AC 2007-2247: OUTCOMES ASSESSMENT AS A SITE OF INTEGRATION: ABET MEETS THE COUNCIL OF WRITING PROGRAM ADMINISTRATORS

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Teaching to Transfer: Establishing a Rhetorical Foundation for Communication Practices Through an Engineering – First-Year Composition Partnership

The value of communication, collaboration, and related professional skills has become increasingly clear to engineering faculty and students in recent years, and many course developers seek to integrate these skills into existing engineering courses. However, few describe strategies for leveraging non-engineering courses as viable – perhaps even critical – pathways for developing these skills. Even when engineering faculty partner with experts in fields such as technical communication, organizational behavior, and information literacy, restricting those partnerships to engineering classes can limit both the metacognitive knowledge students develop and students' abilities to cross disciplinary boundaries successfully. To begin addressing these gaps, we have established a partnership between Engineering Education and the First-Year Writing Program. Together, we have developed an experimental pilot course of first year composition that explicitly connects the ABET professional skills to the WPA outcomes first to establish a metacognitive framework for learning communication skills and second to demonstrate that curricular choices in the humanities not only promise a "liberal education," but also provide valuable tools for developing the ability to think like a 21st century engineer. Specifically, the goals of this course were to: 1) help students develop a rhetorical framework for communication practices that builds transferable skills, 2) build a curriculum that effectively crosses disciplinary boundaries, 3) help students see how non-engineering disciplines can help them be better engineers, and 4) initiate and test a pedagogical approach explicitly intended to adopt both humanities and technology perspectives on a range of issues. This paper describes the basis for our approach and presents preliminary findings from the pilot study.

Learning to Communicate in the Engineering Curriculum

The initial focus of our partnership is on "the ability to communicate effectively." While many universities still include stand-alone technical writing courses in their curricula, numerous reports at the annual ASEE and FIE conferences and elsewhere describe strategies for effectively incorporate writing and speaking into engineering courses[1-41]. The approaches include writing-to-learn exercises to enhance students' mastery of technical concepts, individual courses that address specific types of documents and presentations (e.g., the design report, the laboratory report), and integrated curricula that support students throughout a curriculum. What all of these approaches share is a commitment to helping students learn to use writing productively in their engineering careers. Whether it be an emphasis on writing to learn, where students come to see writing as a tool for thinking, or introducing students to the types of genres common in a particular discipline, engineering faculty are seeking ways to support student development, often in collaboration with communication faculty in English departments, Writing-Across-the-Curriculum programs, and centers housed within engineering colleges themselves.

What many of these same efforts lack, however, is an approach to communication informed by research on how students learn to write, and particularly on the metacognitive rhetorical skills students need to transfer their experiences from one context to the communication challenges of a new situation. In a 2004 article in the *International Journal of Engineering Education*, Carol Boiarsky outlined the metacognitive knowledge engineering students need to ground their communication practices – knowledge focused on understanding the ways in which audience,

purpose, and context guide the selection, organization, and presentation of information in a document or presentation.[42] Boiarsky's approach mirrors the work done in the fields of composition, rhetoric, and technical communication in recent decades emphasizing the social and transactional nature of communication. In other words, as Dias et al. explain, "the context always defines the activity of writing; to write is to address or mediate a given concrete situation by producing a text. Just as there is no such thing as just writing, only writing *something*, so all writing is a response to, and assumes as a starting point, a particular situation."[43] Carolyn Miller's seminal 1984 article, "Genre as Social Action," established the ways in which workplace genres (e.g., proposals, trip reports, progress reports) take their form not from any arbitrary or idealized set of "rules" or templates, but from the social situations to which they respond; [44] those forms become regularized into genres when the social situation recurs often enough to support standardizing responses. Work by Bazerman, Berkenkotter and Huckin, Spinuzzi, and others have further developed this approach,[45-48] and analyses of the functions of specific genres have provided detailed insight into the ways in which the structure, tone, content, organization, and related features of texts support the human activities to which those texts respond.[43, 49-52]

One key implication of this research is that the quality of a given report, presentation, memo, or sketch, moreover, is not determined by conformity to an ideal standard of "good writing," but rather by the degree to which it successfully mediates the exchange of information between the writer and the readers. Surface features such as grammatical correctness, smooth transitions, and informative headings, as well as appropriate content, targeted organization, and graphical representations are valuable to the degree they support (or hinder) the exchange, but are not in themselves the features that define quality. Thus the documents circulating through a design project typically mediate the interactions among design engineers to ensure that each individual has the information needed to make subsequent decisions, calculations, or modifications. They also mediate the relationship between the engineers and the manager responsible for keeping the project on track (often the course instructor in academic settings), and between the designers and the client to insure that the emerging design is meeting the clients' specifications. Documents are "good" when the audiences involved can accurately and quickly extract the information they need for subsequent tasks.

