Attitudes about Graduate L2 Writing in Engineering: Possibilities for More Integrated Instruction

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Abstract: International graduate students often face significant challenges with academic writing. These challenges create uncertainty about faculty members' roles as teachers of discipline-specific writing, especially in relation to the roles of writing specialists in other academic units. This qualitative case study explored faculty members' attitudes about second language writing in a College of Engineering at a large state-supported university. The college under study systematically and successfully integrates writing instruction into undergraduate engineering courses, but does not do so for graduate curricula. Thus, we also explored the implications of faculty members' attitudes for fuller graduate-level integration of writing instruction. We conducted semi-structured interviews with four engineering faculty members who have mentored L2 graduate students. Results show that all of the advisers appreciated the importance of strong writing skills and recognized the need for more focused attention directed toward improving students' writing. They encouraged their students to use the resources currently available and are also open to the development of more direct instruction at the graduate level. We advocate a distributed, social approach to writing instruction in graduate students' labs to bridge the divide between individual and public professional writing.

Introduction

Despite its widely recognized importance in professional settings, writing is infrequently emphasized in graduate engineering education. Students often find themselves writing theses or dissertations with almost no prior extended writing experience. Even if they do write in coursework or other pre-thesis activities, their writing typically takes the form of lab/technical reports (Bridgeman & Carlson, 1984; West & Byrd, 1982), which may be composed of charts, equations, or figures with minimal connecting prose. While such reports often require recursive revision and other identifiable writing processes, writing serves as the "glue" that holds key technical parts together (Buell, 1991). For many students, then, extended composition is not a required component of graduate writing tasks until late stages (Bridgeman & Carlson, 1984). Even more troublesome are pervasive views of thesis writing as the "test" or indication of mastery of writing skills (Jenkins, Jordan, & Weiland, 1993).

These mixed messages about writing certainly present challenges for native-English-speaking students, but the challenges are often exacerbated for second language writers—especially international second language

students. Most tertiary institutions in the US require minimum scores on the Test of English as a Foreign Language (TOEFL), but high scores do not necessarily translate to authentic spoken or written proficiency. When the challenges of extended technical writing in high-stakes situations combine with the challenges of writing in unfamiliar cultural, linguistic, and rhetorical contexts, opportunities for writing development may be sacrificed to the goal of finishing capstone projects efficiently. In fact, Jenkins et al. (1993) showed that faculty members reported writing approximately 25% of the theses for their non-native speaking students.

Obviously, advisers' writing students' theses is not the optimal solution to second language writing challenges: it is neither an ethically defensible nor a sustainable strategy. A wide variety of more productive potential solutions exists, depending on institutional resources and, perhaps more fundamentally, attitudes about second language writing and writers. With this national diversity in mind, we focused on our own institutional context, in which extensive and integrated support exists for *undergraduate* engineering students but not for *graduate* students. We were interested in examining, first, what attitudes about writing circulate among faculty members working with international second language graduate students and, second, what implications these attitudes might have for fuller integration of writing support at graduate levels.

Background and Literature

Literature on the role of writing in graduate-level engineering education is part of a larger body of research and practice on Writing Across the Curriculum/Writing in Disciplines (WAC/WID). Influenced by fields such as rhetoric and composition, genre theory, and applied linguistics, WAC/WID philosophies stress the value of students' learning to write and "writing to learn" throughout their educational careers as they advance toward professionalization and specialization (Wells, 2010). As a result of their interest in preparing students for academic and professional genres, WAC/WID researchers have analyzed text types and faculty expectations in fields ranging from the humanities to the applied sciences. Significant attention has focused on the sciences and engineering—attractive fields of study in the US for both domestic and international students that have seen consistent enrollment increases at all levels of tertiary education (NSF, 2010). The large numbers of students in these fields typically meet high expectations for their writing frequently driven by prospective employers: surveys show that nearly 40% of a new professional engineer's time is spent writing and that more senior engineers may write for as much as 95% of their time on the job (Kreth, 2000; Silyn-Roberts, 1998).

Writing in whatever discipline is a well-known challenge for native-English-speaking students, but it can be even more challenging for international second language students, whose academic and social experiences with English vary widely. Most tertiary institutions in the US require minimum scores on the Test of English as a Foreign Language (TOEFL), but such scores do not necessarily equate to comfort or proficiency in academic or pre-professional writing. This mismatch is perhaps most apparent for students from south and east Asian countries, such as the People's Republic of China and South Korea—countries representing linguistic and rhetorical traditions markedly different than those of the US. Coincidentally, however, students from these countries represent a plurality of all international students in the US and a near-majority of international students studying engineering (Open Doors, 2010).

