

An Investigation into Interdisciplinary Team Teaching in Writing and Engineering: A Multi-Year Study

Frances S. Johnson¹, David Hutto¹, Kevin Dahm², Anthony J. Marchese², Carlos Sun², Eric Constans², Kathryn Hollar², and Paris von Lockette²

- 1. College of Communication, Rowan University, Glassboro, New Jersey**
- 2. College of Engineering, Rowan University, Glassboro, New Jersey**

Abstract

The Sophomore Engineering Clinic I is the third course in an 8-semester multidisciplinary engineering practice and design sequence taken by all engineering students at Rowan University. This course is taught jointly by a team of faculty from the College of Communications and all four departments within the College of Engineering. The Sophomore Clinic students receive classroom training in technical communication and in the engineering design process, and work on design projects in multidisciplinary teams of 3-4 students. This paper presents the second year results of an on-going experiment involving the integration of technical writing and engineering design in Sophomore Engineering Clinic I. The highlights of this experiment include: 1) Comparing sections which are jointly taught by engineering and writing faculty with sections solely taught by writing faculty, 2) Tracking the effectiveness of increasing active engineering faculty participation in writing instruction over multiple semesters, and 3) Fully integrating engineering design and communication deliverables and grading. Time series data from student surveys and faculty assessments are analyzed to investigate the effectiveness of the integrated teaching efforts. In addition, the nature, quality, and definitions of the interdisciplinary team teaching as seen from the perspective of the professors and the students are assessed. The results of this on-going study show that rectifying student misconceptions on the duality of engineering and writing requires active interdisciplinary team teaching efforts and full integration across all course aspects.

1. History and Background

In 1992, Henry M. Rowan donated \$100,000,000 to the then Glassboro State College to establish a unique engineering program in southern New Jersey. What is now Rowan University boasts an innovative College of Engineering comprised of four programs: Chemical, Civil and Environmental, Electrical and Computer, and Mechanical. The College graduated its first class in May 2000 and serves 15 to 35

students per year in each of its four programs for a total of approximately 60 to 125 students per year¹.

The hallmark of the Rowan engineering program is an emphasis on technical communication and integrated, hands-on design and experimentation, which is realized in the multidisciplinary, project-oriented Engineering Clinic sequence. Beginning in the freshman year, all students enroll in Clinics and work with students and faculty from all engineering disciplines on laboratory experiments, real-world design projects, and research projects of increasing complexity. Freshman Clinic focuses on reverse engineering and an introduction to each engineering discipline. In the sophomore year, students learn engineering design and effective technical communication skills. In the Junior/Senior Clinic, multidisciplinary student teams work closely with faculty on original research and design projects. The importance of effective written and oral communication skills, teamwork skills, and technical proficiency is reinforced in the Clinic sequence¹.

In the sophomore year, students from all engineering disciplines work together on semester-long design projects and present results through either written reports (Sophomore Clinic I) or oral presentations (Sophomore Clinic II). Students learn not only the fundamentals of the design process, but also hone their technical communication skills. This paper focuses on Sophomore Clinic I, which is a combined composition and design course team-taught by faculty from the College of Engineering and College of Communication².

The challenge in developing and delivering the course has been in integrating the various educational objectives of both the Engineering and Communications Colleges while maintaining a focus on meeting the students' needs. The goals of Sophomore Clinic I include combining argumentative discourse, rhetorical awareness, technical communication, and engineering design principles. The course structure has been modified each year, with each new change reinforcing the integration between the two disciplines²⁻⁴.

2. Current Team-Teaching Arrangement and Course Structure

Throughout the history of Sophomore Clinic I, we have striven to strengthen the collaboration between communications and engineering faculty. These efforts are detailed elsewhere¹⁻⁴. Briefly, faculty from both colleges collaborate in designing all engineering and writing assignments. Team meetings are held throughout the semester to talk about classroom activities (both writing and laboratory sections), plan assignments, and discuss broad course planning issues. In addition, the team jointly evaluates several assignments as well as the individual final grade assessment for each student. The course is structured so that students meet twice a week in small (~20 students) 75 minute writing sections, and once a week in a 165 minute engineering design lab. The two aspects of the course are linked through the major deliverables. In the lab, students work in teams on designing and building a product.

