knowing and doing (Carter, 2007) to define themselves in relation to other students. STEM writing tutors also complicate the ways that disciplinary identity and writing tutor identity have been considered in WAC/WID and writing center scholarship.

Disciplinary identity has long been of interest in WID research that seeks to better understand the role of writing as learners are socialized into disciplinary communities (Berkenkotter & Huckin, 1994; Carter et al., 2007; Dressen-Hammouda, 2008), and some scholars recommend more discipline-specific peer mentoring opportunities for STEM writers (Simpson et al., 2015). Although much WID research on the development of disciplinary knowledge and identity focuses on novices (students) being introduced to the discipline's ways of writing and knowing by experts (faculty/professionals), less attention has been given to how students develop these identities through peer tutoring interactions, where the constant negotiation of peer and expert identities is well-documented (Agne & Muller, 2019; Fitzgerald & Ianetta, 2015; Grouling & Buck, 2017; Shamoon & Burns, 1995; Trimbur, 1987). Recently, writing center scholars have offered valuable practical advice for working with science writers (Shome, 2019) and integrating writing centers into engineering programs (Walker, 2013). While these studies provide some insight into the role of writing centers in WAC and WID programs, they largely focus on undergraduate and graduate tutors from English and humanities backgrounds, who cross disciplinary boundaries to help STEM students with writing.

In this paper, I argue that undergraduate peer-to-peer instruction in STEM writing offers new possibilities for understanding the relationship between writing and disciplinary identity. Below, I briefly summarize previous scholarship on identity as it pertains to STEM, writing, and tutoring. I then analyze multiple forms of data from a writing center staffed by undergraduate STEM students, indicating that STEM writing tutors (a) construct disciplinary identities in part by drawing on coursework and extracurricular writing experiences that contribute to rhetorical knowledge, and (b) leverage this knowledge and experience within tutoring sessions by engaging in explicit genre instruction and disciplinary socialization.

Identity, Knowledge, and Writing in the Disciplines: Relevant Scholarship

Self-and Social Identities

Identity has been theorized in myriad ways to better understand how writers internalize and build knowledge, view themselves as members of disciplinary communities, and participate in the social processes of learning. For the purposes of this study, I use the term "identity" to refer to:

1. writers' self-identities, the "self description that allows the individual to place themselves within the various worlds they inhabit" (Gao, Heliot, & Riley, 2010, pp. 23-24; see also Burke, 1980; Stryker, 1987), and
2. the social identities co-constructed through learners' shared activities, knowledge-making, and professional practices (Jacoby & Ochs, 1995; Tajfel, 1978).

Self-identities are "used by individuals for the purpose of defining themselves and regulating their behavior" (Niedenthal & Beike, 1997, p. 106), and can be observed by listening to individuals talk about their backgrounds, behaviors, and relationships. Self-identities related to disciplinary and/or writing identity may be intrinsic (e.g., "I'm very tech-minded") or relational (e.g., "I'm always the proofreader for my roommates") (Neidenthal & Beike, 1997; Turner, 1985). Observing self-identity helps us understand how

novice learners or experienced professionals see themselves as members of a community, and the knowledge, experiences, and relationships that have contributed to that sense of belonging.

However, self-identity alone is insufficient to understanding the multidimensional identities that writers may form, particularly because much of the work of identity construction occurs through "communication with others in the society" (Niedenthal & Bieke, 1997, p. 112). These social identities are best observed by studying various kinds of talk between individuals. Observing tutoring sessions, for instance, can indicate how tutors and writers "play out, reaffirm, challenge, maintain, and modify their various (and complexly multiple) social identities as turn-by-turn talk unfolds" (Jacoby & Ochs, 1995, p. 177). Examining both self-identity and co-constructed social identity presents a richer understanding of writers' identities as they are understood by writers themselves and as they play out and unfold through knowledge-making processes with others.

The Role of Knowledge

Like identity, knowledge has been found to be simultaneously personal and social, intrinsic and relational (Cook & Brown, 1999; Van de Ven & Johnson, 2006). Gao, Heliot, and Riley's (2010) work combines knowledge-building and transfer with the psychology of identity, arguing that "there is a reciprocal relationship between knowledge and identity in which both the individual psychological perspective and the social identity of the individual matters" (p. 5). Knowledge-making is particularly important in the formation and enactment of disciplinary and professional identities, as writers associate their membership in a field with their growing level of expertise.

