Writing Across Engineering: A Collaborative Approach to Support STEM Faculty’s Integration of Writing Instruction in their Classes

Ryan Ware, University of Illinois at Urbana-Champaign

Ryan Ware is a PhD student in Writing Studies primarily interested in cultural-historical theories of writing and learning to write. He is part of an interdisciplinary team that focuses on helping STEM instructors integrate writing into their courses, and that helps departments integrate writing across undergraduate curricula.

Nicole Turnipseed, University of Illinois at Urbana Champaign

Nicole Turnipseed is a PhD student in the Department of English and the Center for Writing Studies. She currently serves as Assistant Director for Center for Writing Studies. She teaches a range of writing courses and works with faculty and teaching assistants across disciplines to help hone their writing pedagogy. Her research and teaching focus on holistic literate development.

Dr. John R. Gallagher, University of Illinois, Urbana-Champaign

I am an assistant professor of English at The University of Illinois, Urbana-Champaign

Ms. Celia Mathews Elliott, University of Illinois at Urbana-Champaign

Celia Mathews Elliott is a science writer and research administrator in the Department of Physics at the University of Illinois at Urbana-Champaign. She has been teaching technical communications to upper-level undergraduate physics majors since 2000, and recently developed, with S. Lance Cooper, a graduate technical writing course.

Prof. John S. Popovics, University of Illinois, Urbana-Champaign

John Popovics is a Professor in the Civil and Environmental Engineering Department at the University of Illinois at Urbana-Champaign. He earned his B.S. and M.S. in Civil Engineering from Drexel University and his Ph.D. in Engineering Science and Mechanics from Penn State. His research interests include testing, sensing and imaging of infrastructure and geologic materials. He is also involved in efforts to improve writing skills in engineering students.

Prof. Paul Prior, University of Illinois at Urbana-Champaign

Paul Prior is the Director of the Center for Writing Studies and Professor of the Department of English at the University of Illinois at Urbana-Champaign.

Julie L. Zilles, University of Illinois, Urbana-Champaign

Dr. Zilles is a Research Assistant Professor in the Department of Civil and Environmental Engineering at the University of Illinois Urbana Champaign. She received her B.S. in biology from the Massachusetts Institute of Technology and her Ph.D. in Bacteriology from the University of Wisconsin Madison. She teaches biological principles of environmental engineering and a graduate level scientific writing class, conducts research at the intersection of microbiology and environmental engineering, and is leading an interdisciplinary collaboration between STEM and Writing Studies focused on intervention and research related to developing the writing skills of engineering undergraduates.
Writing Across Engineering: A Collaborative Approach to Support STEM Faculty’s Integration of Writing Instruction in their Classes

Abstract:
As the Accreditation Board for Engineering and Technology (ABET) has emphasized, engineering students must develop effective communication skills for successful transition to the workplace after graduation. Embedding communication instruction in technical courses signals to students that their profession values communication, facilitates transmission of discipline-specific conventions, and tackles difficulties associated with learning transfer. However, STEM faculty seldom receive any preparation to teach writing or other types of communication. Situated in the College of Engineering at the University of Illinois at Urbana-Champaign, we have undertaken a multi-year collaboration between STEM and Writing Studies faculty and graduate students that aims to improve engineering students’ writing and communication. Taking a transdisciplinary action research approach, we follow an integrative, iterative model of intervention and assessment. This paper describes a program titled “Writing Across Engineering” (WAE). WAE was designed to support STEM faculty as they work to integrate writing and writing instruction in their classes and curricula. We see our paper as a theoretical-methodological framework for others interested in designing collaborative professional development for writing instruction at their own universities.

I. Introduction
With modest financial support from the College of Engineering at the University of Illinois at Urbana-Champaign, an interdisciplinary team of Engineering and Writing Studies faculty and graduate students has undertaken a comprehensive, multi-year effort to improve STEM instruction and student communication skills by studying best practices in writing instruction and adapting them to the needs of large-enrollment (50 to 170 students) science, technology, engineering, and mathematics (STEM) courses. Despite the emphasis placed by the Accreditation Board of Engineering and Technology (ABET) on developing engineering students’ mastery of communication skills [1], we found a number of obstacles to teaching these skills in our engineering courses, including large class sizes, lack of faculty and teaching-
assistant (TA) training in teaching or grading writing, widely varying opinions about what constitutes “good” writing, and already crowded individual course content and departmental curricula [2]. Similar obstacles have been reported at other institutions [3].