This understanding of writing quality informs the analytical approach advocated by Boiarsky and others, where students learn an analytical framework for approaching communication tasks; standard reporting structures, grammatical correctness, transitions, and related surface features are then taught within that larger context – the context necessary for successfully transferring "the ability to communicate effectively" from one situation to another. Current research on students' transitions from school to work bears out the need for this approach. School and work are, in short, fundamentally contexts governed by different constraints, as a number of scholars have made clear.[43, 53-60] At the most basic level, writing in school is often primarily a way for instructors to evaluate students' knowledge and performance (notwithstanding the substantial role writing plays in fostering student learning and development, as documented by numerous studies of writing to learn). That is, the desired outcome of the classroom is student learning and development. The desired outcome of an engineering design project in the workplace, in contrast, is a product or process the supports the company's overall profitability and mission. Thus teachers read student writing not because they need to act on the information a given report

includes, but because they need to determine whether or not the student has mastered the content and skills the course attempts to teach. In the workplace, managers, clients, and coworkers read reports or listen to presentations to extract information they need in order to perform their jobs. Data from a workplace test becomes the basis for subsequent design or process modifications; progress reports enable managers to allocate resources or report to clients; proposals allow those with money to determine how best to allocate it. And multiple studies have shown that students, even when they have been taught "workplace formats" in school, typically struggle when moving to the workplace because they lack the kind of understanding of audience and context that enables them to communicate successfully.[12]

Despite this extensive body of research, most descriptions of efforts to integrate communication into engineering curricula do not address the metacognitive framework critical to success; instead, they tend to focus on the kind of surface features that are important in a given document or presentation, but not sufficient in themselves to build transferable skills. Whether they are partnerships with writing consultants or efforts within engineering alone, the emphasis of most programs is on providing students with models of technical reports, helping students with paragraph structure, emphasizing conformity to standard academic English (i.e., grammar and mechanics). The list presented by Gunn is typical; he argues that if engineering faculty were to focus on "the problems involved in simply beginning the production of a text, specific grammatical mistakes, difficulty in creating text that flows, awkward wording, and a lack of direction in editing" then "the text production in engineering courses would improve."[28] And while documents written for engineering courses probably would improve with that emphasis, most of the research on student learning suggests that, unfortunately, students' ability to transfer their knowledge and communicate successfully in other situations may not improve. Another common approach is the emphasis on particular kinds of documents, exemplified by Georgi's description of teaching "four writing styles[…]: lab reports, software documentation, technical presentations, and proposals" in a first-year course and Norback's stress on workplace formats in the classroom.[17]

Notable exceptions to this approach do exist, of course. Hodges et al. describe a partnership between the University Writing in the Disciplines Program and the College of Engineering that brings a metacognitive framework to a sophomore design course.[17] Work by Douglas et al. describes a similar rhetorical approach to an engineering designed lab that also focuses on helping students understand the influence of writing contexts on textual production.[10] The Research Communication Studio established by Alford et al. focuses on providing opportunities for situated cognition as students have opportunities for authentic writing experiences through their participation in undergraduate research.[1]

Most partnerships described in the literature pair engineering faculty with faculty in writing or communication programs. Most often, however, these approaches focus on bringing technical communication into engineering programs – that is, on incorporating documents such as proposals, laboratory reports, and design reports into engineering courses.[22, 24, 35] Few, if any, offer models in which first-year composition courses serve as sites to ground students' rhetorical development in college and provide the framework for subsequent communication learning. Fewer still take full advantage of the broad skill base developed in the composition classroom. In

fact, disturbingly, a number of authors speak quite disparagingly of English courses, as the following examples suggest:

- "Traditional composition courses cannot adequately prepare students for the writing required to solve discipline-specific intellectual problems or help them understand the complexities of their chosen professions" [17]

- "English professors are ill prepared to engage engineering students in a discussion of technical issues currently relevant to the students' course work, or to share personal experiences with engineering report writing, or to understand students' writing from an engineer's view point. English professors are not familiar with engineers' thought processes and are not prepared to direct students in clarifying engineering concepts through writing." [61]

Such comments, though they certainly reflect individual faculty's experiences, suggest significant misunderstanding of current work in the field of composition and the value that first-year composition courses offer to engineering students – even (or perhaps especially) without an immediate focus on the kinds of documents traditionally considered part of technical writing.

