From the Trenches: Killing Three Birds with One Rather Large Stone

Dr. Robin H. Lovgren, Dr. Michael J. Racer, Anna Phillips
Industrial and Systems Engineering/
Counseling, Educational Research, and Psychology
University of Memphis
Memphis, TN 38152

Abstract

The ABET2000 criteria call attention to the need for engineering faculty to take a broadened approach to engineering instruction. Lurking behind this are two other factors that we must consider as we review our own program - our college and university mission statements and general "instructional objectives."

It may certainly be the case that these three factors are at odds with each other. For instance, in seeking to develop a program that enhances the students' critical thinking skills, some sacrifice might have to be made with respect to material coverage. Likewise, it might be the case that an ABET objective works in concert with these other factors. For instance, aptitude in communication is well aligned with a college goal of providing graduates for entry into local engineering practice.

In this paper, we will discuss how these objectives were addressed through:

- Motivating students and faculty (concern for varied learning styles, modified teaching styles)
- Improving critical problem solving and skills transfer (customized programs, cross-disciplinary studies, use of outside consultants)
- Assessing the impact, both good (improved learning, invigorated teaching, accreditation) and bad (time investments, research to identify effective possibilities, getting people to change the way they view the instructional process)

I. Introduction

The ABET 2000 Criteria calls attention to the need for engineering faculty to take a broadened approach to engineering instruction. Lurking behind this are two other factors that engineering educators must also consider as engineering programs are refined and redesigned: the college mission statement and the university's "general instructional objectives." Can any program of instruction meet all three goals simultaneously? What sacrifices are necessary in order to do so? Are there any areas in which the goals work together?

This paper discusses how these objectives were addressed at a large urban university's engineering program through a combination of motivational techniques for engineering students and engineering educators implemented with increased attention to students' problem solving and critical thinking skills. Finally, a brief assessment of the impact of incorporating these objectives is included in order to share our experience with both the positive and the negative effects of meeting three major instructional goals in the same classroom.

Where to begin? Lohmann's summary of the EC 2000 experience at Georgia Tech strongly advises engineering educators to look first at the mission statements of their individual colleges and look second to see if those statements already support ABET criteria or if modification is required[1]. Likewise, good instructional methodology is often an implicit part of the college mission statement, but an explicit part of the university's goals and objectives; the ABET criteria supports both. Lohmann notes "that, fundamentally, EC 2000 requires the development of educational objectives and program outcomes consistent with the mission of the college, an assessment process that demonstrates they are being achieved, and a system of continuous evaluation and improvement"[1]. Clearly, refining current educational practices to fit these guidelines is a large task, but one that is certainly worth doing.

The format of the paper is as follows. The next section provides an overview of the history of the Industrial and Systems Engineering (INSE) Program, which will reveal the driving factors in the growth of our attitudes towards learning. Section III provides a summary of the mission of INSE, The College of Engineering and The University of Memphis. In Section IV, we continue with a detailed discussion of the key activities undertaken to create a comprehensive program, along with a discussion of the impacts of that effort. In the last section, we provide some conclusions and identify our directions for the future.

II. INSE - A Historical Perspective

This section discusses the evolution of the Industrial and Systems Engineering (INSE) Program at The University of Memphis from a graduate program to a combined undergraduate/graduate program. INSE began as a graduate program. In the early 1970's, a group of industry representatives approached the university expressing the need for a program to teach systems engineering skills to people in industry who possessed technical knowledge in other areas. These local industries provided the first students as well as the adjunct faculty to teach the courses. Thus, the connection to the "real world" was established at INSE's inception.

In 1990, we began the process of creating an undergraduate program. Part of this effort required a look at the demand for the curriculum and, indeed, what that curriculum should look like. With the growing demand for operations research (OR) skills this type of curriculum seemed natural, and this belief was supported through interviews with several industry representatives. The undergraduate program began in 1996.

As a consequence, the INSE Program has always been grounded in the community. Students receive a significant level of immediately applicable knowledge. Faculty members use examples

pulled from experiences with the community. The commitment to both solid technical skills and applications has fueled the drive to create a program that is in line with the goals of ABET2000.

III. Missions

In this section, we provide some detail on the various mission statements within our university and comment on the relationships among them.

3.1 Initial Development of The INSE Mission Statement

Historically, the development of a mission statement for the Industrial and Systems Engineering Program was a natural part of the development of a new program, rather than one that we undertook as an "exercise." As such, the statement was more a recognition of our beliefs than a search to establish them. The statement is provided in Table 1.