To address these issues, our team implemented a voluntary “Writing Across Engineering” (WAE) program for interested faculty that integrated concepts of “community of practice” models [4] with transdisciplinary action research principles [5]. This paper reports on the implementation of this program in academic-year 2017/18 and is meant to serve as an open roadmap for those interested in developing an interdisciplinary community of practice to support writing instruction in STEM.

In Section II, we describe our institutional context, project background, and preparatory work. In Section III, we describe the central concepts that informed our activities, namely writing-across-the-curriculum approaches to writing instruction, the community of practice notion of shared knowledge-making, and principles of transdisciplinary action research. This section briefly reviews the literature and elaborates on the structure of the WAE program. Section IV presents our framework for WAE, which is largely based on a study we conducted in the 2016/17 academic year [2]. Here, we trace the uptake of one key concept across three voluntary participants: writing-as-process. We conclude with challenges and recommendations we see growing out of our collaborative approach to support STEM faculty in their integration of writing instruction into their courses (Section V).

II. Project background

Institutional Context and Our Team

The authors are affiliated with a large land-grant research (R1) university. The curricula within the College of Engineering (COE) at our university have not traditionally addressed the development of undergraduate students’ writing skills in a comprehensive and organized way. Recognizing the benefits of such an approach, the COE has funded several instructional innovation projects to improve engineering students’ writing and communication skills.
The authors, comprising faculty and graduate students from engineering and Writing Studies programs form one team – what we describe later as our core “community of practice” [4]. Our core team comprises two faculty from Civil and Environmental Engineering (CEE); one faculty, one academic professional, and one graduate student from Physics; and two faculty and three graduate students from Writing Studies. The team is co-led by one faculty in CEE who has a strong interest in improving writing in STEM not only in CEE, but across engineering curricula, and one faculty in Writing Studies who directs the Center for Writing Studies and oversees the Writing Across the Curriculum work at our university. Our group has adopted a sociocultural model of learning and writing [4, 6]. Sociocultural theories of learning argue that learning is situated in concrete activities that are mediated by the use of tools that encompass “machines, made objects, semiotic means (e.g., languages, genres, iconographies), and institutions to structured environments, domesticated animals, plants, and indeed, people themselves” [6: pp. 55]. Sociocultural theories of learning can be contrasted with typical, more individualistic notions of learning, in that people are understood not as passive recipients of knowledge, but rather as participants in activities who use tools (such as language and writing practices) in legitimate ways and are thus socialized and individuated into ways of thinking and acting [4, 6] in disciplines.

Our team has been awarded a series of three one-year instructional innovation grants by the College of Engineering. In the first year, our team used this support to study the nature of STEM writing instruction at our university. We deployed a mixed-methods approach to gather data. This process included two surveys, one administered to faculty and one to department leaders in twelve departments within the COE, along with other ethnographically situated materials that would drive the development of our approach and the ways in which we operate as what Lave and Wenger [4] call a “community of practice.” Our STEM faculty surveys illuminated some key findings. In particular, while all participants noted that undergraduates’ facility with written communication in their classes, in their overall departments, and after graduation, was important (to varying degrees), they ranked themselves as poorly prepared to teach concepts related to writing. Moreover, survey respondents noted time for teaching of writing was severely constrained by already packed content in classes and curricula necessary to

---

1 The project is currently in its third year of funding.
meet degree requirements. They also expressed ambivalence about their abilities to effectively assign grades to student texts. In the second year, we implemented a program to share our findings with COE faculty and promote improved writing instruction in their classes. A complete review of our methods and findings from the first year study can be found in *Examining engineering writing instruction at a large research university through the lens of writing studies* [2].

In the next sections, we highlight three core concepts that help make explicit our work as a community of practice and our broader approach to the improvement of writing instruction in STEM courses.

