# Collaboration, English Composition, & the Engineering Student: Constructing Knowledge in the Integrated Engineering Program

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## Abstract

*To meet the needs of today's engineering students in a global technology-based environment, programs like the Freshman Integrated Program in Engineering (FIPE) must produce engineers who can work creatively in teams. Our program must also produce students who can think critically about engineering, who can construct knowledge in teams, and who can do so both through talking and through writing. To meet this goal, we present writing as problem-solving thereby helping students to construct knowledge about issues and ethical dilemmas in engineering through writing. Hence, English composition can enhance and reinforce the construction of knowledge that is occurring in other classes the students take. If the composition teacher ties collaborative writing tasks to engineering issues and ethical dilemmas, the students will benefit in two ways: from the practice they gain in collaborative writing before they take more senior technical writing classes and from the ability to explore issues and ethics that other classes may raise but do not have time to thoroughly develop. One example of a collaborative writing task on which students collaborate from invention to final revision is the team research paper our students write on a technological versus a social fix to a problem they choose to study. Our paper will briefly address the composition theory behind collaborative writing and then show how students can collaborate on such a paper from invention to revision.*

Traditionally writing has been regarded as a solitary act. Alone in a crumbling garret, or these days alone in front of the shimmering screen, the writer sits and creates. After several hours, and perhaps with the intervention of an obliging muse, a paper comes forth. However, over the last twenty years, composition specialists, responding to theoretical developments in psychology, sociology, and the sciences about how knowledge is constructed, have suggested that this paradigm is obsolete. Certainly in many professions writers collaborate to produce documents, and this is especially true of technical and professional writing. Nevertheless, in first-year English programs the individual paper remains the dominant form of writing as it did in our earlier iteration of the Freshman Integrated Program in Engineering (FIPE) when we focused mainly on integration of content. Subsequently we recognized that because engineers do indeed work and write in teams, to truly integrate composition with engineering in the FIPE program at Arizona State University and thus to complete our students' preparation for their roles as engineers, we had to build collaborative writing into our composition course. Therefore, we developed a team-based paper that would enable students to learn how to write in teams.

Even though collaborative writing is the norm in many workplace settings, some composition specialists question whether collaborative writing is a positive activity. David Smit, basing his argument on the lack of definitive research about the effectiveness of collaboration, argues that collaborative learning does not necessarily produce better writing [1]. However, Andrea Lunsford and Lisa Ede [2] maintain that studies done by Abercrombie, Bruffee, and Garth show that students learn both writing skills and content material more effectively in teams, as do Angela O'Donnell et. al. [3], John Clifford [4], and Elizabeth Tebeaux [5]. Karen Lefevre[6] extends this notion of collaboration to show that knowledge itself is socially constructed through collaborative writing and so the act of collaboration reflects the reality of how meaning is made. Not only does current theory support promoting collaborative writing in the classroom, but workplace practices make collaborative writing an imperative.

Although our students will be expected to write collaboratively in their professional lives, they are nevertheless unprepared to do so without training. As complaints from companies and engineering professors show, they cannot just sit down and be expected to write together. Because our culture encourages competition rather than cooperation, and students are taught to strive for individual, sometimes even cut-throat accomplishments, they resent being asked to work in teams. They especially resent that their grade depends on

their teammates' performance. Therefore, by emphasizing collaborative writing in our class, we complement their overall team training in the FIPE program. Furthermore, simply assigning students a team paper without showing them how and why they should assign roles and responsibilities in no way prepares them for collaborative writing. As collaborative writers ourselves, we recognize that our abilities to write together have not just happened. We have learned how to work together. Therefore, we developed a series of structured tasks that prepare students for team papers from collaborative invention to collaborative revision so that when they write in teams in senior engineering classes and then professionally, they have had some training and preparation for the task.

The assignment we developed, inspired by last year's FIE conference paper "Teaching Engineering Design with Humanities and Social Science Companion Courses" by John Schumacher, Gary Gabriele, and Jeff Newcomer [7], asks students to compare the technological and social fixes for a social problem and draw conclusions about the merits and drawbacks of each solution. As these authors explain, engineering students are typically driven to see only the technological fix. To meet the engineering student's need to question the uses of technology--thus addressing content needs--we decided to build this topic into the research paper (which most second semester Composition students must write). More importantly, to meet the need to learn to write collaboratively, we made this paper one of a series of incremental tasks that teach students how to write in teams.

We began by assigning several readings that discuss the controversy surrounding technological versus social fixes [8]. Students first wrote individual critical analyses of these essays so that they each became familiar with the arguments both sides would take. We believe that this individual work was an important preparation for the teamwork that would follow because each team member needed to feel that he or she knew as much and had as much to contribute as the other team members. We then followed this individual work with a series of tasks that allowed students to develop a topic that their team would like to research. These tasks included whole-class invention to generate lists of topics on whiteboards that the rest of the faculty team contributed to during the week, and then selecting a topic by using an affinity diagram in each team to reach consensus about which topic the whole team thought most interesting.

Typically, students find collaborative writing especially difficult because they lack problem-solving methods for invention, that is choosing and developing an idea and then following through with developing that topic and writing the paper. Therefore we devote significant time to

invention as a group activity. Lefevre explains that because problems arise when students collaborate to invent, they need assignments that invite them to take the time "to think through ideas in the company of others" [9]. Unfortunately, as James Adams explains, few people like problems, so to solve them quickly, they choose the first solution that comes to mind. Engineers would do better, he suggests, to "select the most attractive path from **many** ideas or concepts" [10]. Adams advocates accepting a certain amount of chaos, generating ideas over judgment, and he notes the importance of incubation: "Students often claim to come up with a winning idea the morning that it is due, but they do not realize that they have been incubating the idea for days. Perhaps unconsciously"[11]. Adams suggests using "list-making," "morphological forced connections," checklists of new ideas, and Polya's problem solving process [12]. Such generative chaos and incubation are precisely the qualities we desire in rhetorical invention but which traditional pedagogies prevent.