Developing a Metacognitive Framework Through Engineering – First-Year Composition Partnerships

A Framework for Rhetorical Learning

In arguing for a rhetorical framework for communication instruction, we recognize that few engineering faculty have either the curriculum time or the disciplinary background to develop and implement this approach. Also, we agree that efforts to improve students' grammatical competence or design assignments that mirror current workplace practices are valuable. But, following Boiarsky, Hodges et al., Dias et al., Winsor, and others, we argue that it is most important to develop students' ability to communicate through curricular efforts that are framed by and taught in the context of a rhetorically-based, metacognitive, analytical approach. The goals of such a framework are to help students understand 1) how areas of expertise are discursively structured and 2) how they will contribute to their own disciplines through their own communication practices. English departments offer a solid foundation for teaching such values, we argue, when they base their curricula on the outcomes for first-year composition defined by the Council of Writing Program Administrators (WPA), defined in 2000:

Table 2: WPA Outcomes for First-Year Composition [62]

Rhetorical Knowledge

By the end of first year composition, students should

- Focus on a purpose
- Respond to the needs of different audiences
- Respond appropriately to different kinds of rhetorical situations
- Use conventions of format and structure appropriate to the rhetorical situation
- Adopt appropriate voice, tone, and level of formality
- Understand how genres shape reading and writing
- Write in several genres

Critical Thinking, Reading, and Writing

By the end of first year composition, students should

- Use writing and reading for inquiry, learning, thinking, and communicating
- Understand a writing assignment as a series of tasks, including finding, evaluating, analyzing, and synthesizing appropriate primary and secondary sources
- Integrate their own ideas with those of others
- Understand the relationships among language, knowledge, and power

Processes

By the end of first year composition, students should

- Be aware that it usually takes multiple drafts to create and complete a successful text
- Develop flexible strategies for generating, revising, editing, and proof-reading
- Understand writing as an open process that permits writers to use later invention and re-thinking to revise their work
- Understand the collaborative and social aspects of writing processes
- Learn to critique their own and others' works
- Learn to balance the advantages of relying on others with the responsibility of doing their part
- Use a variety of technologies to address a range of audiences

Knowledge of Conventions

By the end of first year composition, students should

- Learn common formats for different kinds of texts
- Develop knowledge of genre conventions ranging from structure and paragraphing to tone and mechanics
- Practice appropriate means of documenting their work
- Control such surface features as syntax, grammar, punctuation, and spelling.

Clearly, these outcomes include the kind of grammatical and structural competence many engineering faculty hope to emphasize, particularly under “Knowledge of Conventions.” But they begin with the metacognitive rhetorical knowledge that research suggests is critical to knowledge transfer. In addition, the Outcomes Statement includes an emphasis on writing as a mode of thinking and learning, and thus sets the foundation for subsequent writing-to-learn activities that are gaining ground in engineering curricula, as evidenced by parallels in the ABET outcomes.

Moreover, the WPA outcomes also emphasize analytical thinking, a process-oriented approach not unlike design, collaboration, and life-long learning – all elements that are central to the ABET outcomes. The breadth of intersection between the WPA and ABET outcomes, in fact, suggested a much broader partnership than one solely focused on communication skills. Moreover, preliminary analysis of student responses (described below) suggest that students themselves view their composition classes as key sites for learning teamwork, ethics, and analytical and critical thinking. Consequently, we believe that an effective partnership between

first-year composition and engineering has the potential to provide students with a strong basis for the broad education stressed not only by ABET but by the National Academy of Engineering,[63] and employers.[64, 65] We argue that this partnership, framed by the WPA outcomes, has the potential to address a full range of professional practices in interdisciplinary settings and thus help engineering students more effectively cross disciplinary boundaries.