**III. Project Description**

*Sociocultural Theories of Learning and Writing: Toward a WAC-based interdisciplinary community of practice.*

The basic framework of the current writing-across-the-curriculum (WAC) movement emerged in the 1970s [see 7, 8]. WAC programs generally assert that writing instruction should take place across all disciplines rather than being isolated in “English” coursework. WAC programs and initiatives are usually predicated on social conceptions of writing (i.e., again, contrasting with more individualistic notions, and seeing writing not as a solitary act, but as socially distributed across people and varied practices), and on writing-as-process and writing-to-learn models [7, 8, 9]. Writing-as-process has a long, complex history [10, 11], but can be summarized as being in direct opposition to product-based conceptions of writing [11], which tend to freeze (and grade) one instantiation of writing, neglecting the complex, social processes and trajectories through which writing is developed, often being co-constructed with others and with various tools. Writing-to-learn models are predicated on a history of empirical research, and argue that writing helps individuals figure out what they already know and what they need to know more about [12]. Thus, writing is not a clean process of translating what students know into written text, it is a process of discovering and developing what they do know through using semiotic tools. As Witte [13] argues, “an adequate theory of writing must be able to account for the fact that writing can be both a process of translating ideas or thoughts into visible language and a process of discovering meaning through language” [pp. 263, emphasis added].
WAC practitioners understand writing as deeply intellectual, epistemological, and situated in disciplinary activities – not as a simple skill that can be learned once, and transferred to new, disparate, inter-and-extra-disciplinary situations. Altering entrenched constructs of writing-as-product and writing-as-discrete-skill-set, WAC activities can introduce faculty and graduate TAs to best practices from Writing Studies, helping them think through basic tenets of “good” writing pedagogy (i.e., writing-as-process and writing-as-knowledge-making, effective and efficient instructor and peer response practices, and more clearly elaborated assignment design).

WAC has traditionally employed workshop models to convey its principles to faculty across disciplines. WAC programs are usually housed in whatever department administers first-year writing, and workshops are led by writing specialists who present talks and organize activities regarding best practices in Writing Studies and pedagogy [14: pp. 69-71]. While we believe in the utility of WAC work, it is not without faults. Generally, traditional WAC models have led to critiques that such work reduces exceptionally complex pedagogical practices for teaching writing to simple strategies that can be mastered in a short time [15] – an ironic critique, given that WAC proponents hope to challenge overly simple notions of writing. Walvoord et al., [14] have warned against more stabilized “WAC orthodoxy.” Others critical of WAC have likened its practitioners to missionaries, delivering “good” writing pedagogy to those who attend workshops with little or no follow up to determine whether what they have demonstrated is actually put into practice by faculty across disciplines, and if it has been, whether or not it works.\(^2\)

Traditional WAC approaches may frame STEM instructors as passive participants receiving “best practices” from Writing Studies rather than as participants in a knowledge-making enterprise. For Writing Studies theory and practice to align with STEM needs, we believe that STEM instructors should be co-developing the theory and practice of writing in conjunction with Writing Studies faculty. By creating a more collaborative endeavor, pulling together a team of Writing Studies and STEM faculty and graduate students to form a core community of practice,

\(^2\) We believe that our elaborated model addresses these issues, particularly in our work in mentoring WAE participants following our semester of workshops, but a full assessment of our first semester of mentoring is still underway and beyond the scope of this paper.
we hoped that our pedagogical innovations would be more attuned to the needs of instructors in the COE, and that our project would branch outward with our participants joining as members of our community in varying capacities. Lave and Wenger [4] define a community of practice as “a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities of practice. A community of practice is an intrinsic condition for the existence of knowledge” and later note that “participation in the cultural practice in which any knowledge exists is an epistemological principle of learning” [4, pp. 98, italics added].

A community of practice model is a natural progression of our team’s sociocultural view of learning and writing that we bring to our WAC work in Writing Across Engineering. We see knowledge as located not solely in persons, but as distributed across the activities and practices of people acting together using tools in specialized settings. While most WAC approaches are not predicated on the formation of sustained communities, we have come to see it as a critical starting point. Figure 1 is a visual representation of our core team and our Fall 2017 cohort in Writing Across Engineering, supported by our wider instructional innovation program housed in the COE.