Table 1. INSE Mission Statement

The discipline of systems engineering is vital to the effective, efficient operation of any organization. This is provided to the community via two sources - students and faculty.

1. The primary product of the INSE Program is the student. In this regard, INSE graduates will:

- Be highly competent in mathematical understanding
- Develop a systems-oriented approach to problem analysis
- Be aware of process design, as well as product design
- Possess and be able to apply problem-solving skills
- Be effective in all segments of society
- Possess decision-making skills
- Be able to solve new problems, in unfamiliar areas, as well as solve old, familiar ones
- Be able to apply their INSE skills in a wide variety of areas: engineering, management, distribution, service industries, manufacturing, and communications, to name only a few.

2. The existence of this program will also be of benefit to other programs in the College of Engineering.

3. Recognize the special needs of an urban university. Be aware as well as responsive.

The success of the program hinges on the quality of the faculty. It is these who will be asked to ensure that the previously mentioned goals are met. In this regard, the evaluative measures employed within INSE will be developed with this vision in mind. The quality of each faculty member will reflect his contribution to this vision of INSE.

Our statement was prepared in 1993, well before any mention of ABET2000 criteria. Since then, the statement has been an integral element in the development of course curricula and is included in the *INSE Faculty Orientation Handbook.*

3.2 Assessment of Agreement Between College and University Mission Statements

In our case, the INSE Mission statement was complementary to the University of Memphis Mission Statement. Both statements share a common explicit commitment to quality undergraduate education, with the need to prepare undergraduates for both careers in the workplace and the ongoing nature of life-long learning. Specifically, both statements also address the importance of teaching problem solving skills in the academic realm, which will transfer into the student's post-collegiate employment. Finally, both statements call attention to the University and College's responsibility to the greater community, both locally and nationally, by providing students who are well versed in critical thinking and analysis skills and competent in application of these skills.

The activities of the INSE Program are in concert with the goals of The University, probably exceeding the expectations envisioned by the framers of that document. In particular, faculty members have developed a wide range of tools to ensure a "vibrant atmosphere" in the classroom:

- Letters to Mom (students write letters to the instructor's mother, explaining in layman's terms the course content
- Journals
- Self-paced classes
- Competency-based teaching
- Team projects, with a balanced evaluation of three elements - group dynamics, technical merit, and communication

Table 2. University of Memphis Mission Statement

The University of Memphis is a member of the State University and Community College System of Tennessee and is governed by the Tennessee Board of Regents. As an urban university, The University of Memphis provides a stimulating academic environment for its students, including an innovative undergraduate education and excellence in selected research areas and graduate programs. The academic environment extends beyond the campus boundaries to encompass the entire community.

- Education is enhanced through exposure to diversity in the composition of the student body, faculty, staff and administrators, including women, minorities, individuals with disabilities, and various age groups and religions. The University has responded to the challenging responsibility of being located in a culturally diverse region by developing a unique blend of teaching, research, and service that contributes to the growth of the Mid-South region.

- Teaching brings the benefits of scholarship and research to students and through them to the people of the area. The University of Memphis asserts that excellence in teaching traditional and non-traditional students is its central responsibility. A

comprehensive undergraduate education, grounded in the arts and sciences, develops intellectual, cultural, and ethical qualities in its students. The innovative General Education Program challenges students to develop the analytical and critical skills necessary for life-long learning. The University of Memphis offers masters and doctoral degrees in selected graduate programs as well as degrees in the major professional areas. Through learning begun at The University of Memphis, graduates compete in the global intellectual community in which they live.

- As a research university, The University of Memphis develops, integrates, disseminates, and applies knowledge. Faculty maintains on-going programs of basic and applied research or creative activities appropriate to their disciplines. The University's urban environment provides a rich opportunity for research and creative scholarship, and for the use of that scholarship in the intellectual and cultural development of the region. The University's commitment to fostering a research and creative environment harmonizes with the other aspects of its mission.

- The University of Memphis fulfills its outreach mission through its contributions to professional organizations and to the needs of the community. The University promotes intellectual, cultural, and community development of the region through, for example, its artistic programs, lecture series, assistance, continuing education, and intercollegiate athletic programs.

- The University of Memphis, through its research, teaching, and outreach roles, responds to individual needs, such as the support of health care and preventive health services. The University addresses broader issues as well, for instance, K-12 education, economic development, initiatives, international programs, computing, and telecommunications.