Disciplinary identity has been theorized by WID scholars through its connections to socialization, knowledge-sharing, and activities that encourage apprenticeship (Carter et al., 2007; Dressen-Hammouda, 2008; Emerson, 2019), all of which can be facilitated through writing. Indeed, Emerson (2019) notes that "within disciplinary communities, literacy…is positioned as one of the central practices which defines an individual's identity as a member of that community" (p. 172). While several studies have examined the relationship between writing knowledge and disciplinary identity in professional STEM writers, as well as in faculty, graduate students, and undergraduates participating in WAC programs (Emerson, 2019; Gere et al., 2015; Simpson et al., 2015), studying the knowledge-making and identity construction that occur in peer-to-peer writing instruction can help WID scholars better understand undergraduate disciplinary socialization.

Identity and Knowledge in Tutoring

Writing center scholars have considered the various identities tutors bring with them to the writing center (Denny et al., 2018), and several studies have focused on how tutors negotiate "instructor" and "peer" identities in writing consultations (Grouling & Buck, 2017; Shamoon & Burns, 1995; Swarts, 2001; Trimbur, 1987). In much of this scholarship, the line between peer and expert falls along disciplinary lines: writing tutors are peers in a broad sense in that they are fellow students, but their expertise comes from rhetorical knowledge not shared by the writer, who instead claims knowledge of the discipline (Swarts, 2001). However, Agne and Muller's (2019) study of STEM content tutoring found that tutors and students co-construct discipline-specific peer and expert identities within tutoring sessions and that a STEM content tutor's expertise comes from being a successful student in that discipline. While many writing centers employ student tutors from multiple disciplines, and recent research has considered science work in the writing center (Shome, 2019; Walker, 2013) the implications and effects of writing tutors' and students' overlapping knowledge domains and disciplinary identities has not specifically been examined, particularly when it comes to writing tutors from STEM backgrounds.

In studying the self- and social identities of STEM writing tutors, the following analysis brings together previous studies of tutoring with WID research on writing and disciplinary identity, providing an additional

lens for understanding disciplinary socialization, tutor identity and expertise, and undergraduate WID instruction. The next sections will describe the STEM writing tutors observed in this study, identify two themes related to the tutors' disciplinary and writing tutor identities, and discuss some potential implications of these themes.

Institutional Background and Context

This study follows writing center tutors at a private, STEM-focused university in the southern United States. Nearly all the institution's degree programs are STEM-related, with an emphasis on aviation and aerospace fields. Though the university offers a B.S. in Communication, this program is extremely small, comprising less than 3% of the student population. Therefore, the writing center is staffed by a combination of adjunct English department faculty and undergraduate students. At the time of data collection, the writing center employed six student tutors: one business major, two majors in space policy and law, and three current or former engineering majors. This study follows the three tutors who hold a current or previous major in engineering.

Lila was the first student tutor hired by the writing center when it transitioned from a faculty tutor model to a combination of faculty and student tutors. Although currently enrolled in an Interdisciplinary Studies program, she spent her first two years as a Mechanical Engineering major and has retained an Applied Mathematics emphasis in her Interdisciplinary Studies degree.

Raul is a senior in Aerospace Engineering. A transfer student from a nearby state college, Raul previously earned an A.S. in Information Technology. Raul is also a creative writer who has self-published a chapbook of poems, writes screenplays for a local film festival, and is currently working on a short science fiction novel. In our interview, he described his "engineer" identity as informing his creative writing and vice versa, noting that he is able to leverage his engineering background to make his science fiction more "accurate."

Diego is a junior studying Aerospace Engineering. He joined the tutoring staff after coming to the writing center as a client and working with Lila, who was then his classmate. Like Raul, Diego is a transfer student and took most of his general education courses at another university. English is Diego's third language, and he describes his experiences learning English as an elementary school student as formative in his identity as a tutor and writer.

In this study, I focus on how these STEM writing tutors describe themselves as scientists, engineers, or mathematicians, and as writers or writing "experts," as well as how STEM writing tutor identities are constructed through talk in tutoring sessions. While previous studies of writing tutor and STEM writer identities have primarily focused on either self-identity as expressed in an interview or survey (Emerson, 2019; Grouling & Buck, 2017) or on social identities negotiated through talk between tutors and students (Agne & Muller, 2019), this study analyzes data from multiple sources, including observations of 20 writing consultations ranging from approximately 20 to 70 minutes, one-hour interviews with tutors, and analysis of tutor bios. In adopting this approach, I hoped to better understand tutors' identities as self-reported concepts (how tutors see themselves) as well as the social identities co-constructed during tutoring sessions with other STEM students.

Observations are a common practice in writing centers for purposes such as tutor training, evaluations by center leadership, and center assessment and research. Students at this writing center are informed through their appointment confirmation that their sessions may be observed. The writing consultations were audio recorded using Audacity to supplement observation field notes. Tutor interviews took place via Zoom and were audio recorded using Zoom's built-in recording function. Tutor bios were retrieved from the center's public-facing scheduling website.