The emphasis on bringing together a small cohort of faculty to study and innovate around a topic, and working to build community, are elements that we take as exceptionally important in creating and sustaining positive relationships with our participants. We believe, based on anecdotal evidence, that these practices increase buy-in. We’ve found that the bonds we foster lend themselves to sustained participation in WAE activities far downstream from when participants initially begin working with us. Our project team has become a key infrastructure for this community of practice [4] as it spirals outward. Additional faculty are brought into our community through word-of-mouth, targeted recruiting, seminars by outside speakers, participation in our WAE program, informal gatherings, and the inheriting of course materials influenced by our project. Graduate students have similarly variable types of exposure and degrees of involvement. Involvement is most intense for those who work on the project, but spreads out to graduate students who receive TA training from our project team, who serve as
TAs for faculty influenced by our project, and who are advised and/or taught by faculty so affected and influenced.

**FIGURE 1.** Structure of the Writing Across Engineering team showing partnership and sustaining support for WAE faculty participants.

Communities of practice are critical for researching and understanding complex issues, so that achieving and sustaining pedagogical and curricular change falls within reach. However, we also believe that institutional and cultural changes are needed to realize our students’ communicative potential within their disciplines and professions and within society. On this note of research, intervention, and change, we turn to a third critical concept in defining our approach to WAC-based pedagogy in a community of practice model: *transdisciplinary action research.*
Transdisciplinary Action Research

Our approach is aligned with the notion of transdisciplinary (or transdisciplinary action) research (TDAR). We use “transdisciplinary” as it is related to our methodology for action-based intervention within varying departments in the College of Engineering. Stokols [5] highlights that transdisciplinary action research brings together multiple disciplines and stakeholders who collaboratively aim to simultaneously investigate and ameliorate real-world problems, to act in community and institutional settings, and actively monitor whether that action is achieving desired goals, is sustainable, and is not producing new problems. Pohl and Hadron [16] define transdisciplinary research as research that “deals with problem fields … in such a way that it can: (a) grasp the complexity… of problems, (b) take into account the diversity … of life-world … and scientific perceptions of problems, (c) link abstract and case-specific knowledge, and (d) develop knowledge and practices that promote what is perceived to be the common good” [pp. 431-32]. Perrin [17] notes that transdisciplinary action research projects are “designed cyclically and planned incrementally to allow for unpredicted developments and foster mutual learning,” and that they aim “to define and solve a complex real-life problem sustainably”—a goal that requires stakeholders “to handle risks related to crossing borders between scientific and other fields” [p. 18, emphasis added].

Our project team and the wider community of practice identified a set of problems related to writing development and instruction in engineering. We brought together faculty and graduate teaching assistants from several engineering departments with those from the Center for Writing Studies. We have devoted considerable time (meeting weekly during the academic year) to discussing our understanding of, and research on, writing, writing assessment, academic and professional engineering practices, institutional structures that support (or complicate) teaching in engineering, understanding of genre and discourse, and research methods. We have engaged,

---

3 We use “transdisciplinary” and “interdisciplinary” for slightly disparate purposes. We define the word “interdisciplinary,” which we use to describe our team built of members across disciplines.
in conjunction with our broader community of practice, in a series of linked processes of inquiry and action followed by inquiry about the effects of the action and redesign of that action. None of us have been able to simply hold the views or continue the practices that we brought to the collaboration three years ago. A transdisciplinary action research methodology mapped well onto the problems identified in our first-year study [2], and following the cyclical design-redesign nature of TDAR, our continued findings lead to adjustments in our work and interventions in real time to suit our and our participants’ needs in situ. We see this as a strength of our approach to our WAE activities.