The challenges faced by international students in engineering have created uncertainty about faculty members' roles as teachers of discipline-specific writing, especially in relation to the actual or perceived roles of writing specialists in other academic units. This uncertainty mirrors debates in the fields of second language writing and English for Specific Purposes (ESP) about the efficacy of teaching writing in designated courses as a generalized and transferable set of skills versus teaching writing as an activity explicitly connected to disciplinary genres and conventions (Braine, 1989; Casanave, 2003; Horowitz, 1986a, 1986b; Johns, 1988; Spack, 1988). The idea of teaching writing "in disciplines" receives significant

support in ESP literature (Berkenkotter, Huckin, & Ackerman, 1991; Johns & Swales, 2002; Snow & Brinton, 1997) and in literature on engineering education (Lax, 2002; Leydens & Olds, 2007; Untener & Reynolds, 2001; Wheeler & McDonald, 2000). However, disciplinary faculty members may have little time or incentive to teach writing, either in formal courses or in more informal adviser-advisee contexts (Kranov, 2009; Pierson & Pierson, 1997). Recognizing the central importance of writing to their disciplines, however, engineering educators have proposed a variety of solutions, ranging from identifying writing support outside of engineering (Melles, 2009; Watkins & Green, 2003) to collaborating with departments of English or linguistics (Daniell, Figliola, Moline, & Young, 2003; Oakley, Connery, & Allen, 1999; Pinkus & Simmons, 2000) to creating "in-house" writing courses and other supports (Lax, 2002; Untener & Reynolds, 2001).

In fact, what emerges from the literature is that there is no single best solution, nor can there be: approaches to effective writing support radically depend on student backgrounds and experiences, faculty investments, and faculty and student attitudes about the role of writing in academic and professional engineering. This last component—attitudes—may be most crucial, especially in graduate education. Most graduate programs in the US require students to quickly identify topics worthy of thesis/dissertation research, which in turn requires significant self-motivation, direction, and initiative in identifying potential research supervisors. Even in engineering, in which graduate students more frequently work on "well-defined" problems than on research questions they invent themselves (Hasrati, 2005; Kuhn, 1996), differing expectations and attitudes can make writing-mediated adviser-advisee relationships more complex than they might initially appear. Students often bring with them culturally specific academic, professional, and broader rhetorical strategies that conflict with locally defined and field-specific conventions (Connor, 1996, 2002). They may be reticent to interact with native-speaking advisers or peers because of actual or perceived problems with English proficiency, which can impede their discovery of additional resources in and out of their departments (Dong, 1998; Leki, 2006). They may (at least tacitly) expect continuous and explicit feedback on their writing as it develops, where their advisers may be more focused on the finished products of articles, dissertations, or theses (Belcher, 1994; Leki, 2006) or may expect them to acquire writing knowledge on their own or "on the job" (Kranov, 2009; Krase, 2007). Adding to such mismatches, few faculty have significant knowledge of intercultural communication or second language acquisition or writing (Angelova & Riazansteva, 1999; Hoshino & Sanders, 2006).

These differences in attitudes and expectations about writing can have serious impacts on student performance: one study describes students' and advisers' attempts to negotiate their often tacit attitudes as "awkward" and "painful," especially when international students are involved (Donnell, Petraglia-Bahri, & Gable, 1999). Despite common difficulties in identifying and communicating about attitudes, the affective dimensions of adviser-advisee relationships, especially in high-stakes writing projects, are vitally important to students' growth as members of academic and professional communities (Hasrati, 2005; Lave & Wenger, 1991). In the absence of sustained, formal, classroom-based interactions in advanced stages of many graduate programs, it can be a challenge to encourage students and advisers to clarify their attitudes and expectations about the role of writing and about how mastery of disciplinary writing tasks can best be achieved.

Context

We conducted our research in the College of Engineering at the University of Utah, a large, state-supported university in the Intermountain West region of the United States. As of Fall 2010, the College enrolled 3,563 students in eight degree programs; 948 of those students were working at graduate levels. Three hundred sixty graduate students were identified as "non-resident aliens," accounting for 38% of the College's graduate enrollment. Those students were working with 143 faculty members, of whom four were identified as non-resident aliens as of fall 2010. As numerous commentators on second language writing have observed, "foreign" or "alien" status in the US does not necessarily translate to "second language": some visa-holding

foreign students may indeed speak English natively if they come from British Commonwealth countries or former British colonies, such as India. And by no means are all U.S. citizens or permanent residents native speakers of English (Roberge, Siegal, & Harklau, 2009). The university's enrollment statistics implicitly recognize this complication, noting that students and faculty who are immigrants, refugees, or applicants for U.S. citizenship are reported by their respective self-identified ethnicities. Thus, since the university does not maintain statistics on language backgrounds of faculty or students, it is impossible to determine how many speakers and writers of English as a second language there are in the College. The counts of non-resident aliens are the best available estimates, but it is worth noting that the actual number may, in fact, be higher, given the increasing linguistic diversity of U.S. citizens and residents.

In addition to its general national rankings, the College distinguishes itself by incorporating support for speaking, writing, collaboration, and leadership into undergraduate engineering courses. Physically housed in a new College building, the Communication, Leadership, Ethics, and Research Program ("CLEAR") pairs instructors of speaking and writing with engineering faculty members to provide instruction, consultations, class activities, direct student assistance, and curricular development. CLEAR instructors, mostly graduate students in communication and English, bring into the program their experience teaching professional and technical writing, and they acquire more nuanced, discipline-specific understandings of engineering writing as they observe and interact in the courses to which they are assigned. CLEAR bills itself as a unique program because of (1) its emphasis on speaking, writing, and teamwork, (2) the integrated nature of its professional skills instruction, and (3) its situated, developmental approach to teaching and learning. CLEAR represents a model of writing in the disciplines in which instructors provide context-specific, genre-specific writing support in required, undergraduate core engineering classes rather than in separate upper-division writing courses. CLEAR's goal is that students in supported engineering courses learn *how* to write as well as *how* writing facilitates the engineering design process.