After observation and interview recordings were transcribed, transcripts and tutor bios were coded using frameworks derived from previous scholarship on identity, writing, and tutoring, notably Neidenthal and

Beike's (1997) examples of self-concept statements and Agne and Muller's (2019) emphasis on relational identity construction in tutoring talk. This resulted in the two primary coding dimensions (Geisler, 2003): self-identity and social identity. Within these two dimensions, four broad categories were coded initially: self-identity related to STEM, self-identity related to writing, social identity related to STEM, and social identity related to writing. This approach accounted for both self- and social identities and enabled observation of distinctions between how tutors describe and enact writing-related identities versus disciplinary identities. Coding continued using what Grouling and Buck (2017) describe as a first impression process gradually honed by returning to the data multiple times to refine emerging themes. Using "episodic units" (Grant-Davie, 1992) that cover the duration of an idea rather than syntactic units, the coding process attempted to account for the abrupt changes in direction that can occur in the middle of a tutoring consultation, as tutors may receive feedback from students and adjust their approaches to explaining concepts mid-phrase or sentence. Through this process, each of the four initial categories was further analyzed to identify the kinds of knowledge and experiences that tutors (a) referred to when describing self-identities or (b) leveraged when engaging in identity construction alongside students and other tutors. These sub-categories included references to coursework experiences (in STEM or in writing), professional or apprenticeship experiences (Carter et al., 2007), language-learning experiences and linguistic knowledge (Kibler, 2017), and rhetorical knowledge (Dressen-Hammouda, 2008; Swartz, 2001). From this tiered scheme, two themes emerged as the most prevalent and relevant to the purposes of this essay. These themes are presented in the following section.

STEM Writing Tutor Self-Identities and Co-Constructed Social Identities

The STEM writing tutors followed in this study displayed complex and multifaceted self- and social identities related to their STEM disciplinary backgrounds, their experiences with writing, and their roles as writing tutors. Tutors described and enacted their self- and social identities in the following ways:

1. By calling upon rhetorical knowledge (and particularly genre knowledge) related to writing in their disciplines;
2. By complicating the peer/expert duality of their writing tutor roles through connections to STEM disciplinary identity and student writer identity.

Below, I outline the self-identities tutors describe related to writing and to their discipline, as well as the processes of identity construction and negotiation that occurred in their writing consultations. These results suggest that undergraduate STEM students who are trained as writing tutors develop a keen sense of rhetorical knowledge in their disciplines, and that they intertwine rhetorical and disciplinary knowledge to engage in disciplinary socialization with other STEM writers.

Rhetorical and Genre Knowledge

Multiple scholars have acknowledged that acquiring rhetorical knowledge (the ability to recognize and negotiate writing contexts, audiences, and purposes) through discipline-specific genre experiences contributes to disciplinary identity (Berkenkotter & Huckin, 1994; Carter et al., 2007; Dressen-Hammouda, 2008). As Swarts (2001) argued, experience with different genres is central to the formation of one's "multiliterate expertise" because genre conventions are informed by and thus "embody the motivations and interests of practitioners in a field." The present analysis suggests that leveraging rhetorical knowledge, particularly facility with the main features and expectations of genres in a given field, plays a key role in STEM writing tutor identities, influencing how tutors describe themselves as well as how they interact with other STEM writers.

In interviews and tutoring observations, STEM writing tutors leveraged rhetorical knowledge as part of their disciplinary identities. For these tutors, claiming an identity as a scientist or engineer requires experience in the "practical applications" of STEM work, including applying rhetorical knowledge to achieve discipline-specific goals. All three tutors described most of their STEM writing as requiring well-honed descriptive skills to effectively recreate the work done in a lab setting. Diego also described writing in engineering as akin to "selling something": "You have to justify your choices for materials and make comparisons. Engineering is all about improving what you have. Writing needs to convince people that the new thing or process is needed." In his interview, Diego also discussed the importance of discipline-specific genre knowledge multiple times. When describing how his coursework and other experiences had contributed to his self-identity as a STEM writer, Diego reflected that his experiences in STEM courses, as well as his participation in extracurricular activities like engineering clubs and mentorship programs with NASA, had influenced his genre knowledge, and by extension, his sense of disciplinary identity:

> "Before coming to the STEM classes, I had some raw knowledge of writing, but I didn't know about the specific styles and how the technical reports work, I guess. It's very strict, so that across everyone's papers there's a certain method to the madness so that everyone speaks the same. It's kind of like a manual, when you open something new for the first time, like your car's manual. You expect things to be in a certain place and a certain order and following the same format, almost. Technical reports are like that. It's like speaking the blueprint for whatever you're doing."