Development of the Writing Across Engineering program.
Knowing that we planned to start with introducing faculty in the COE to key concepts from Writing Studies, our core community of practice (that is, those members named as part of the team working in conjunction with instructional innovations funding) met several times to map out what sort approach might work best. For instance, would weekly meetings be better than meeting four times per semester with longer sessions? Ultimately, we decided to meet weekly in order to build community. We also wanted our project to gain traction across campus (as well as to maintain strong attendance), thus we opened it up to other STEM faculty who were in some fashion already associated with the COE. We identified what practices we would present from the field of Writing Studies and traditional WAC approaches with an explicit aim of balancing highly theoretical Writing Studies concepts with useful tips and pragmatic solutions (which might, of course, oversimplify the theory). Some [18] have identified tensions as typical WAC approaches are considered in STEM. For example, WAC aims at broadening constructs of writing-as-process and writing-to-learn, but those notions are often at odds with STEM fields’ focus on products and desire for quick and simple practices that help their students communicate effectively (see above in this section). Keeping these issues in mind, and in conjunction with some of our survey findings regarding STEM instructors’ needs for pragmatic solutions for writing instruction [see 2 for fuller review], we decided to emphasize “time-saving” strategies and related tips at the beginning to entice faculty to return weekly to our workshops while also creating regular opportunities for faculty to apply ideas to their classes and assignments. Table 1 depicts the structure of our first semester of Writing Across Engineering.
<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Process and writing-to-learn</td>
<td>Introduced different purposes for writing in the classroom and a process orientation to writing</td>
</tr>
<tr>
<td>2</td>
<td>Responding to writing</td>
<td>Introduced effective techniques for responding and discouraged line-by-line editing</td>
</tr>
<tr>
<td>3</td>
<td>Saving time when responding to writing</td>
<td>Addressed concerns from previous week and introduced more response techniques, including video/screen capture</td>
</tr>
<tr>
<td>4</td>
<td>Designing effective writing assignments</td>
<td>Discussed assignment goals</td>
</tr>
<tr>
<td>5</td>
<td>Unpacking clarity (guest speaker)</td>
<td>Discussed terms like clarity and conciseness, trying to articulate what they mean</td>
</tr>
<tr>
<td>6</td>
<td>Assignment design workshop</td>
<td>Workshopped assignments the participants brought in, discussed alignment with goals and ways to incorporate writing process and scaffolding into the assignments</td>
</tr>
<tr>
<td>7</td>
<td>Assignment design workshop</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Source use, citation and plagiarism</td>
<td>Reviewed legal, ethical, pedagogical and research perspectives. Did activities reflecting on multiple norms and the complexity of rephrasing technical material that is unfamiliar.</td>
</tr>
<tr>
<td>9</td>
<td>Assessment</td>
<td>Analyzed current practices, introduced sample rubrics and concept of portfolios</td>
</tr>
</tbody>
</table>
Assessment workshop

Workshopped existing assessments, discussed strategies to separate response and assessment

Supporting English language learners

Reflected on diversity of needs, did an activity illustrating how grammar rules may not represent language in use well, and considered ways of applying writing-to-learn and different response strategies to support multilingual students.

Examples of implementation

Presented examples of changes faculty have made in engineering assignments to reflect a process orientation

Because of the limited scope of this paper, we cannot elaborate on all aspects of WAE or all the ways pedagogical strategies played out across all our participants’ highly disparate teaching contexts. Instead, we will focus here on one key thread—the ways that we can begin to trace “writing-as-process” from our work in WAE as it branched out across individualized mentoring of three STEM faculty (see below) and influenced our participants’ practices in teaching writing.

Writing-as-Process.

While process approaches to writing have become well known in many educational and workplace settings, including STEM contexts, our initial inquiry suggested that writing in the COE was still dominated by a focus on single written products. Thus, in our first meeting of WAE in the fall of 2017, we mapped writing-as-process by contrasting it with “product orientations” to writing. Product-oriented pedagogies look mostly—or solely—at the documents students produce for a final grade, depicting a simple, linear process of writing framed as a logical progression of

IDEA → OUTLINE → WRITE → SUBMIT → GRADE.

Such an approach emphasizes “forms” or “genres” in the traditional sense and can mislead students into understanding writing, and types of writing, as recipes to follow for the production of highly standardized texts [19]. Product-oriented notions of writing and writing instruction can be traced back to the origins of what is usually called “first-year writing” (and further) and is an
unfortunate, still very extant consequence of current-traditional rhetorical approaches that were
developed in the United States in relation to writing at Harvard in the later part of the nineteenth
century [19]. Product-oriented constructs of writing since have long radiated outward to
disciplines that look to English and rhetoric departments for models of writing instruction.