Despite its success at the undergraduate level, the program currently does not provide similarly systematic support for graduate-level communication. CLEAR was developed with and charged for the purpose of enhancing undergraduate engineering education, and the program's funding is directed to that end. Nevertheless, the program's visibility attracts notice from graduate faculty and students, including those who are part of and/or are working with the large international second language graduate cohort. Aware of the comparatively ad hoc, often highly individual nature of writing support in graduate engineering curricula, we were curious what attitudes about writing we would encounter among graduate students and faculty. We were also curious what those attitudes would imply about the feasibility of broader, more sustained writing support on the CLEAR model.

Methods

We employed a qualitative case study approach to data gathering and analysis to explore faculty members' attitudes toward second language writing. We invited 14 faculty members to participate in our research. These 14 faculty members were selected because they have some knowledge of the CLEAR Program, whether through formally collaborating with CLEAR instructors in the classroom, or through participation on curriculum committees. Additionally, they have all mentored graduated students. Of those invited, eight faculty members never responded, one declined because he was not advising any second language students, and one could not participate because she was out of the country at the time of data gathering. Thus, out of the 14 invitees, we secured agreements to participate from four faculty members representing computer engineering, civil engineering, mechanical engineering, and materials science. We conducted semi-structured interviews with each faculty member in his/her office. We followed an interview protocol (see Appendix), but we did diverge from the script at times in order to follow up where appropriate and explore tangential comments and ideas. Each interview was recorded and transcribed. The transcriptions yielded 35 pages of single-spaced text, which became our data set for analysis.[1]

Our inductive approach to data analysis consisted of several steps. First, we read through all the transcripts, making marginal comments and highlighting interesting and compelling phrases. Second, we compiled responses to four specific interview questions: What do you see as most challenging (regarding writing) for your second language students? What is your approach to feedback? Do your students collaborate on the writing and conduct peer review? What recommendations do you have for improving graduate students' second language writing skills? The responses to these questions provided descriptive information on faculty members' experiences with second language writers. Third, we generated broad themes across all the interviews. After re-reading the highlighted phrases and marginal comments, we described commonalities in a few sentences. Then, we "named" each theme appropriately after re-reading our narrative descriptions. In the end, we developed six themes—four of which emerged directly from our initial protocol questions and two of which emerged from further recursive reading and comparison.

Results

We were interested in learning about faculty members' experiences with and attitudes toward second language writers. In our interviews, we learned about their views on the unique challenges facing their students, their style and approach to providing feedback, their sense of opportunities for collaboration and peer review, and their recommendations for how to improve second language writing at the graduate level. We report in this section on faculty responses during our interviews; we provide more detailed analysis of those responses as well as our own recommendations in the section that follows.

Specific Student Writing Challenges

Faculty members described four challenges to second language writing at the graduate level: grammar, time, comprehension, and precision. A common issue that arises in the writing is what interviewees consistently described as poor grammar, including incorrect use of articles, verb tense, and basic sentence structure. One faculty member noted, "Their writing skills are awful and they're at a mid-elementary school level in terms of their ability to use grammar" (Interviewee 2). Other faculty members supported this general comment by pointing to students' difficulty with articles and sentence structure: "Articles are really bad. Maybe these are my pet peeves, but articles are a very common thing. Another thing is tense issues" (Interviewee 3). "They're writing you're and your, and punctuation is all screwed up, and they write very simple sentences like subject, verb, object; no subordinate clauses, no complex sentence structure, so it's generally just low-level written English" (Interviewee 4). All of the faculty interviewees expressed frustration on this point, noting that it muddies their ability to adequately critique the technical content. As a result, they feel torn between correcting the grammar—which they do to a point—and sending students to other resources for help. While they recognize their role in mentoring students, they are reluctant to work with their advisees on grammar because "it's not their job":

> It's not like I'll sit down and try to correct their grammar. I'll give them some general broad-brush things and then as soon as I get a sample in of their writing, once they get here, if they're pretty bad, I'll say you need to get some help. (Interviewee 2)

In short, engineering faculty members would rather focus their comments on "the science . . . because that's hard enough." For them, the focus has to be on training engineering scholars: "I want to focus on changing somebody's thinking and understanding to move into the PhD level and world class expert level on whatever topic we're researching" (Interviewee 4).