Research Methods: A Qualitative Case Study Analysis

To leverage these outcomes and examine their impact on engineering students' ability to communicate effectively, we have created a partnership between the Virginia Tech Engineering Communications Center (VTECC), housed in the College of Engineering, and the First-Year Composition Program, housed in the Department of English, funded by the WPA. This approach is more closely matched to those that involve first-year composition and learning communities[66-68] than those that bring writing into engineering courses. In its pilot phase, the partnership seeks to use the outcomes established by ABET and by the WPA as the basis for a first-year composition course for engineering students, taught by an instructor in composition. By linking the two sets of outcomes, we hope to provide a stronger connection for students between what they learn in their first-year composition course and the concurrent/subsequent work in their disciplines. Thus even while the composition course does not teach "engineering writing" or "technical communication," the bridge established by the attention to outcomes is designed to help students connect what they learn about writing in this course to the writing expected of them in subsequent engineering courses and workplace contexts.

Currently, two sections of the course are in process. VTECC faculty, responsible for communication-in-the-disciplines programs in several engineering departments, provided information on the ABET accreditation outcomes for undergraduates and described the coursework of the first-year engineering sequence, but the course itself retains the emphasis on critical writing and reading (including literature). It does not attempt to teach technical writing to first-year students; instead, as with all sections of composition (a course that serves the entire university), it focuses on the WPA outcomes. However, it does explicitly bring the ABET outcomes into the course to help students understand their own academic and professional contexts, and it uses texts such as Mary Shelley's *Frankenstein* as a tool not only for literary analysis but for exploring the complex nature of technology and the "broader impacts" of engineering solutions that often reach far beyond solving the technical challenge at hand. The course instructor, an experienced writing teacher who is also a published fiction writer, has a background in both the humanities and the sciences (having begun her career in fisheries and wildlife). She has designed a course that emphasizes, in her words, "creation/design and the ill consequences of abandoning one's creation" where "published work by women and minority writers will offer voices frequently not heard in the engineering profession, and will be used to promote discussions of the responsibilities and complexities of the work engineers do." Thus rather than offering a narrow concept of "technical writing" and teaching specific report formats that may or may not apply to subsequent courses or workplaces, the course establishes a framework for understanding writing in a full range of contexts.

To examine the effectiveness of this approach, we are conducting qualitative research on student learning throughout the course, using multiple research instruments:

- *Baseline Surveys*: Surveys were conducted of engineering students in first-year composition at the end of the Fall 2006 semester to determine what connections students saw between the ABET and WPA outcomes when the course made no explicit connections between the two. Similar surveys were conducted in the cohort section under study at the beginning of the Spring 2007 semester.

- *Participant Observer Data*: VTECC faculty trained two undergraduate research assistants in participant-observer data collection, and these students are sitting in on one section of the course and taking observation data on classroom interactions. In addition, the course instructor is also taking field notes at the conclusion of each class to provide additional qualitative data.

- *Course Assignments*: The research team is collecting copies of all written assignments associated with the course; the assignments will be analyzed in terms of communication practices, degree of rhetorical knowledge, and degree of connection between engineering outcomes defined by ABET and communication outcomes defined by WPA.

- *End-of-Course Surveys:* At the completion of the course, students will again be asked to articulate connections between the ABET and WPA outcomes; in addition, as part of the regular programmatic assessment of all first-year composition courses, students will be asked questions that evaluate their competence with respect to the WPA outcomes.

- *Interviews/Focus Groups*: At the end of the semester, and annually thereafter, the research team will conduct individual and focus group interviews with the student participants that focus on questions of rhetorical knowledge and the relationship between communication practices in their first-year composition courses and their engineering courses.

Preliminary Findings

Data collection is currently in progress, and at this point any findings from the course are tentative only. However, data collected to date does suggest that students are making connections between first-year composition and engineering in ways that can support transfer of learning and foster the development of rhetorically sophisticated communication practices.

Baseline Surveys: Both the Fall 2006 (n=36 out of 36 students) and the Spring 2007 (n=37 out of 37) surveys suggest that students see a number of areas of overlap between what happens in their English courses and what is expected of them as professional engineers. Key findings include:

- In the Fall 2006 survey, *every* ABET outcome was cited by at least one student as a point of intersection.

- While "the ability to communicate effectively" was the most common ABET outcome cited by the Fall 2006 students, approximately half of the student also cited "the ability to function on multidisciplinary teams," "the ability to design and conduct experiments, as

well as to analyze and interpret data," and "a knowledge of contemporary issues" as key ABET outcomes they saw supported/developed by their first-year composition course.