In contrast, in practice, writing is messy, non-linear, and exceptionally complicated, and we use
“writing process” in two interrelated ways. First, most expansively, writing-as-process
approaches look not only at what the students produce, but how they produce it. Writing
assignments (handouts in whatever form), class discussions about writing assignments,
conversations writers might have with friends or instructors, reading and researching, note-taking
and/or annotation, thoughts writers might have on a bus or walking on campus are all seen as
important parts of the writing process that in some way shape text production. Second, more
narrowly, writing-as-process can simply mean that students do not follow the idea-outline-write-
submit-grade model, but instead work through a recursive, multi-draft process of writing,
feedback, and revision, so they can return to, rethink, and reshape their texts and their knowledge
of what they are writing about [13]. Writing-as-process pedagogies emphasize purpose over
form, and can serve as key points in socializing students into the writing of particular disciplines
and into disciplines themselves. After all, writing “is learning is socialization is social formation”
[20: 139], and what we call “disciplines” owe much of their formation to writing, language, and
other symbolic/inscriptional practices.

We chose to highlight writing-as-process in our first week of WAE, because we find it to be a
generative pedagogical construct that ripples out to nearly all other aspects of teaching writing.
For instance, designing a scaffolded, multi-staged, and multi-draft writing assignment for a
course requires resituating assignment design – the form or document distributed to students and
the overall purpose(s) of assignments – (weeks 4, 6 and 7 on Table 1); and it requires instructors
to account for and plan their response practices, and perhaps peer response practices and
workshops (weeks 2 and 3 on Table 1).
Next, we will describe our practice of mentoring, highlight briefly some changes we can readily see in our participants’ writing pedagogy as they are related to WAE and subsequent mentoring, and finally conclude with a discussion of challenges and recommendations.

*Mentoring.*

The second phase of our WAE program is individualized mentoring. From our first WAE cohort, three faculty opted to participate and were provided with a mentoring group, usually made up of one faculty and/or graduate student in a STEM field and one faculty and/or graduate student in Writing Studies. We work with the participants to design a mentoring program that is best suited for their instructional needs in their given courses and curricula. This practice distinguishes our approach even further from traditional WAC work.

One faculty member in Writing Studies, Dr. John Gallagher, and one in Civil and Environmental Engineering, Dr. John Popovics worked with Dr. Nicole Riemer a professor in the Department of Atmospheric Sciences who had no prior training in, and limited experience with, teaching writing. The course was an advanced graduate course serving eleven students. The objective for this mentoring team was to rework a semester-long literature review assignment situated disciplinarily in atmospheric sciences. The assignment focused on activities involved with writing a “literature review” and, through the course of the mentoring, was taken through five drafts.