Diego contrasts what he calls "raw knowledge"—a general awareness of effective writing, or perhaps mechanical fluency with academic English, to the applied knowledge he has gained through learning about specific genre expectations. The latter, which Diego connects to technical processes like using blueprints or manuals, is part of Diego's sense of being an engineer.

Raul likewise stated that his sense of belonging in the engineering community is informed by his writing experiences in STEM courses. In his interview, he commented at length about the expectations for writing in engineering, and his understanding of how writing functions in the field.

> "We do a lot of writing [in engineering]. The style is very technical, very explicit, like, 'this is what we did in the lab, these were the results that we gathered, these are the conclusions we can make based on the results.'… A descriptive approach to writing is essential in engineering just because, like, especially when you're working on a group project, where you're communicating to do something where human lives are sort of involved, so if you're designing aircraft, or you're designing spacecraft, it's really important that everyone is on the same page."

Describing the lab reports he completes weekly for his courses, Raul emphasizes the descriptive techniques he uses to achieve the "very technical, very explicit" style expected of engineers. Importantly, Raul frames detailed descriptive writing as part of the responsibility of being an engineer, noting that "human lives" can be at risk if data and instructions are not communicated clearly. In this passage, Raul connects his experiences writing lab reports for undergraduate courses to the higher stakes writing he will do as a professional engineer, suggesting that as a STEM student, Raul sees his current writing tasks as preparing him for the real work of the discipline.

As Carter et al. (2007) have noted, experiences that allow students to participate in the activities of the discipline, even peripherally, are especially important to the formation of disciplinary identity, but Linton et al. (1994) argued that undergraduate STEM coursework often limits these experiences by assigning "pedagogical genres" rather than authentic ones. Raul, however, can see connections between the detailed descriptions he has to produce for lab reports in school and the teamwork he will need to do as an engineer

to make sure "everybody's on the same page." Raul's discussion of lab reports suggests that these pedagogical genres can contribute to undergraduate STEM writers' disciplinary identity.

For Diego, mastering genres like technical reports has allowed him to approximate the expectations and practices of the engineering field, but in contrast to Raul, Diego notes that authentic writing experiences have been less common in his coursework than in his extracurricular participation in the discipline. Talking about the kinds of writing he has done through his engineering clubs and mentorship programs, Diego says that it is these experiences, rather than coursework, that put him a step closer to internalizing his identity as a member of the disciplinary community: "If this is how they do it in the real world, outside of college, then once I'm actually in the field, this is what will be expected of me. Even though writing isn't as out front as the science or technology part, it's required in every single aspect [of engineering]." Diego's comments here slightly contrast Raul's, more closely echoing Linton et al.'s (1994) distinction between the writing done in college and in STEM professional work. Diego acknowledges that explicit writing instruction is rare in his courses, stating that learning to write like an engineer takes a backseat to the "science and technology part" of the discipline, but despite this lack of emphasis on writing instruction, Diego sees writing as central to "every single aspect" of engineering work.

While Diego and Raul have different impressions of the STEM writing activities in their undergraduate coursework, both see rhetorical and genre knowledge as central to success in their discipline. In tutoring sessions, they leverage this rhetorical knowledge of writing in STEM to provide explicit genre instruction, something that can be rare in undergraduate STEM education (Coppola & Daniels, 1996; Linton et al., 1994). Below, I provide brief examples to indicate how tutors leveraged their rhetorical knowledge to provide genre instruction, connecting conventions of classroom writing to broader disciplinary activities and showing STEM student writers "how they do it in the real world."

Compared to Raul and Lila, Diego's sessions involved fewer references to his writing experiences in STEM coursework, which is unsurprising given that in his interview, Diego stated that writing instruction was "not out front" in his engineering courses. However, his advice to writers does echo statements he made in his interview about writing as a means of "selling" ideas and justifying choices in engineering. The following exchange comes from a consultation with Josh, who was working on a research proposal.

> Diego: You just gotta make sure that, you know, when you—before you make these [choices], you've got to make sure that you have the requirements for, for example, the ANOVA test…It's really hard to go wrong with this as long as you pick one that you think works best with your specific type of [project].
>
> Josh: Yeah, for sure. So, it sounds like what I should add here is…just making sure that I am clearly articulating that, like, what I am what I'm trying to do satisfies the requirements for the test that I'm suggesting.
>
> D: Yeah. You've already listed your independent and dependent variables. But you've also got to know, before you do this type of data analysis, you've got to try to explain what you're about to do and then explain like, "this is what Group A has, and this is what Group B has, and this is how I'm going to compare the two," you know? You need to have all your tools set out and explained before you start.
>
> J: Yeah, you do.
>
> D: So that way it's like, I know your teacher is going to read this, but you've got to write it like, you know, it's like any other day, you gotta write like there's an audience.