With that lofty goal in mind, all of the faculty members we interviewed hold weekly meetings with their advisees. However, since these meetings may only last an hour at a time, they hardly seem adequate in trying to address the dense combination of research, science, and writing:

> What I want to be thinking about is the science, the ideas, what's novel about the research we're doing, what's happening with the student's understanding of the subject, rather than getting bogged down in grammar and spelling. I mean, that stuff just gets in the way. (Interviewee 4)

So, faculty send students to the campus writing center or encourage them to hire a tutor to "fix" their grammar. While this results in a "clean" document for faculty members to critique in terms of the technical work, thus maximizing their time together, it fails to teach the students how to apply preferred grammatical standards to their own documents as they revise: in one informant's words, "they get help and they push their way through, but they don't learn it. [They go to a writing expert to] get help on the side and that person basically corrects their grammar, but they don't learn it" (Interviewee 2).[2]

In addition to grammar problems and a lack of time for the teaching and learning of writing, faculty members also reported problems with comprehension. Students have difficulty with specific English vocabularies, which can lead to miscommunication that is especially frustrating in individual meetings:

> The language provides your bandwidth for transferring ideas. So, in somebody with limited bandwidth, [he/she] can only learn [so much]. In the best case scenario, your learning is limited by your innate skills and how much you know already so you can add to your schema. In this case, the pipeline is kind of shut down. You tell somebody something, you think they understood, and they go and do it wrong anyway and you're just like pulling your hair out. (Interviewee 4)

To make matters worse for some faculty advisers, students would apparently rather leave meetings without asking for clarification and do what they think they should, according to one informant, rather than risk embarrassment by asking a question or admitting that they don't understand: "We'd talk about . . . you need to change this equation this way and try this approach, but she'd still sort of do what she thought you were saying, but it wasn't always exactly what you were saying" (Interviewee 1). Advisers readily admitted that the pressure to prove oneself in graduate school is high and some students—especially international second language students—may not want to risk losing credibility by asking questions in a meeting:

> It would take a very confident person to admit they didn't understand what you're saying. They are already trying to prove themselves to their adviser and prove that they're worthy of working in this situation. There's incentive for them not to speak up. (Interviewee 4)

To circumvent the problem of students' not asking for clarification, faculty members may directly ask students if they understand. But further frustration may result if students seem unaware they are being asked a question:

> I'll tell them outright, you've got to catch up in this area, and you're not doing this experiment right. I'm not going to beat around the bush. I just got frustrated trying to train this guy because he would be saying uh-huh, uh-huh, uh-huh and I'd say, well what did I just say? And he didn't even know that I'd asked him a question. (Interviewee 4)

Finally, precision, commonly articulated by faculty informants as a unique feature of technical writing, presents problems for many students. While most students come to graduate school having read numerous technical research papers, interviewees reported that students still struggle with the transition from imprecise, descriptive writing—common in lower-division undergraduate writing classes whether focused on first- or second language writers—to the precise writing required in engineering:

> The precision in mathematics and stuff like that is where a lot of the challenges come in technical writing. So, it's not even English per say, it's getting your head around, you know,

> writing technically, which is really different than writing, say, a story, an essay, or even a project report, where you can get away with being a bit imprecise. (Interviewee 3)

In summary, while these general writing challenges appear in the writing of many students, regardless of background, second language writers may face such challenges more acutely. And the problems are often exacerbated by different levels of comprehension and by the time required to (re)learn and apply preferred grammatical standards. These challenges not only frustrate faculty members, but they also impact their approach to feedback.

Feedback Styles and (Implicit) Views of Engineering Writing

All of the faculty members we interviewed follow a similar approach when providing feedback to their students: markup of drafts with limited grammatical corrections. They would rather emphasize the research, ideas, and conclusions and direct comments toward what they clearly perceive to be the science content than spend time on what they perceive to be more general, less technical writing concerns.

While they all prefer to mark up papers and then meet with students personally to discuss their comments, only one faculty interviewee expressed a preference for printing documents and hand-writing comments:

> I don't generally prefer [the word processing editing utility that allows a reader to] track changes. My preferred format is [for them] to send me the document, I print it out, do my scribbles, and then I sit down with them. I might explain how they are mixing up [the relative pronouns] that and which or explain that they're leaving out a lot of articles. In some cases, I would just look at them and say, you need to go to the writing center. I'm not going to do a whole grammar check for you on this. (Interviewee 1)

This informant went on to explain the view that not using track changes actually "forces" the students to make the corrections, rather than merely "accepting the change": "they have to make the changes. It's not just like, oh okay, she corrected it for me." Although this approach is by no means facilitating *learning* of grammar rules in all applications, it squares with this faculty informant's belief that students should model application of a particular rule and, through repetition, glean some understanding.

Other faculty members use the "track changes" feature to document comments and edits before meeting with their students one-on-one to discuss feedback. It is then the student's responsibility to implement the recommended changes:

> Generally, the way it works is they'll send me electronic [version of the paper] and I'll work through it and then we'll sit down and work through it and I'll explain everything to them and then they go off and revise based on that. (Interviewee 2)

Whatever their preferences for commenting and editing, all of the faculty interviewees explained that they are involved until the very end of the process and feel responsible for final edits and submission of all papers. They commonly articulated that they are responsible for anything that "comes out of their lab." As a result, they review all "final" versions of papers and submit them. And, in some cases, they take it upon themselves to rewrite entire papers if necessary:

> I do the final draft on everything that comes out of my group. We submitted three conference papers last spring and I spent the better part of an afternoon on each one of those, rewriting the entire thing completely. It's my group they're representing and I have very high standards for where we should be and I'm not going to accept crappy language and poor idea presentation. My focus is really, it has to be on the final product. (Interviewee 4)

The personal investment that our faculty interviewees feel in their labs' written products translates at times to personal responses to apparent writing problems. Without a doubt, many instructors in the course of responding to student writing at the level of grammar and style attend to some problems more often than others. While a particular student's writing may show difficulties with paragraphing, syntax, punctuation, and word choice, for example, the student's instructor may focus on comma use. Such "pet peeves" may, as the term implies, simply reflect idiosyncratic preferences, but they may also reflect tacit expectations about written style that connect to more systematic, generic, and/or disciplinary conventions.