Table 3. Herff College of Engineering Goals (Draft as of 11/99)

o To provide undergraduate programs of study which enable our graduates to grow beyond the entry level position and to pursue life-long learning
o To provide graduate programs of study which prepare students for leadership roles in tomorrow's research environment by advancing today's state of knowledge
o To provide and promote outreach programs which meet the technical needs of the Mid-South region
o To create a vibrant atmosphere which encourages learning and stimulates the exchange and advancement of ideas
o To encourage diversity in all aspects of the College's endeavors

3.3 Link to ABET 2000 Criteria

Fortunately, our University and College Mission statements already address many of the ABET Criterion 3 goals for outcome and assessment of engineering programs For example, criteria A,

B, C, D, F, and L focus on engineering-specific requirements that graduates must meet to prove competency in the field of engineering, and both our University Mission Statement and our College Mission Statement include the same goals. ABET criteria G, I, and K are more general goals which relate to the graduates' knowledge of areas within and outside of engineering, and are designed to measure the graduates' ability to transfer knowledge from one realm or discipline to another; all three goals are supported in both of these Mission Statements.

TABLE 4. ABET Outcomes

Outcome	*Type*
A. Ability to apply knowledge of math, engineering, and science	Engineering
B. Ability to design and conduct experiments	Engineering
C. Ability to analyze and interpret data	Engineering
D. Ability to design system, component or process to meet needs	Engineering
E. Ability to function on multi-disciplinary teams	Post-college Performance
F. Ability to identify, formulate, and solve engineering problems	Engineering
G. Understanding of professional and ethical responsibility	Social
H. Ability to communicate effectively	Post-college Performance
I. Broad education	Social
J. Recognition of need and ability to engage in life-long learning	Post-college Performance
K. Knowledge of contemporary issues	Social
L. Ability to use techniques, skills, and tools in engineering practic	Engineering

However, ABET's criteria E, H and J are not specifically represented in either the University Mission statement or our College Mission Statement, while we have focused instructional energy on integrating and documenting these goals into our curriculum[2]. These goals relate to the students' ability to work productively as team members and to communicate effectively, both verbally and in writing. We agree, of course, that these are important goals, and as such, we've added both measurements to our program.

IV. Development and Implementation of Linked Goals

In this section, we discuss the activities that have been instituted to ensure the success of the program. Section 4.1 reviews efforts undertaken to prepare the faculty, and the next section addresses activities directed towards the students. Sections 4.3 and 4.4 consider the motivational

preparation and critical thinking issues, respectively. Section 4.5 presents an overview of our philosophy for assignments and grading. In the final section, we summarize and consider the impact that these changes have had, both on faculty and students.

4.1 Faculty Preparation

Both formal and informal sessions have been developed to guide INSE faculty members. All new faculty members are given an orientation manual; during the first semester on-campus, a series of sessions are held with new faculty, addressing the following topics:

- The Industrial and Systems Engineering Program - Vision/Mission/Goals
- Personal Assessment - strengths, weaknesses, needs
- Faculty Planning & Evaluation Records
- Tenure & Promotion
- Teaching
- Research
- Service
- The College
- Development of Personal 5-year Plan

(This document is available from the authors.)

While this mentoring effort is extremely time-intensive, it is also extremely valuable with respect to inculcating new faculty. At the same time, these new faculty members are encouraged to add to the framework of the Program; this "buy-in" has proven effective.

New faculty have been instrumental in making changes in the classroom. The first author, now in her fourth year, has already taken a leadership role in those activities mentioned earlier, creating a vibrant classroom atmosphere.

After completing the orientation, mentoring continues to be a concern. With a new program and untenured faculty, it becomes a balancing game. The mentoring guides the tenure-track faculty member in achieving a balance of teaching, research and service that will contribute to the success of the program.

This paper is in fact one product of that process. Recognizing both the need to publish and the desire to teach well, the first two authors have been quite active in "dual purpose" work - linking teaching innovation with research efforts.

More formally, faculty members have been involved in a number of workshops and conferences that enhance classroom effectiveness:

- NETI Workshop
- ASEE Conference
- INFORMS Forum on Education Teaching Workshop
- On-campus workshops

By providing the faculty member with this support - both financially and morally - faculty are assured that their concerns and goals are recognized and appreciated.

4.2 Student Preparation

To guarantee the effectiveness of the program, students must be aware and involved in the direction. At the time of advising, both the framework and rationale for the classes are discussed, and the students' orientation guide includes a copy of the INSE Mission Statement. Consequently, students are aware from the start of the vision of the faculty.