J: Yeah. For sure.

In this session, Diego takes some time to explain the conventions of a quantitative research proposal in which the writer must adequately describe the data and its suitability for a particular analytical method—in this case, an ANOVA test. Like his comments in our interview, Diego frames this as a process of justifying choices to a reader who needs to be convinced that an intervention or improvement is necessary. However, he distinguishes between teacher-centered writing and the more genuine audiences that STEM writers would write for, suggesting that STEM writing tutors can help students bridge the rhetorical gap between pedagogical tasks and "real" disciplinary writing.

In tutoring sessions, Raul frequently blends personal experience from his courses with broader statements about how things are done in STEM professional communities. In one session, he uses the following phrase to begin a conversation about abstracts in scientific report writing: "I know that when we have to do papers or reports in my classes, the way that we use abstracts is…" Here, Raul uses his rhetorical knowledge to establish himself as a member of (and to a certain extent, an authority on) the disciplinary community. His use of "we" in this sentence includes himself and his classmates in the aeronautical engineering program. The discussion continues, and Raul explains the abstract's relationship to the rest of the report, differentiating it from an introduction and describing its function for readers, continuously using phrases like "we" and "for us" to describe himself and his fellow engineering students. However, later in the conversation, Raul adopts a slightly different tactic, this time seeming to include the student, Sally, in a broader discourse community that uses abstracts:

Raul: So, the abstract is used to communicate in a scientific community…

Sally: Mm-hmm, okay.

R: So when you're researching and have all these articles being published constantly, you can use the abstract to get a feel for what the article will be about.

Here, Raul positions Sally and himself as members of a "scientific community" of researchers who need to keep up with a high volume of published data in a certain subfield or related to a specific topic. By describing the abstract's use in a professional context rather than as an expectation in a class assignment, Raul connects the pedagogical genre of the abstract to the authentic work of the field.

Like Raul, Lila draws on her own writing experiences to demystify science writing genres. In one session, she breaks down the individual sections of IMRaD style papers, discussing the differences between a literature review, which she and the student, Neil, had discussed the previous week, and a methodology.

Lila: So usually a methodology is used, um, so that if somebody else was to want to write a paper about a similar topic, they could look at your methodology, understand the steps you took, and then write a paper very similar to this. Does that kind of make sense?

Neil: I still don't understand, sorry.

L: No, you're totally fine. Let me think, um… I think I actually have an example of a methodology within one of my own previous papers, so I can see if I can find it and we can pull it up and look at it together.

Lila first tries to explain the methodology by referencing what Swarts (2001) calls "an idealized form of the text" and explaining its purpose outside the context of the class assignment. When this broader rhetorical knowledge of the IMRaD research report genre doesn't quite get through to Neil, Lila turns to her more

specific, applied knowledge of the genre by offering to share her own writing as an example. In this session, Lila not only constructs her identity as a STEM writer who is aware of the "usual" uses of a methodology in science writing, she also positions herself as both writing expert and peer writer, with her text serving as a concrete and achievable representation of the "idealized" genre. Like Raul and Diego, Lila moves back and forth between the pedagogical use of the genre and the genre's function in the "real world" of STEM. In addition, Lila's rhetorical knowledge intertwines with her disciplinary expertise to construct her dual role as STEM peer and writing tutor.

Negotiating "Peer" and "Expert" Role Identities

The dual nature of tutor identity as both expert and peer is well established in tutoring scholarship, both in writing centers and discipline-specific tutoring (Agne & Muller, 2019; Grouling & Buck, 2017; Swarts, 2001; Trimbur, 1987). Writing tutors and content tutors must navigate the "uncertain relational space of simultaneously being instructor–student and fellow student," (Agne & Muller, 2019, p. 266). While a writing tutor's "instructor-student" identity is sometimes thought to originate from rhetorical knowledge that is distinct from the tutee's disciplinary knowledge (Swarts, 2001), STEM writing tutors and tutees occupy overlapping knowledge domains as members of similar disciplinary communities. This means that writing tutors from STEM backgrounds are constantly negotiating an expert-peer identity that involves both their writing knowledge and their disciplinary knowledge.