One faculty interviewee suggested that communication problems are more readily apparent and more problematic in writing as opposed to oral presentations, while at the same time qualifying his observation as an individual matter:

> It always seems like, oh yeah, I can understand what they're saying when they're talking. With their writing, it's like, maybe you can just see more details on paper so you can actually pinpoint all the mistakes versus just listening to a presentation and seeing slides [where] it comes across a little bit easier. . . . And so it's like, okay, I understand all this and so it must be making sense to me, but when you're reading it, you're like, that word's not supposed to be here and they're missing a word here and it's quite clear when they're missing those details in the writing. So maybe it's just me that's observing it when that's not really the case. (Interviewee 2)

More specifically, the same interviewee reported a visceral response to seeing confusing verb tenses in international students' writing—a response that makes a highly questionable connection between students' verb conjugation and broader language ability:

> I've seen some people who are awful and I'll say, you're supposed to use is instead of was here and I just get blank stares. They don't even know what is or was is. They're just like I don't even know what those words are let alone which one I'm supposed to use at which point. (Interviewee 2)

Another faculty commentator, who is also an associate journal editor, brought up his own pet peeves on several occasions in his interview, frequently speaking about them somewhat dismissively even as he acknowledged their prevalence in his revision advice to both students and peer authors:

> I mean maybe these are my pet peeves or maybe I don't even know, I mean maybe that someone from writing would say differently, but there are various things that really rub me the wrong way. So, I mean, I review a lot of papers that are clearly written from people that are English as a second language, and there are certain things that I see. Articles is a very common thing. Another thing is tense issues, where I was taught technical writing should all be present tense—no matter what you're talking about, because what you're describing is something that doesn't change. If you're saying it in the past tense, what you're saying basically is "this was true then—it's not true now." But when you're writing technically, it's still true—even though it's not been, I mean, you write it in the tense of the facts rather than when you discovered the facts. (Interviewee 3)

The same interviewee further qualified his responses to article use and to verb tense by speculating that "maybe that's just who my adviser was and what she taught me."

Despite both interviewees' linkage of style concerns to personal preference, it is clear from our interviews and from other sources that apparently peevish remarks about verb tense, for example, reflect broad concerns about technical clarity and the nature of scientific writing. Near the end of the excerpt above, Interviewee 3 explicitly mentioned the stakes of using present tense: "when you're writing technically, it's

still true," and present tense effectively signals a stable condition undisturbed by the writer's discovery of that condition. Alongside this articulation of a stable present, technical writers should also avoid overuse of personal pronouns:

> You can occasionally use ["we"] as an emphasis, but a lot of the time what you really mean is, you're describing your method, and you say, "we did this" when you could say that "the method does this," because the fact that you did it is not important, because it's something that would still work even if it wasn't you. (Interviewee 3; see also Daniell et al., 2003)

As the tense example demonstrates, faculty interviewees saw particular stylistic decisions as hallmarks of good technical writing, which implies that "good" technical communication and "good" grammar go hand in hand. However, each interviewee at least tacitly revealed tensions between that view and the view that technical writing and more general English-language writing are easily separable. Similar to comments we reported earlier about perceived grammar problems, one of our interviewees was especially direct about his view of the discrete difference between technical work and writing, as well as the implied division of labor:

> In general, I don't want to spend my time doing that [correcting/responding with marginalia]. It's not what my job is. I generally want to see the students get to the point where they can do the science, because that's hard enough. (Interviewee 4)

Interviewee 4 reiterated this claim ("it's not my job") in explicit terms once more in the interview and connected the claim to the idea that students he works with should already have mastered a basic, general set of writing competencies so they can "do the science":

> so the [native English-speaking] student that I was talking about, worked with the post doc from Myanmar on one paper and they sent me a draft and I think there are some problems with who owns this work, that's kind of making people hesitant with wanting to take control of it. So, it's collaborative writing and it's not going perfectly well. But, on the whole, I looked at it and the thing was crap…. [A]nd I told him, you know, I'm not even going to look at it until you go over to the writing center or CLEAR or something and get them to go through it with you because I don't want to be working with your English. (Interviewee 4)

This interviewee's claim about the separability of "the writing" and "the science" was generally supported by our other interviewees, whether they believed individually that their (international or domestic) graduate students had trouble with technical concepts and precision or not. Interviewee 2 clearly stated that

> they [international second language students] pick up on that ["technical stuff"] pretty well. Numbers and figures and charts and concepts and stuff like that is generally not a problem. So it's not a communication issue as much as it is an English language issue and the writing and the rules.