- As expected, at the beginning of the Spring 2007 course, students saw the obvious connection between ABET's "ability to communicate effectively" and the WPA emphasis on writing.

- A few students in the Spring 2007 course also noted overlap concerning the ability to analyze and interpret information and the ability to follow a process.

These results, not surprisingly, suggest that even without explicit pedagogical intervention, students have at least a limited sense of how the work they do in their first-year composition course can support their development as engineers. Perhaps most importantly, the recognize that such support is not limited to the mechanics of writing, or even metacognitive knowledge about communicating across various contexts, but encompasses analytical thinking, collaboration, and related arenas.

Preliminary Analysis of Course Assignments: As of this writing, students in the cohort section have completed one assignment designed to foreground the ABET and WPA outcomes: In response to Frankenstein, the students have worked in teams to present oral arguments debating the ethics of Victor Frankenstein's actions in the novel. Upon completing the assignment, each student was asked to reflect on three questions pertinent to this study:

- What ABET outcomes did you address in this group work?

- What WPA outcomes did you address in this group work?

- What correlations did you see between ABET and WPA outcomes?

Students' responses show a clear awareness of the role of rhetorical knowledge ("focus on a purpose," "respond to the needs of different audiences") in creating any type of presentation. In describing how the WPA outcomes applied to the project, student responses consistently talked about the ways in which they had to define the purpose of their debate and consider the needs and interests of their classmates as the audience. Several described listening carefully to student responses and adjusting their presentation accordingly. Their attention to audience and purpose as the starting point for communication (rather than following any specific format defined by a course instructor) suggests that the students are building the kind of framework argued for by Boiarsky and called for by the research on how students learn to write.

Moreover, students also see their work on this "literary" text as explicitly connected to the understanding of professional and ethical responsibility and the knowledge of contemporary issues expected by ABET. A number of them mentioned not only the ethics of contributing meaningfully to their team, but also the larger ethical dilemmas raised by the novel. Disturbingly, however, with respect to the ethics of Victor Frankenstein's actions, the students' responses tended to focus on the failure of Frankenstein's *professors* to teach him the rules for ethical behavior, and absolved the scientist of responsibility. This approach is particularly troubling in light of ongoing research by Paretti and McNair on interdisciplinary collaboration in engineering

courses that suggests that engineering students demonstrate significant difficulties valuing the contributions of other fields.[69] The participant-observer comments shed more light on this issue, as explained below.

Finally, many of the responses included two additional areas in which the project supported the ABET outcomes and the ABET and WPA outcomes overlapped: analyzing and interpreting data and working in teams. Students consistently drew parallels between their need to gather evidence from the novel to support their stance and their responsibility in engineering to collect and analyze data to support engineering judgments. They also repeatedly commented on the role of teamwork in both sets of outcomes, and described the ways in which they learned to collaborate through the project. As one representative student succinctly explained,

> The two outcomes essentially say the same thing. The ABET says to work with different people and communicate your ideas efficiently and the WPA says to "respond to the needs" of different people and to talk to them appropriately. They both want to make sure that when we leave the class/college we are able to work with other people efficiently.

Such comments clearly suggest that students not only recognize the centrality of communication and collaboration to their future careers, but that they are able to recognize the ways in which courses outside engineering build those skills in productive ways.

Participant-Observer Data: Two undergraduate research assistants from engineering departments were trained as participant-observers to take notes on the instruction and student activity during each class period, guided loosely by the following themes:

1. Students contextualizing engineering practice and societal impact.

2. Students seeing impacts of English classes on Engineering classes, and vice versa.

3. Instructor helping students bridge gaps between humanities and engineering.

4. Students comparing, contrasting, privileging or minimizing humanities and engineering approaches.

Generally, the researchers noted verbal and non-verbal actions within class and reported discourse between the all of the participants. Three examples are described here that draw attention to some of the guiding themes, including 1) predilection toward engineering viewpoints, 2) responses to open-ended assignments, and 3) recognition of skills common to humanities and engineering.