To address this need for generative rather than selective invention, our strategy involves a collaborative problem-solving process most closely paralleling real writing situations which our students will encounter as engineers. Students are first given an assignment, for example, "Compare a technological fix and a social fix to a social problem." In teams, students come up with as many examples of social problems and the fixes that could apply as they can, writing these on all the whiteboards in the classroom. The goal is not to evaluate or rank items, but to generate as many as possible. Since our students remain in the same room for all of their classes, they can think about and add to the list during the day. Furthermore, their chemistry and physics professors became interested in this particular project and put items on the list as well. This kind of group invention involving students and professors, and any other interested person who happens into the room, creates a true community of learners and helps students understand how knowledge is constructed socially.

To help the group reach consensus as to a choice of topic, we conducted affinity diagrams with the teams so that they could see which topic each team member found interesting and had some ideas about. This strategy enabled all members of the team to participate and, in turn, physically demonstrated to team members which topic they might focus on. Once students chose a topic, their next task involved discovering whether this topic had been written about in periodicals. If no information existed, the topic was not workable. Since we teach in a technology classroom, the students could dial into the library data banks from the classroom and so again they were able to work as a team. When they established that sources existed, and our library had those sources, their

first collaborative writing task involved an annotated bibliography of the sources they intended to use. Such a task is beneficial because it trains them to divide up a whole task equally. Each student in the team was responsible for finding, reading, summarizing, and annotating three sources. This task also works well because students must then come together to produce a seamless bibliography, agreeing on issues such as a consistent tone and style, and transitions. They also learn accountability to the team because the accuracy of each student's summary is crucial to the final paper; inaccuracy affects team members' understanding and interpretation of the material since they have not all read the same sources. In this way, students are eased into the collaborative writing process.

Now familiar with their sources, each team had to construct a writing situation that would identify audience, purpose, and constraints. Because we base our whole course on the premise of writing as problem-solving, our students are familiar with the notion that a piece of writing should be designed to solve a problem in a particular situation for a particular audience. Since each team was working on a different topic, each team had to determine its rhetorical situation, in other words, the team's role as writers, their situation, the problem, and whether a technological or social fix would solve the problem more effectively. To help students develop their writing situation, we designed a collaborative planning sheet for this task, and students spent an entire class period using their sources and annotated bibliography to construct this planning sheet.

Once the teams had constructed their writing situations and shown their completed assignment sheets to us, they then assigned roles to each group member to complete the paper. For example, one member might be responsible for writing about the technological fix; another responsible for the social fix; and another might write the introduction. Again, we devoted class time to discussing how the task might be subdivided and discussed our own strategies as collaborative writers. We did not, however, tell students which method they should use. We then followed through by devoting class time to workshops that allowed them to merge and revise their document together because although the students are accustomed to working in teams outside class on homework and projects, we did not feel that writing the paper collaboratively should put extra stress on them. We believe that not devoting sufficient class time to collaborative writing is one reason why teachers often find that students resent it.

Despite this carefully planned process some teams did experience problems. For example, one team e-mailed us about a dsyfunctional team member. They explained what steps they had taken to resolve the matter and asked if we could help. We agreed to facilitate a meeting of the whole team, and that meeting proved to be a real learning experience for all involved. During the meeting, the nonproductive team member explained that he had done the work but had not submitted it to the rest of the team since he felt that his writing was so weak. He explained that since his writing would require major revision, he felt that the team would be better without his work. We did not comment during this speech, but rather listened and then asked the other team members to respond. They explained that even if the writing was weak and needed significant revision, revising something was still much easier than having to create the whole thing from scratch. After further discussion, the nonproductive member suggested to the rest of the team that since he had caused them to do extra work, he should receive partial rather than full credit on the completed paper. Another team found choosing a topic especially difficult. Each member wanted to work on something different. However, after we conducted an affinity diagram, asking team members to list topics and then generate what they knew about the topic before they had done research, the team saw clearly that one topic would work for all members. Thus the team had a method for resolving what could potentially have been a major impediment. Finally, one other team e-mailed us to ask us for help solving a dispute they had as they wrote the introduction. They had worked on the paper separately, and were able to merge the paper together; however, they could not agree whether to address the audience directly in their introduction. Rather than tell them what to do, we e-mailed a response that listed the pros and cons of the three solutions they had proposed and they resolved this together.

Because we built a series of tasks that allow students to collaborate from invention to final editing and see how a team undertakes a large task, assigns parts to various members and then collaborates to produce the whole, we believe that we were able to begin the learning process of how to write in teams. Since all of us have been trained to view writing as a solitary act, collaborative writing does not come without nurturing. Therefore, responsible instructors must prepare and guide students through the process, and this process must begin early in students' academic careers. Relegating such experience to senior level or capstone courses is a recipe for disaster. Instead, students must learn at an early stage how to collaborate with others. Finally, our students' educational experience is more complete because of the addition of collaborative writing instruction to a team-based integrated approach to engineering education: they learn that working in teams is not just something that engineers do when they want to design an airplane or a bridge.

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