Interviewee 3 reported a very different assessment of some students' technical abilities, but nonetheless affirmed this perceived separation:

> I had a Japanese student who writes this stuff beautifully. I mean, occasional grammar mistakes, occasional wrong "the" …commas here and there and stuff like that—it's not like so bad that there's blood on the page, right? It's very minor sort of corrections there. And it's the technical part they struggle with. Not the writing part.

On the other hand, however, this separation is difficult to sustain. Especially as graduate students turn their attention to single authorship of theses and dissertations, the stakes increase along with the expectation that effective technical writing merges with more general ideas about effective communication. Interviewee 1 reported on difficulties a native Hindi-speaking graduate student encountered in writing a literature review, thus blending "technical" and more identifiably academic writing:

> I knew she read the reference and I knew she reworded it, but I could tell she didn't quite understand the English enough to reword it differently in a way that still flowed. So that one we did a lot of editing on to get to its final state. I could tell she wasn't plagiarizing—she was rewording it, that was clear, and that she knew what the paper said because she could restate it. But, in the restating and I think probably in the trying to sound scientific—if she had just been saying it casually, she would have said it fine. But in the trying to sound scientific, there's funny words that don't quite belong.

Interviewees 2 and 3 commented more directly that more general, and arguably more basic, considerations of writing and other language use are inevitably in play—even going as far as conflating technical writing proficiency with elementary comprehension ability:

> if someone's got a third-grade comprehending level and writing level, they're not going to be able to get to the level of writing papers in professional journals in six months or a year or a year and a half. It will take them five years, and most don't have that time. (Interviewee 2)

> You can't understand if they've got the technical part right because you can't parse the sentence, right? (Interviewee 3)

In fact, the relations between technical elements and stylistic considerations, especially in long writing tasks, is a large factor in Interviewee 3's assessment of the time it takes to respond to writing. More so than other interviewees, this faculty informant reported spending significant time working directly with students on revision. Not coincidentally, the same informant reiterated a sense of surprise that the revision process is so time intensive:

> I never realized that my job was going to be spent—a very huge percentage of my time is spent just reading and critiquing writing, and same with speaking—practice presentations and things like that. Not to mention the papers I review. (Interviewee 3)

Collaboration and Peer Review

Given the high level of collaboration that many engineering projects require, we expected to encounter much evidence of group-based tasks and interactions. In fact, it is typical for engineering students to work in peer groups on different elements of a larger project. Yet collaboration in terms of writing and peer review is not common practice for the advisers we interviewed nor for their students. On this point, the difference between graduate and undergraduate writing education in the college is perhaps clearest: the faculty members we interviewed also teach undergraduate classes with integrated instruction and support from CLEAR Program writing teachers. And they have seen the benefits of collaborative writing and peer review at that level. When asked about peer review, for example, one faculty member had an "aha" moment and stated: "I haven't done peer reviews with them [graduate students] in the past. I think that would potentially be really good" (Interviewee 1). Another faculty member saw peer review as a process to be employed only after development of novel scientific ideas. He stated: "I wouldn't say we've gotten that sophisticated yet … you should have it pretty polished…. My goal is to get to that point" (Interviewee 4).

Another faculty member explicitly stressed the importance of collaboration in several stages of a research project but does not see those stages tied to writing processes. He argued that "engineering papers are straightforward, and thus, don't need a collaborative process." However, this informant seemed to contradict his statement about their apparent simplicity in describing study planning:

> Mostly the collaboration comes in conducting the research study, which would be how are we going to run this model? What results do we want to show in the paper? What makes sense? Do we think we're framing the introduction to the paper [appropriately]? Do we need to rethink the conclusion? That's probably where the most collaboration takes place is with results. (Interviewee 2)

And he went on to explain how interpreting results and drawing conclusions are iterative processes tied to writing:

> Synthesizing all the results we usually do together and we do it iteratively where we'll sit down and we'll put the results, draw our conclusions and usually we are modifying conclusions because we start off making our conclusions and then we set out to prove that through hypothesis driven research. So, we usually iterate. We'll say, well, we didn't quite get what we expected, how do we change what our conclusions are? (Interviewee 2)

In short, collaboration seems to play an important part in strategizing and refining papers. But the faculty members we interviewed claimed to incorporate no formal collaborative writing nor peer review at the graduate level, despite having success with peer review at the undergraduate level.

Advisers' Recommendations

We asked the faculty informants what they would recommend to improve writing at the graduate level, with particular attention to the writing of international second language students. Each of them responded differently. One adviser thought the current resources available to help with graduate student writing are sufficient; rather, the issue is increasing awareness and utilization of available resources:

> There's this broad spectrum of resources out there that people can take advantage of. First, they or the adviser have to know they're out there. Second, there has to be the impetus to take advantage of them. Third, they have to do the work. The pressures on most faculty are great enough that they may not bother to try and do something extra outside of what they're directly responsible for and that's get this paper in by this deadline. (Interviewee 4)

He went on to explain that setting high expectations for writing is a necessary first step to solving perceived problems with second language writing:

> The best thing in my mind is to set expectations and examples that are high. If we accept poor writing and poor communication, then nobody's going to fix it. So, it's really about making the decision that this is something we're going to value and then doing something about it. (Interviewee 4)