Another mentoring team (led by Ryan Ware, a graduate student in writing studies and Dr. Julie Zilles, a faculty member in engineering) worked with Dr. Angela Kent, a professor in natural resources and environmental sciences (NRES). The objective for this mentoring team was to revise an assignment for a term paper in an upper-level mixed undergraduate and graduate course in which around twenty students were enrolled. It is difficult to say how many drafts of the assignment description were written, as the meetings were focused on disparate parts or sections of the assignment itself with the team talking through – and crafting – each section in real time, discussing the ways the professor might deploy the assignment in her class in conjunction with other practices such as instructor and peer feedback mechanisms and grading apparatuses.
Lastly, our largest scale, most intensive mentoring group was for a course in physics. PHYS 280: Nuclear Weapons & Arms Control is an upper-division-undergraduate course that fulfills a university general-education requirement for a writing-intensive, beyond first-year composition course. It is taken by a mix of majors and non-majors; many of the latter come from political science. The course serves about 65 students and is offered each spring. The Spring 2018 iteration of the course (following our first semester of WAE) employed five TAs (two undergraduate and three graduate students), many of whom had taken the course themselves or who had previously served as teaching assistants for it. A writing specialist in the Physics Department also joined the instructional staff in the Spring 2018 semester. Two of our project team members served as mentors: Niki Turnipseed, a graduate student in writing studies and concurrently assistant director of the campus Center for Writing Studies, and John Yoritomo, a graduate student in physics, who was concurrently employed as a TA for the course. At the initial mentoring meeting, the lead professor, Dr. Matthias Perdekamp who had participated in the WAE program, outlined three areas of focus: improving TA response practices, shifting the focus of weekly writing labs from technical content to writing, and revising assignment prompts to scaffold writing processes. At the start of the semester, the Center for Writing Studies staff led a focused workshop on response practices for the instructional staff, introducing a rubric crafted for one of the course assignments. Throughout the semester, the mentoring team met weekly to sketch out material (new rubrics, writing lab curriculum, assignment revisions) that would then be workshopped with the full instructional staff at their weekly meeting. The mentoring team participated in and took field notes on these weekly staff meetings. On one occasion, Niki observed all writing lab sections and ran a follow-up session to debrief the TAs. The team carried out end-of-semester discourse-based interviews with the faculty member, writing specialist, and TAs, which centered on changed materials and practices.

IV. Three Examples of Course Changes

We surveyed our WAE participants prior to and at the conclusion of the WAE semester schedule. While it is difficult to generalize findings from a survey administered to eight individuals, all eight participants reported higher levels of preparedness to teach writing skills to students in their varying disciplines and courses. Moreover, all eight individuals reported that
they had changed writing instruction in their courses in some fashion, and we are in the process of tracking the changes made to the courses of those we mentored through ongoing data collection and analysis. Those changes attuned their practices with evidence-based best practices in writing pedagogy. We turn next to focus on how changes worked toward enhancing *writing-as-process* in the three mentored courses.

Findings from our mentoring in atmospheric sciences showed that the *writing-as-process* orientation helped the faculty member reevaluate the purpose of writing in the particular assignment, as well as how writing functions more broadly in her course. In consultations with John Gallagher, the iterative, recursive process of assignment development bolstered her as she explored not only how to teach writing but how to design assignments. She also shared that the multiple consultations bolstered her confidence in rewriting assignments for other courses she was preparing to teach in 2019. Figure 2 represents her *process-based* assignment sequence.

Figure 2. Writing-as-process in a literature review assignment for an atmospheric sciences course.

In our mentoring work in natural resources and environmental sciences, Dr. Kent took up a nuanced construct of “purpose” and a writing-as-process model. Prior to participation in WAE, she used a product-based pedagogy for assigning and grading writing, similar to those described above. She noted in our first mentoring meeting (January, 2018), “I’d like this writing assignment...[to] be useful, serve some purposes, to explore a topic...Right now it’s not
benefiting, you know, the information people are generating is not benefiting the rest of the class.” Over the course of our mentoring sessions, Dr. Kent revised her “Writing Assignment” to include writing-to-learn exercises and multiple drafts with feedback from instructor and peers, and she designed a mechanism – an internal blog site – so that part of the students’ assignment was to explore and evaluate all of their peers’ writing. Thus, her assignment not only fit writing-as-process pedagogy, but was inherently social in that the students would see and learn from one another’s work. This effort was no small task, as she was redesigning her writing assignment as scaffolded and process-based while the course was in progress. Her first foray into teaching scaffolded, process-based writing is represented in Figure 3.

![Figure 3. Writing-as-process in a blog assignment for a natural resources and environmental sciences course.](image)

Dr. Kent noted after her course was finished and grades were submitted, that participation in WAE and subsequent mentoring helped her see the importance of “multi-step process” with regard to writing instruction, and that she would integrate such pedagogical practices into her future teaching (May 2018).