This introduction is followed up within each course. Detailed syllabi present both content and grading specifics, as well as class philosophy. Outlines of competencies have been created in most classes and are distributed at the start of the semester. Specific innovations are discussed during the first day of class, along with an explanation of the rationale; examples are also made available to the students.

In order to prepare the students for multi-disciplinary teamwork, we followed a construct already being piloted in our Freshman Civil Engineering Program. In this program, a writing instructor works closely with one of our civil engineering instructors to integrate reader-based communicative strategies into traditional engineering project assignments by considering authentic engineering tasks. For example, students might be asked to conduct an assessment of water filtration by interviewing various University employees from different departments and using that information to describe to another audience how a particular water system works. In addition, our students are provided opportunities to consult with students from the Professional Writing Department for editing/stylistic assistance with compilation of these projects.

We have customized the Civil Engineering approach to fit our goals by building on the skills taught in these freshman core courses. Grades on team activities reflect the importance of the team - projects (2 weeks long) and mini-projects (1½ hours) are graded on a pass-fail basis as a group. This forces the students to explicitly and internally address the issue of individual contributions. (As an example, students are allowed to fire group members.)

Also building on the Civil Engineering core, we have continued to emphasize communication activities. Both oral and written reports are required. Different formats have been employed, including traditional presentation, discussion group leadership, debate, and teaching. All students are required to participate at this level.

So far, we've found this particular approach to be quite useful, largely because it allows our students to conduct authentic tasks in a real situation and prepare their findings in a method very similar to what they'll be expected to do as professional engineers.

Students are well aware of the attitude of the faculty and have expressed their approval. The most notable has been in regards to the introduction of self-paced courses, which were initially received with a significant lack of enthusiasm. Those students most vocal in the initial opposition are now the most supportive. In fact, these students have taken leadership roles in helping new students in the program.

Second, and probably most satisfying, is that students acknowledge that the INSE paradigm makes them think. The strategy we undertake in the classroom fosters a solid, internalized, understanding of the concepts.

4.3 Motivational Preparation

Motivation of participants is crucial to the success of any serious endeavor, and we strongly advise engineering educators to consider motivational theory before undertaking any widespread system of change. Before presenting our theories of change to fellow faculty members and students, we attempted to learn all we could about current educational motivational studies, and we then applied this information to our program.

One of our most interesting findings in the literature came from Sharon Beder's "Beyond Technicalities: Expanding Engineering Thinking," in which she laments that the public perception of engineers is likely to be a factor in decreasing the number of students who pursue engineering careers in the future[3]. After effectively lambasting the stereotypical descriptions associated with engineering as a career, Beder calls for a "new educational approach" designed to give young engineering students a broader education and awareness of the authentic tasks and responsibilities they will face professionally, and she calls for attention to "critical analysis, ethical judgment, and an ability to assess the long-term consequences of their work"[3]. Although as engineers and engineering educators we found parts of Beder's assessment insulting, we agree with her overall call to adapt traditional engineering programs to fit the needs of the community and employers, and we used her research, her rhetoric, and her findings as motivational inspiration to move ahead with our changes.

Research conducted with professional engineers regarding the actual time spent and self-assessment proficiency in writing was also crucial to motivating our colleagues and students to take these issues seriously as undergraduates[4]. This research, conducted by Heather Silyn-Roberts in 1998, found that many professional engineers report that they spent between 30% and 90% of their work time engaged in writing, and because they actively disliked the task of writing and felt less than proficient with their grammatical skills, they often wrote with a "need to impress rather than inform"[4]. Silyn-Roberts took these findings and suggested strategies customized to the cognitive patterns of many engineers, and her research suggested that utilization of these strategies helped the engineers to feel more proficient in their communication skills[4]. Again, as engineers and engineering educators we weren't surprised to find many professional engineers disliked writing and felt unprepared for the amount of actual writing required in the profession. However, this research was useful in convincing our students and colleagues not only that this problem exists, but also that our customized instructional strategies can help to solve it.

4.4 Problem Solving/Critical Thinking Skills

The emphasis in the statement on critical thinking was the product of the second author's background as an applied mathematician. All course materials in the graduate program had been developed from an operations research perspective, with a focus on modeling and analysis.