In Fall 1999 and 2000, students worked in teams to design a portable/semi-permanent bridge large enough to accommodate a riding lawn mower and span a backyard brook. Students worked in conceptual design teams during the first 5 weeks of the semester to develop conceptual designs and write a persuasive proposal for their design. Three designs were chosen, and students were reassigned to product development teams with specific tasks that supported the full-scale product development effort. These design and product development efforts provided the subject matter for the major written deliverables during the semester.

In Fall 1999, engineering professors “sat-in” on writing sections. They took seats with students and asked questions and made comments as if they were students. They did occasionally reinforce what the communications professor said, but they did not lead lessons. In Fall 2000, we increased this collaboration in two areas, cross-classroom faculty attendance, and further integration of writing and design assignments. We took this action based on the inconclusive results of the previous survey. The team felt it was necessary to place the engineering professors in a more active role in the writing classroom. In Fall 2000, to increase the opportunities for collaboration and communication between engineering and communications faculty, as well as demonstrate to students the importance of written communication skills, engineering faculty actively took part in selected writing sections of the course, in essence team-teaching the course. Engineering professors stood in front of the room, directed questions to the students, answered questions, and reinforced the lesson as much as possible. In several instances, the engineering and communications professors actually prepared and ran the class together.

In Fall 2000, we also further cemented the connection between writing and design by relating more of the writing assignments (progress reports, memos, client reports) to activities in the lab. The major deliverables for the course and the extent of collaboration for each activity are shown in Table I.

| <i>Table I: Major course deliverables</i> | | |
|--|---|--|
| <i>Assignment</i> | <i>Objectives</i> | <i>Extent of collaboration</i> |
| Resume and Cover Letter (Individual assignment) | <ul style="list-style-type: none"> • Writing for different audiences • Letter and document formats • Description of qualifications and interests as in employment correspondence | <ul style="list-style-type: none"> • In-class motivation (in writing sections engineering faculty attended)—cover letters and resumes were required in both bridge proposals and client report. |
| Proposal for Bridge Design (Team assignment) | <ul style="list-style-type: none"> • Proposal requirements • Library and internet research • Summary • Persuasion • Collaborative Writing | <ul style="list-style-type: none"> • Co-development of proposal requirements • Engineering faculty introduced patent search & other databases • Joint writing/engineering |

| | | |
|---|--|--|
| | | <p>faculty in-class discussions of report format, “nuts and bolts” of technical writing</p> <ul style="list-style-type: none"> Proposals jointly evaluated by all faculty |
| <p>Technical Description (Individual assignment)</p> | <ul style="list-style-type: none"> Technical description Document design Graphic design Library and internet search Narrative techniques Writing for different audiences | <ul style="list-style-type: none"> Engineering faculty developed bottle rocket laboratory (subject of technical description) In-class emphasis of importance of relaying technical information to non-technical audiences |
| <p>Annotated Bibliography & Literature Review (Individual assignment)</p> | <ul style="list-style-type: none"> Summary Library and internet research Evaluation of sources Bibliography Organizing information Citation and bibliography | <ul style="list-style-type: none"> In sections attended by engineering faculty, noted application of this form to proposal writing |
| <p>Bridge Design Final Report (Team assignment)</p> | <ul style="list-style-type: none"> Interpreting technical data Making recommendations Persuasion & audience awareness Summary Library and internet research Use of graphics Short report format | <ul style="list-style-type: none"> Co-developed criteria and “client report” format Writing and engineering faculty available for consultation on each team’s portion of report Joint evaluation of final reports |
| <p>Memos & Progress Reports (Team assignment)</p> | <ul style="list-style-type: none"> | <ul style="list-style-type: none"> Required in both lab and writing sections |

3. Results of Current Investigation

3-1. Comparison of 1999 and 2000 Survey Results

Over the course of two semesters, Fall 1999 and Fall 2000, we have compared the results of end-of-semester surveys with respect to students’ attitudes towards writing. Five questions in particular point to students’ perceptions of the importance of writing in their professional life. We compare not only results from year to year, but compare

writing sections in which engineering professors participated at least once a week with writing sections which were not attended by engineering professors.