Raul was the only tutor to identify himself as a writer through an intrinsic self-identity. His bio begins, "Writing has been a passion of mine for many years." For student tutors, bios can be an important space to contextualize their ethos as peers and as professionals in the center. By beginning his bio this way, Raul positions himself as a writer first, before mentioning his STEM student status. Conversely, Diego and Lila describe their identities as writers and as writing "experts" relative to others. Diego articulates his self-identity as a writer in relation to two groups: other STEM students, and the writing center's faculty tutors who have graduate degrees in English. In his interview, he described himself as a "better writer" than most of his engineering peers, but when asked if he considers himself a writing expert, he responded:

> "I compare myself to the other tutors in the lab, like Pete [a faculty tutor], who have been teaching writing for a long time…in relation to them, I don't see myself as a writing expert even though other students have told me that I am one. I think that's because when students come to get help, they want to be helped by an expert. I feel like I do exceptional work, but I still wouldn't consider myself an expert."

Although Diego stated that working in the writing center gave him a sense of professional identity related to writing, he did not feel confident claiming a "writing expert" identity because others around him had more experience teaching writing. Here, Diego also taps into an important element of tutor-student relational identities: students' expectations that they will receive help from an expert when visiting the writing center. He goes on, "Before, no one had expectations of me as a writer, but now my writing means more." Diego acknowledges that his writer identity is partially constructed for him by other students and through his association with the writing center.

While Diego feels his role as a tutor automatically constructs a "writing expert" identity he may not feel comfortable claiming, STEM tutors also construct identities that simultaneously emphasize their writing expertise and disciplinary peer-ness. Both Raul and Diego use their tutor bios to invoke rhetorical knowledge (including genre knowledge) and disciplinary experience. After claiming his writer self-identity, Raul's bio states: "Pursuing a STEM degree, I often encounter technical writing in the form of Research Papers, Technical Reports, and Lab Reports." Raul references his institutional identity as a STEM student, linking that aspect of his identity to his experiences with various genres common to his degree program. Diego, meanwhile, writes in his bio, "Because of my degree, I excel at helping students with their research

assignments. I have written my fair share of technical reports, especially for my engineering clubs." For Diego, his identity and ethos as a writing tutor come from his STEM-specific writing experiences both within and outside the classroom. Like Raul, Diego invokes technical reports as a genre important to engineering, and the mention of his engineering clubs establish him as a knowledgeable member of the engineering field with practical experience.

Diego continued to emphasize his engineering clubs in our interview, describing at length the influence of mentorship and learning the expectations for disciplinary writing from a member of the field: "Having someone looking over what you're working on and saying, 'that's how we do it,' it's like—'I'm doing it!', you know?" As Diego notes, some of the most significant disciplinary learning experiences come in the form of what Carter et al. (2007) call "apprenticeship," learning alongside a representative of the field who can confirm "that's how we do it." It is therefore unsurprising that Diego, Raul, and Lila take on similar "disciplinary representative" social identities as tutors. As a result, their writing consultations become spaces for tutor and tutee to participate in disciplinary socialization (Agne & Muller, 2019; Carter et al., 2007) through writing tasks.

Within writing consultations, STEM tutors draw on their rhetorical and disciplinary knowledge in ways that affirm or bolster their ethos as tutors, and in ways that co-construct tutor and writer as members of similar disciplinary communities. It is common for tutors and students to leverage different kinds of knowledge and participate in various kinds of talk to co-construct their social identities and define their relationships to each other. Swarts (2001) argued that in the context of writing center sessions, tutors and student writers have distinct areas of expertise due to their membership in disparate disciplinary communities, and that "rhetorical knowledge constitutes tutors' writing expertise" (para. 4). In my observations, STEM writing tutors do leverage rhetorical knowledge in tutoring sessions, but they appear to do so as a means of connecting with students on a disciplinary level as much as to construct their own identities as writing instructors or experts. In other words, STEM writing tutors' rhetorical knowledge does not exist as a separate domain from tutees' disciplinary knowledge; instead, the two are intertwined. In writing consultations, STEM tutors engage in disciplinary socialization, drawing on and constructing co-relational identities with STEM writers that are based on their mutual experiences and participation in disciplinary communities.

All three tutors discussed their STEM majors or minors multiple times in tutoring sessions. In tutoring sessions, the tutors sometimes invoked disciplinary experiences in ways that suggest they are a "step ahead" of their peers, with more experience in the discipline in general as well as disciplinary writing in particular. Raul's method of leveraging his own engineering coursework to explain genres like abstracts and technical reports simultaneously positions him as an experienced engineering student and as a skilled STEM writer. When working with Sally, Raul first establishes his STEM writing expert status by referring to "how we use abstracts" in engineering courses, and then describes a "scientific community" that includes Sally and himself. Thus, he combines rhetorical and disciplinary expertise to co-construct his and Sally's relationship within that community, positioning himself as a representative of the discipline who can confirm "that's how we do it." Likewise, in the session with Chris described in the introduction to this article, Raul draws on his disciplinary knowledge to help the writer navigate both the scientific and rhetorical aspects of working with data in his technical report.