Findings from our most extensive mentoring endeavor, in PHYS 280, show a broad integration of the writing-as-process model. Following the faculty mentee’s goals, major changes aimed at mirroring the writing processes of professionals were made across the whole semester of the course to instruction, assignment design, and response practices. Some instructional changes included using weekly, TA-led discussion sections for writing activities around invention and genre analysis – getting students thinking and talking though assignments together in advance of drafting. Previously, discussion sections were mainly dedicated to reviewing technical content.
Revisions were added to more of the writing assignments, and students were prompted to reflect on the revision process through writers’ memos that asked them to explain how they have incorporated feedback and/or justify why they have not incorporated it. Peer response activities were expanded and restructured for all assignments across the course, as students were asked to complete their peer response activity as homework, and writing lab time was dedicated to discussion between the author and reviewer, talking through their feedback and planning for the upcoming revision. While this faculty mentee was aware of his own writing processes and had already built some process-oriented components into his course, the discussion in WAE and subsequent work with the mentoring team aided a fuller integration of writing-as-process across the course. A fuller analysis of this intervention is reported in Yoritomo et al. [21] at this year’s (2019) ASEE conference.

Data analysis (and in some cases, collection and intervention) is still ongoing for the above three cases, and a fuller analysis is beyond the scope of this paper. Nonetheless, that these instructors each substantively changed their practices in already packed courses, and that they are all planning more integration of writing in their courses, shows that participation in WAE changed their practices. Documentation of such changes in pedagogy following WAC programs and of alignment to best practices is understood as key (if indirect) evidence of student impacts [14, 22]. While we are continuing to evaluate the contributions of the weekly sessions distinct from the individualized mentoring, our observations suggest that the follow-on mentoring is a key component. These observations echo findings from a faculty development program at the University of Arizona, where unplanned, individualized coaching was added after requests from participants [23].

V. Challenges and Recommendations
Although the WAE program promoted beneficial changes to both attitudes and practices for participants, several general challenges to this type of faculty development program remain. One is promoting increased faculty participation. In our first WAE group, the participants were

---

4 While our assessment of the first cohort of WAE participants focused on changes in faculty behavior, in the current offering we have added collection of student writing samples before and after intervention, to better understand the effects of these changes on student writing.
deliberately recruited from faculty already teaching writing-intensive classes and thus represented a self-selected group that was likely more passionate about the topic and more willing to invest their time than STEM faculty in general. Truly integrating writing across STEM curricula, however, will require involvement of faculty who are not already engaged in this type of work. Subsequent iterations of the WAE program have and will investigate ways to reach a broader group of STEM faculty. Another challenge is obtaining financial and administrative support for the people developing and offering the WAE program. Our first offering of the WAE program was supported by a course release for one Writing Studies faculty member and administrative time supported by the Center for Writing Studies of the other Writing Studies faculty member. However, pre-existing departmental policies prevented the engineering co-leader from having a similar course release or other reduction in duties. More generally, institutional structures are often not set up to reward contributions to course, curricular, or faculty development, particularly at research-oriented universities. This situation presents substantial obstacles to educational innovation and research. Another key challenge can be sustaining financial support for these types of programs over the long term, particularly through administrative transitions and budgetary stresses.

Additional challenges to improving our students’ writing skills exist, for example faculty time limitations and the large population of many courses in the COE. These challenges are not unique to our institution [23, 24]. While a variety of evidence-based best practices exist in the Writing Studies literature, they have largely been developed and studied in small (30 student, or less) classes, due at least in part to a long advocacy for individualized attention [25]. We do not deny the power of such approaches, but we also believe that: i) there are many under-explored possibilities for encouraging students to develop as writers that can be effective in large-scale classes across STEM curricula; ii) cross-disciplinary teams spanning Writing Studies and STEM are critical for effective development and evaluation of those possibilities; and iii) scaffolded development of writing can amplify the ability of smaller, resource-intensive classes, such as senior design courses, to improve students’ writing by providing them with a better foundation coming into those classes.

Acknowledgments
We thank the faculty and graduate students who enlivened our Writing Across Engineering sessions, who participated in our subsequent mentoring, and who contributed surveys, course materials, and interviews to this research. This project was reviewed and approved by our Institutional Review Board and was conducted in keeping with relevant human subjects research requirements. This work was supported by funding from the College of Engineering’s Strategic Instructional Innovations Program, the Center for Writing Studies, and the Departments of Civil and Environmental Engineering and Physics at the University of Illinois at Urbana-Champaign.

References