- Question 1: How much time and effort do you put into improving papers for writing courses?
 1. None; write one version and turn it in
 2. A little; write one draft and proofread
 3. Some; write one draft and make revisions on your own
 4. A lot; write two or more drafts in advance
 5. Quite a bit; write multiple drafts well in advance

| Year | No engineering faculty in writing sections | Engineering faculty in writing sections | Averaged score |
|------|--|---|----------------|
| 1999 | 3.13 | 3.20 | 3.15 |
| 2000 | 3.00 | 3.24 | 3.11 |

- Question 2: How would you describe your attitude toward writing?
 1. Avoid if possible
 2. Dislike intensely
 3. Tolerate; do if have to
 4. Do willingly
 5. Enjoy

| Year | No engineering faculty in writing sections | Engineering faculty in writing sections | Averaged score |
|------|--|---|----------------|
| 1999 | 3.13 | 3.20 | 3.15 |
| 2000 | 3.23 | 3.30 | 3.26 |

- Question 3: When you are writing for engineering courses, to what extent do you consciously employ strategies you learned in writing courses?
 1. Never
 2. Rarely
 3. Sometimes
 4. Frequently
 5. Always

| Year | No engineering faculty in writing sections | Engineering faculty in writing sections | Averaged score |
|------|--|---|----------------|
| 1999 | 3.00 | 3.00 | 3.00 |
| 2000 | 3.61 | 3.57 | 3.59 |

- Question 4: How do you think your proficiency as a writer will affect your career as an engineer?
 1. Not at all
 2. Somewhat helpful

3. Helpful but not crucial
4. Essential
5. Significantly advance career

| Year | No engineering faculty in writing sections | Engineering faculty in writing sections | Averaged score |
|------|--|---|----------------|
| 1999 | 3.75 | 3.40 | 3.62 |
| 2000 | 3.86 | 3.89 | 3.88 |

- Question 5: To what extent do you think problem-solving skills in communication are related to problem-solving skills in engineering?
 1. Not at all
 2. Hardly related
 3. Somewhat related
 4. Closely related
 5. Fully integrated

| Year | No engineering faculty in writing sections | Engineering faculty in writing sections | Averaged score |
|------|--|---|----------------|
| 1999 | 3.13 | 3.40 | 3.23 |
| 2000 | 3.93 | 3.88 | 3.89 |

While there was no significant difference between writing sections with engineering faculty and no engineering faculty participation, there was an increase in students' perceptions of the relatedness of problem-solving skills in communication and engineering (question 5), from 3.23 in 1999 to 3.89 in 2000. We also find that with increased integration of assignments, students make a more conscious effort to apply skills learned in the writing sections to their assignments (question 3). Students' attitudes towards writing in general did not change from year to year (question 2), and the amount of effort put into writing assignments (question 1) was also static. Question 4, which addressed the perceived importance increased slightly overall, from 3.62 to 3.88.

3-2. End-of-Term Evaluations

The end of the term evaluations from students' demonstrate mixed reviews. Some of the students comment that the writing assignments were "very helpful toward the technical writing aspect." Others suggest that "learning more different, more to the point, styles of writing" are useful. Students, in general, seemed to grasp the "real world" writing situations the team placed them in well. However, these evaluations also show a general disdain, or tolerance, of writing itself. Students comment that the "subject matter is boring," and repeated calls for making the course "more interesting" by having "more projects that had to do with engineering." Another student writes that "If it [the course] wasn't required I wouldn't take it. Perhaps if one enjoyed writing it wouldn't have seemed so bad, but then again, if I wanted to write I wouldn't have chosen [sic]

engineering.” Another suggested that “as engineering students. . .time could be better used elsewhere.” Clearly these lines still reveal a disconnect between the two disciplines, engineering and writing, at least from the students’ point of view.