A second recommendation was some combination of an exam and a required writing class for all incoming students, not just second language students:

> When I was a PhD student, we had to do a writing exam and if you didn't pass, you had to take a class. So I think especially for foreign students, it would be great if either there was just a

> requirement or an exam. So if you speak English great, no problem, you'll fly through it, but you have to take this class. Or maybe we just have a really high cut off on the TOEFL and below this high cut off, you've got to take the class. I think they could really benefit from it because there are so many challenges learning a different language. (Interviewee 1)

Given some faculty interviewees' positive experiences with CLEAR, it is not surprising that a third recommendation was an integrated, interdisciplinary, collaborative approach to graduate student communication. One faculty member who has seen the benefits of the undergraduate program would like to see more systematic writing support at the graduate level: "I do strongly support, if you're able to get something graduate CLEAR-like going, it would be beneficial. It would certainly save us a lot of time and effort" (Interviewee 3).

In short, all of the faculty advisers appreciated the importance of strong writing skills and recognized the need for more focused attention directed toward improving students' writing. They encouraged their students to use the resources currently available and would also be open to the development of more direct instruction in the form of a required course or more integration of communication support at the graduate level.

Discussion and Conclusions

Our analysis of interview data reveals a range of complex, and often conflicting, attitudes about the efficacy of spending time on communication concerns, the value of faculty members' own experiences as responders to student writing, the effectiveness of individualized versus group instruction, the need for collaboration in writing projects, the separability of "science" and "writing," and the abilities and needs of international second language students. Overall, faculty interviewees demonstrated awareness of and appreciation for the CLEAR Program's support for undergraduate engineering education in the college and articulated a desire for more systematic and sustained support at the graduate level. Indeed, our informants represent not only the best intentions toward graduate education but also a high level of dedication: while they may struggle with determining the best ways to provide discipline-specific writing support for their graduate students, they work at it consistently in spite of the uncertain academic and professional incentives to do so. Thus, our analyses and conclusions here should be read less as criticisms and more as suggestions toward understanding increasingly common faculty-graduate student relationships in engineering and toward managing those relationships both efficiently and effectively.

Time pressures, both at a broad level (career plans, tenure, and promotion) and at a project level (deadlines and deliverables), are perhaps the greatest single influence on faculty informants' attitudes about working with the writing of international second language graduate students. While undergraduate engineering students are expected to be learning their disciplines as pre-professionals at the same time they are meeting more general undergraduate requirements, graduate students are clearly expected to assume more specialized roles as engineering researchers and scientists. Where undergraduates often enter the university as majors in engineering fields who take courses in established curricula, graduate students negotiate entry into "labs," or small, project-oriented groups that are visibly led by individual faculty members. These labs often perpetuate themselves by producing collaboratively authored research reports on ongoing projects—reports conventionally lead-authored by the faculty members in charge. The premium on collaboration for these projects, especially for the sake of graduate students' professional development, thus meets a premium on publishing reports for the sake of faculty members' own development—a tension that helps explain, on one hand, informants' simultaneous recognition of the value of peer review/collaboration and, on the other, their hesitation to employ collaborative writing strategies, which may be time consuming.

Time pressures also seem connected to the belief that technical writing and "correct" English are easily separable—that students can (and should) learn "grammar" prior to and outside of technical coursework

and mentoring. A corollary to claiming that the teaching of grammar and style is not the job of engineering faculty members is claiming that it is (exclusively) the job of dedicated writing instructors and/or tutors, who have both time and incentive to look at writing concerns. To be sure, significant time can be spent on grammatical and stylistic conventions in standalone writing courses and in writing center tutorials, but it is clear even from interviewees' own comments that a rigid division between "the writing" and "the science" is unsustainable. Indeed, in one informant's words, students who only receive grammar assistance "on the side" (in a separate tutorial, for instance) may bring back conventionally correct documents but may demonstrate little understanding of why they are correct. To return to the example of verb tense, a student who brings a "clean," outsourced draft back to an adviser may still violate the adviser's expectations if s/he honors general/academic tense conventions but not the more discipline-specific "technical present." And in the case of international second language writers, this example may suggest even greater complications: as we noted in our introduction, for example, a growing number of international graduate students in engineering are native speakers of Chinese languages, which use aspectual adverbs and particles instead of verb tenses to mark time.[3]

While faculty informants expressed concerns about interactions with all their graduate students, many of their concerns do seem particularly germane to international second language students, who make up a large and increasing fraction of the total graduate cohort in engineering. To be sure, some of our interviews revealed condescending attitudes about the writing abilities of some international graduate students. However, those attitudes seem to reflect interconnections among a range of factors influencing faculty members' responses to their international second language students, including not only students' writing experience and ability but also their technical expertise, language proficiency, familiarity with U.S. academic norms, and intercultural communication skills, not to mention faculty advisers' own attitudes about the value of technical education, writing education, and efficiency, as well as their unfamiliarity with patterns of second language writing development. So, comments about students' lack of knowledge of grammar, for example, may not only reflect a specific reaction to writing but also to those other factors.