In terms of a predilection toward engineering viewpoints, the researchers observed that, in the oral debate assignment, the team that represented the monster's perspective was the most attacked, and that the class tended to side with Victor Frankenstein. The researchers were surprised that the class regarded Dr. Frankenstein's irresponsible methods as less vile than the monster's willingness to kill human beings. The students cited the monster's ability to choose as the ultimate criteria for judgment and that the monster "chose" to kill. At that point in the course,

the students did not see the monster as a technological patchwork of human, animal and artificial parts but rather as a human possessed of independent will. On the other hand, Victor Frankenstein was not vilified for making poor decisions because he was not taught an ethical stance by his professors. Although the oddness of the argument was apparent to the observers, the students in their self-moderated debate did not recognize the contradiction.

In the second example, students resisted an open-ended assignment in which the instructor instructed them to use a "visual aid" to support their group's position. Although several class periods had been spent covering different types of visual imagery, with examples ranging from film, advertisements, comic strips and the cover of the course textbook, many students complained that the assignment was "too vague," that the instructor "didn't define 'visual aid'," and that they had "no picture of the assignment in their heads." Students' visual aids for the assignment ranged from nothing to a polished slide show to the use of textbooks from Calculus, Physic and Engineering to demonstrate that there was no ethics instruction therein. The researchers noted that some of the students had engaged the challenge of the open-ended assignment while others didn't even try, instead falling back into (in the researchers' words) "a typical engineering mode" of "needing explicit instructions." However, the instructor was challenging students to do something that they would likely be required to do in certain engineering design projects later in their engineering curriculum, and one student even acknowledged that this kind of visual argument was "like design—you have to brainstorm and get your ideas organized into a structure."

Finally, the students were observed to recognize the contributions that the English class was offering in terms of skills they would need for engineering. For example, they welcomed the opportunity to practice oral presentation skills and seemed to embrace an assignment in which they were to construct a persuasive argument for a perspective on technology and society. A few students were even observed enthusiastically engaging in an in-class debate about considering both engineering and human consequences of doing engineering research. The researchers were impressed by this occurrence and thought that it qualified as the students contextualizing engineering and its societal impact and the instructor helping students bridge gaps between engineering and the humanities.

The students in the English class had previously taken an introductory Engineering course in which they reviewed the ABET outcomes and wrote reflections on its relevancy in their electronic portfolios. Because of this experience, they were cognizant of not only the technical requirements for engineering, but also of the increasing need for "professional skills" to compete in the new globalized economy. The participant-observers recognized the instructor's efforts to get the students to look through both types of "filters"—both science/technology and humanities—and reported that many students in the class were "getting it." This small study, then, demonstrated that two of our goals—to build on curriculum across disciplinary boundaries and to help students see how non-engineering disciplines can help them be better engineers—could be reached by instruction explicitly intended to adopt both humanities and technology perspectives on a range of issues.

Conclusions

In this paper we propose a strategy for bridging students' experiences in first-year composition and engineering to effectively address a range of professional skills. Beginning with communication skills, we used the outcomes defined by the Council of Writing Program Administrators to establish a pedagogy that relies not on technical writing per se, but on the broader rhetorical education needed to communicate effectively in a range of situations. As the partnership developed, however, it has also become clear that the WPA outcomes intersect with many of the other professional skills outlined by ABET. To provide a context that supports students' ability to transfer what they learn in their composition course to their engineering career, we highlight both of these outcomes statements and through classroom participation encourage students to "try on" various ways of looking at science, technology and society. Explicit discussion of these outcomes is a key tool for helping students see the connections between what happens in their English course to what is expected of them academically and professionally as engineers. Preliminary analysis of student work and classroom behaviors suggests that the approach is both expanding students' rhetorical knowledge and creating opportunities for bridging English and engineering curricula.

The preliminary results of the pilot study suggest several tentative conclusions:

- Outcomes statements provide a useful point of intersections for helping students bridge work in their disciplinary and extra-disciplinary courses. Importantly, through the WPA outcomes, this bridge is built on the kind of concrete, metacognitive approach to learning advocated by education research [70]

- The points of intersection are not limited to the mechanics of writing, but instead address broader metacognitive skills necessary to move from one communication situation to another; they also address collaboration, critical and analytical thinking, collaboration, and ethical behavior.

- While the cohort approach simplifies instruction (the composition instructor needs to attend to only one additional set of professional outcomes), it perhaps unproductively narrows engineering students' ability to see perspectives outside their own. In future studies, we plan to examine more integrated composition classrooms using similar pedagogical approaches.

- Targeted curricular partnerships early on can provide the basis for helping engineering students cross disciplinary boundaries and encourage them to make varied course selections throughout the rest of their undergraduate education.

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