4. Reflections on Results

According to the above data, engineering faculty participate in writing sections apparently doesn’t influence students’ attitudes toward the importance of writing in the engineering profession. Engineering faculty “actively teaching” in writing sections doesn’t have a measurable effect either. There are several conclusions that can be drawn, some of which have been noted by other researchers. Windsor suggests engineering students have trouble “with traditional meanings of rhetorical terms....[such as] persuasion and audience.” (page 3, Windsor---put this in as a fn like the others and I don’t know how you are doing direct quotes.) For many in engineering, persuasion has a sense of “manipulation” while audience suggests a simply sender and receiver model of communication. In general engineering work is object work—it is hands-on work, and this is most clearly emphasized in the Rowan program as has been already noted. Thus the “real” work of engineering, for its students, is not found in the writing sections of the course; rather it is found in the laboratory sections of the course. This argument is in line with Windsor’s research that asserts “engineers have particular problems in accepting the rhetorical view of knowledge.” A fundamental principle of contemporary rhetoric is that making knowledge is a rhetorical act; language informs and shapes our understanding of the world. However, the engineering faculty at Rowan accept and support this rhetorical premise, as indicated by their willingness to team teach and participate in the curriculum planning of the course. It seems then that this “rhetorical view of knowledge” is, alas, not shared by the students. This may be in part due to the fact that they are students of engineering, not engineers themselves, or it may be due to the fact that they are sophomores in college who have not yet attained this level of critical thought. Perhaps as the students move through the program, and in particular, participate in the frequent internships offered through the program, they will come to an increased awareness of writing’s importance in the workplace.

However, further integrating assignments, as we did this year, could be a contributor to the higher values this year in students’ perceptions of the integration of writing and engineering. If we continue this trend, putting increasing emphasis on the connections between engineering and language and making knowledge through collaborative teaching and evaluations, the students’ attitudes toward writing may improve.

Bibliography

1. J. Newell, A. J. Marchese, R. P. Ramachandran, B. Sukumaran, and R. Harvey, "Multidisciplinary design and communication: A pedagogical vision," *International Journal of Engineering Education*, Vol. 15, 1999.
2. R. Harvey, F. S. Johnson, A. J. Marchese, J. Mariappan, R. P. Ramachandran, B. Sukamaram and J. Newell. "Teaching Quality: An Integrated TQM Approach to Technical Communication and Engineering Design." *Proceedings of the American Society of Engineering Education: Mid Atlantic Conference*, April 17, 1999.
3. F. S. Johnson, "Negotiating a Rhetorical Education: Teaching Technical Writing and Argumentative Discourse to Engineering Students," Penn State Conference on Rhetoric and Composition, July 1999.
4. R. Harvey, F. S. Johnson, H. L. Newell, K. Dahm, A. J. Marchese, R. P. Ramachandran, J. L. Schmaltzel, C. Sun, and P. von Lockette. "Improving the Engineering and Writing Interface: An Assessment of a Team-Taught Integrated Course." *Proceedings of the American Society of Engineering Education*, St. Louis, MO, June 2000.
5. Winsor, Dorothy, *Writing Like an Engineer: A Rhetorical Education*. Mahwah, NJ. Lawrence Erlbaum Associates. 1996.

Biographical Sketches

Frances Swigon Johnson is an Assistant Professor in the College Writing Department at Rowan University. She has been teaching technical writing since 1989, formerly at Old Dominion University and the University of Oklahoma, and came to Rowan in 1996. She holds a Ph.D. in English with a specialization in Composition, Rhetoric, and Literary Studies from the University of Oklahoma, Norman.

David Hutto is an Assistant Professor in the Department of Composition and Rhetoric at Rowan University. His PhD is from Georgia State University (1998), where he did work on the writing methods of biologists at the Centers for Disease Control and Prevention.

Kevin Dahm is an Assistant Professor of Chemical Engineering at Rowan University. He received his Ph.D. from the Massachusetts Institute of Technology (MIT) in 1998. Prior to joining Rowan, Kevin was a postdoctoral fellow at the University of California at Berkeley and an adjunct faculty member at North Carolina A&T University.

Anthony J. Marchese is an Assistant Professor in the Department of Mechanical Engineering at Rowan University. He received his Ph.D. from Princeton University in 1996. In 1999, he was awarded a Leadership Development Internship from ASME to serve on the ASME Council on Education.

Carlos Sun is an Assistant Professor of Civil and Environmental Engineering at Rowan University. He received his Ph.D. from the University of California at Irvine in 1998. Prior to joining Rowan, he worked at California Path.

Eric Constans is an Assistant Professor of Mechanical Engineering at Rowan University. He received his Ph.D. in Mechanical Engineering from The Pennsylvania State University. Prior to joining Rowan, Eric was an acoustical researcher at Continental AG in Hanover, Germany.

Kathryn Hollar is an Assistant Professor of Chemical Engineering at Rowan University. She received her Ph.D. from Cornell University in 2000.

Paris Von Lockette is an Assistant Professor of Mechanical Engineering at Rowan University. He received his Ph.D. from the University of Michigan, Ann Arbor, in 1999.