Tensions between faculty informants' desire to improve writing support and the pressures they and their students feel suggest the utility of more (and more systematic) writing support, especially given informants' positive experiences with the CLEAR Program. However, significant differences between undergraduate and graduate education in the college argue against the wholesale application of a CLEAR model. The CLEAR Program integrates expert writing support into existing undergraduate engineering courses, where CLEAR instructors refine their knowledge of discipline-specific technical writing as students progress through organized curricula. At the graduate level, academic progress is complicated by the orientation of faculty-led labs—small groups whose writing tasks are not usually determined by set curricular goals but rather by project-specific goals. The challenge, then, is how to translate the successes of the CLEAR Program to the graduate level in a way that accounts for the graduate program's pedagogical context, including both its lab orientation and its growing proportion of international second language writers.

Overall, the central role that faculty members play in labs and the close relationships they have with students and their writing point to an approach that enlists them as fully as possible in the teaching of disciplinary writing. Time pressures are inevitable and understandable, and they may tempt some faculty members to believe that dividing approaches to student writing—between "the science" and "the English"—is an effective way to manage them. But the same faculty informants who described their attempts to divide response in this way also expressed their understanding that the writing and the technical content are inseparable. The active presence of CLEAR instructors in undergraduate courses is a visible reminder that technical work and communication work go together, and it is also a reminder that the complexity of the work calls for multiple points of contact and socialization. Rather than encouraging a view of engineering faculty members as the "technical" experts and of writing consultants as the "writing" experts, a program of graduate-level engineering writing support should encourage faculty members, consultants, and students to see knowledge of engineering writing as a distributed system. Whether they are fully comfortable with

the idea or not, the faculty members we interviewed are, in fact, technical writing experts, as their own records of publication and, at least in some cases, editorial experiences attest. And to the extent that CLEAR Program writing consultants have attended, actively participated in, and helped facilitate undergraduate courses, they can bring their emerging knowledge of engineering communication to labs, where they can refine it to the labs' specific contexts.

Such a distributed, social approach could well benefit international second language graduate writers and improve faculty responses to their writing. As the literature shows, and as our own faculty informants attest, such students can be hesitant to seek writing support or even to ask questions that would clarify expectations. Unfortunately, the one-on-one relationships that characterize faculty labs can exacerbate international second language students' isolation from critical support. While it would be impractical to propose widespread changes to the lab-based pedagogical structure, we believe enlisting writing consultants in labs could give students an additional avenue for response—one that would not require students to seek outside feedback or risk their (perceived) standing in a lab by going only to their supervising faculty members with writing questions. We also believe that writing consultants, especially those with direct knowledge of and experience with second language writers, could model effective intercultural communication strategies for faculty members: they could, for instance, conduct needs analyses with international second language graduate students when they enter faculty members' labs, augment what they learn from such analyses with findings from studies of contrastive rhetoric, and provide faculty advisers opportunities to learn more about intercultural interactions and second language writing through workshops and other fora at lab, department, and whole college levels.

Finally, we believe all parties should reaffirm the importance of writing not only as deliverable evidence of production but also as a key mode of learning. This view of writing means that consultants would bring more explicitly process-oriented approaches into interactions with students, encouraging them to write outside of the write-submit-evaluate-revise cycle our faculty interviewees saw as typical. Conflicts may, then, arise between a desire on one hand to improve students' writing practices and a need on the other hand to get specific documents done. But for international second language writers in particular, the net effect of more instructional integration at the graduate level could be quite positive. While second language writers may be even less likely than their native-English-speaking peers to seek multiple responses to their writing, they are frequently most in need of those responses and of the time they imply. Adding at least one other source of socialization, especially at the transition between supposedly individual and much more public, professional writing, could be a crucial investment for international second language writers and the faculty advisers who share with them substantial investments of time and energy.

Appendix - Areas of Inquiry for Interviews with Faculty

- On average, how many of your advisees are L2 writers each year?
- What do you see as most challenging related to L2 writing?
- How do you provide feedback to your L2 advisees?What process do you follow?
- Describe a typical meeting. How often do you meet?
- What kind of guidance do you provide to your L2 writers?
- How would you characterize your written comments to L2 writers?
- What do you recommend in terms of improving L2 writing?

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Notes

[1] We plan a follow-up study that will interview matched pairs of advisers and graduate students, allowing us to explore the convergences and divergences of their attitudes and experiences.

[2] There appears to be some conflation in this informant's response between the typical work of a university writing center and the typical work of a hired tutor and/or editor. Where an editor or a tutor for hire might focus on correcting apparent grammatical errors with a specific deliverable piece of writing in mind, writing center tutors/consultants are more likely to respond to a much broader range of discursive concerns and to enlist the

student in discovering and addressing them. The writing center-based approach, then, more closely resembles process-oriented writing pedagogies in its focus on improving a student's writing ability over time rather than on tightly editing a specific piece of writing on a quick deadline.

[3] The research tradition of Contrastive Rhetoric has hypothesized that non-native English writers often show evidence of their native languages' preferred rhetorical styles (see Connor, 1996; Connor et al., 2008). While this hypothesis has been extensively criticized in recent years (see Kubota & Lehner, 2004), students' cultural and language background is certainly salient as one among many factors, including educational history, experiences with different written genres, and length of time in English-speaking contexts, among others.

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