> Raul: Okay. Did your professor provide you with any guide for using this data, how they would want you to plot it?
>
> Chris: He sent out a primer. He said he's not looking for perfection; he just wants it to be an exercise. But the problem I see is that in the conclusion here, I have to prove that the RSSI plummets. But I don't know which part of the data shows that.

> R: Well, I can tell you just right off the bat, because engineering is my major, one of your axes for your data is going to be time. And if they're talking about the RSSI, then at least one of your other axes should be the RSSI. So what you're going to see is RSSI vs. time, and from that graph you should be able to see the RSSI drop at whatever point they mention.
>
> C: …Oh okay, now I see what's going on. That will show how it dips.
>
> R: Exactly. And that should correspond to whatever they said in the case study. It's kind of like putting together a puzzle.

Here, Raul again engages in disciplinary socialization through a combination of technical and rhetorical knowledge. He explains what he calls the "engineering work" of the assignment in a fairly directive style, drawing on his ethos as an engineering major to do so. He then connects this work to the rhetorical goals of the report, "putting together the puzzle" from the data to construct a convincing argument. Thus, he leverages his STEM expert identity to provide discipline-specific writing instruction.

In tutoring sessions, Lila vacillates between being an experienced writer and a STEM peer. Lila frequently referred to her own writing experiences in tutoring sessions, sometimes using her own work as a model, as in the session with Neil described above, or describing knowledge she had acquired in writing coursework: "This is a trick I learned in high school when I started doing college writing. One thing that one of my professors had told me was that whenever you're writing your introduction, do your main points, like your summaries, in the order that you do them in your essay." Lila's first statement positions her as an advanced writer who took college-level courses in high school, but it also emphasizes her student status, assuring the student that the "trick" about organizing introductions originated from an even more knowledgeable writing instructor. In this sense, she both assumes and deflects the "instructor" identity.

Lila's peer/instructor identity may also be affected by the extent to which some students defer to her expertise. I observed multiple sessions between Lila and Jo, who tended to ask for and defer to Lila's expertise more than other students, perhaps because they had worked together several times. In the following passage, Jo asks for Lila's approval before rearranging some of the content in his conclusion:

> Jo: Is it okay if I do this? [deletes and moves several sentences]
>
> Lila: Let me see…Yeah, because you've already explained this earlier…

This type of exchange was common in this consultation. Each time Jo asked for Lila's approval, Lila responded with a brief explanation of why the change was a good idea or not. In this same session, Lila and Jo also discussed feedback Jo had received from his professor on an assignment they had worked on together. In this segment, they break the "student/instructor" relationship and start to commiserate as student peers, albeit briefly, before Jo returns to the paper.

> Jo: I got a 60. I had to resubmit it.
>
> Lila: Oh, really? Wow.
>
> J: Yeah, he grades us—he really wants a lot of information, and my information was too short for him.
>
> L: Oh, so your paper didn't have as much detail as he wanted?
>
> J: Yeah, so I resubmitted and got a 90.

L: Well, that's good.

J: Yeah, that's why I got 11 pages on this one.

[Both laugh]

L: Learn from your mistakes.

J: Yeah, he's crazy, man. So how was your test?

L: Oh, my test? It went well. I think I got an 86 on it. My calc test. I think I did well. I was very pleased with the result.

J: Great. Okay. So. Once we're done with the summary, can we start doing the introduction?

Jo guides the conversation to a casual exchange between peers, expressing frustration with his professor's grading demands before asking Lila about a recent calculus test. Like Agne and Muller's (2019) finding that non-task discourse in STEM tutoring sessions is integral to establishing discipline-specific relational identities, Jo's inquiry may be an attempt to emphasize Lila's status as a peer in STEM rather than/in addition to an expert in writing. Jo thus positions Lila as one who shares his disciplinary experiences (and, perhaps, his frustrations with difficult assignments in STEM). Rather than exposing a dividing line between student and tutor expertise, conversational interludes like this one suggest that tutoring session talk is a space in which STEM writers come together as members of a discipline.

Discussion: STEM Writing Tutors and WID Instruction

Scholarship in WID has often pointed to writing as a means of socialization in a disciplinary community, but some scholars have argued that this socialization is implicit at the undergraduate level, where students may have limited engagement with a discipline's authentic genres. The present study indicates that undergraduate STEM students can observe ways that writing activities in both coursework and extracurricular experiences contribute to their rhetorical knowledge and/as disciplinary identity. The tutors observed in this study emphasized specific genre knowledge as integral to their disciplinary writing identities, even if they did not report receiving direct genre instruction in their courses. In this sense, the present analysis somewhat contrasts previous scholarship that distinguishes "pedagogical genres" from the more authentic writing activities of the field (Linton at al., 1994) and suggests that undergraduate STEM writers do make connections between their engagement with STEM genres (even pedagogical genres like Raul's group lab report assignments) and their participation in the discipline. Moreover, STEM writing tutors leverage this rhetorical knowledge of disciplinary writing to engage in explicit genre instruction when working with other STEM writers. All three tutors relied on rhetorical and genre knowledge in their tutoring practice, offering peers direct instruction in lab reports and research abstracts and connecting those genres to the work of STEM professionals. Thus, this study points to writing centers as spaces to study STEM writing instruction as disciplinary socialization at the undergraduate level.

One way to examine this socialization is by focusing on tutors' and students' co-constructed disciplinary identities. Research on writing tutor identity has long emphasized the dual "peer/instructor" identities tutors must negotiate; however, the boundaries of these identities have traditionally fallen along disciplinary lines, with tutors serving as writing experts and tutees as disciplinary experts. The present analysis indicates that writing tutors from STEM backgrounds continue to negotiate multiple identities as peer and expert in relation to students, but these identities are not cleanly divided; rather, STEM writing tutors intertwine their rhetorical knowledge and disciplinary experiences to connect with tutees as co-members of the discipline and to establish their ethos as STEM writing instructors. The current analysis extends Agne and Muller's

(2019) finding that STEM tutoring sessions are spaces in which "students and tutors use disciplinary language…to [negotiate] their relational identity as peers engaged in coming to participate in the same discipline" (p. 277) and suggests that STEM undergraduates engage in disciplinary socialization not just when working on math and physics problems, but when working together on writing, as well. This indicates that peer-to-peer writing instruction can be a method through which undergraduates develop disciplinary identity.

One of the present study's strengths is its attention to self-identities as reported in interview settings as well as social identities observed in practice. This study combined interviews, observations, and bios to understand how tutors present themselves to prospective students, how they leverage disciplinary/writing knowledge and participate in disciplinary talk in sessions, and how they describe themselves to an interviewer. In doing so, the study accounts for identities as self-reported and as co-constructed. At the same time, this study is limited by several factors that could be addressed in future research. This paper presents early results from an ongoing study, and the data in this stage lacked a formalized cooperative coding process. Future studies should employ this process to ensure reliability in coding. Second, the study focuses on a small group of tutors at one institution. Future research could address this limitation with a multi-institutional study consisting of writing centers that employ STEM tutors.

Conclusion

This study sought to better understand the role of peer tutoring in the development of STEM writers' disciplinary identities. Specifically, the study asked how undergraduate STEM writing tutors construct self- and social identities related to writing and STEM, and how they leverage those identities in peer-to-peer writing instruction. This study offers writing center and WAC/WID program administrators new possibilities for thinking about the relationship between writing and disciplinary identity in STEM undergraduates as well as the role of writing centers and undergraduate tutors in WID.

As this study indicates, STEM writing tutors can leverage what Diego called "raw knowledge" about writing into rich rhetorical knowledge that strengthens their own sense of disciplinary belonging. Likewise, their dual positions as STEM students and writing tutors allow them to interpret the questions STEM writers ask through their own disciplinary experiences as well as through the lens of their writing center training. The tutors in this study engaged in explicit genre instruction, drawing on their own experiences in coursework and extracurricular settings to help students "think like an engineer" in writing (Poe, 2000, p. 31) and verify that "that's how they do it" in the field. Thus, STEM writing tutors "can give tutees access to rhetorical knowledge that is often kept hidden" (Rinaldi, 2015) in undergraduate STEM education. Peer-to-peer tutoring, therefore, may represent a useful way of helping undergraduate STEM students become socialized into their disciplinary communities.

This study extends multiple ideas that could be taken up in future research. For instance, a future study might compare the self- and social identities of STEM writing tutors to tutors from English and the humanities to better understand how tutors across disciplines leverage distinct and overlapping knowledge domains to construct peer/expert identities. In addition, interviews with STEM tutees could help us understand how receiving peer writing instruction from a disciplinary peer affects STEM writers' disciplinary development. Building on the present study can contribute to a better understanding of how undergraduate STEM writing tutors fit within the landscape of writing center and WID programs.

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Note

[1] All names are pseudonyms.

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