Critical thinking and problem solving skills are essential to engineering education, but basic instructional principles of these skills in many engineering departments often fail to acknowledge the importance of basic strategies for thinking and solving problems. As engineers, Robin and I realized that although we were very proficient at problem solving ourselves, our students had difficulty with it, and we consulted a colleague from our university's Department of Counseling, Educational Research and Psychology for some instructional support. By doing this, we were able to use educational research conducted in other educational realms and generalize the findings to our specific program. For example, research conducted by Bereiter and Scardamalia explores how information is stored through each learner's information processing system, and the when the researchers provided teaching strategies to make learners more aware of the explicit process of learning and retrieving new knowledge, we customized those ideas to our program and tried them out in our classes[5]. Likewise, we've used research from metacognitive studies conducted by Borkowski et al. that explores how students can be instructed in metacognitive strategies that will help them form "mental models" of new information which is then connected to previous knowledge, thereby capitalizing and extending what is known about information processing abilities and the storage of new information[6]. What this means to us as engineering educators is that all new information must be linked in the students' minds to previous information in order for the optimal amount of learning to take place. Practically speaking, we designed exercises that allowed our students to take previous information and add new information to it with a series of instructional links.

Another interesting approach to good problem solving and critical thinking instruction concerns instructional style. Much of the recent research in cognitive-based instruction advises moving away from the traditional lecture-style of direct instruction toward more of a learner-centered active approach to instruction, noting that in traditional instruction, the focus is usually on presenting one method of solving a particular problem, compared with the more recent idea of presenting several methods or strategies for problem solving. These ideas support our University and College Mission statements and the ABET criteria by suggesting that learning should be an active process, and by focusing less on tradition and more on student learning, the university's general goal of effective instruction is met at the same time.

4.5 Assignments and Grading

In developing these classroom environments, and responding to student feedback, it became apparent that some re-evaluation of goals with respect to assignments and grading would be fruitful.

In order to guide the students' learning and exploration skills, open-ended, multiple-possible-solution, problems are commonly given. This has proven to be difficult on the students, who expect structure and a single correct answer. To a great extent, we have chosen to concentrate on the process, which the students must follow, rather than simply the product. That is, these students are encouraged to investigate alternatives, present, challenge, and defend their assumptions. In essence, we ask the students to define their own problem.

The difficulty that has arisen is simply in the paradigm shift from a "single correct answer to a well-defined problem" to a "define and defend your criteria, then solve problem." Friction has

arisen in both directions. Students who expect the first type of problem are initially uncomfortable with the latitude and challenge of the second type. Students who enjoy the second type have expressed great frustration with other courses that are more traditional.

In our self-paced courses, we have gone one step further in this "define-it-yourself" approach. In the self-paced environment, students are encouraged to take a broadened approach to learning - investigating their own personal preferences, while also being challenged to attempt those activities that are less attractive. Several examples might be helpful.

One student, a senior, has become a strong proponent of the self-paced approach. A quick learner, he is easily bored with homework, but enjoys journal work and the Internet. His assignments have generally been project-oriented, requiring several weeks to complete a comprehensive assignment.

A second student, a junior, is still uncomfortable with the self-paced approach. She enjoys working with others and is very diligent, and effective in a team. She has been paired with another student, where her main contribution is in "tutoring" her partner on technical details; his contribution is in guiding the development of the project. By recognizing the strengths and weaknesses of each, we have capitalized and created and effectiveness partnership.

A third student, typical in our urban institution, is employed full-time in a technical position with an express mail carrier. This student, a senior, has focused his learning track by applying the concepts to his work environment. These projects provide him with an understanding of the material, and immediate link between the classroom and his profession.

This recognition of our customers - the students - as individuals has essentially led us to re-evaluate the nature and rationale of all assignments. The center of our philosophy is that assignments should be given for two reasons:

- For grades
- For knowledge

The first is traditional. The second, we believe, receives too little attention. Assignments should challenge the students. Failure should be an occasional outcome. False starts must be allowed.

Consequently, we have rethought our approach to grading throughout the program. If we truly wish to encourage critical thinking and lifelong learning, we must give the student free rein to explore. "Failures" must be used, but downplayed from a grading perspective.

Second, items that are graded for one are not necessarily for another. We attempt to avoid "busy work" and focus on tailoring a student’s learning according to his/her own style.

Third, as noted earlier, we focus on the process. Lifelong learning requires feedback and introspection. A grading system centered on the "bottom line" fails in giving the student that opportunity.

4.6 Impact

By and large, the activities undertaken have been successful and student evaluations have supported them. As mentioned earlier, students are thinking more - and recognizing the value of it.

INSE faculty members are likewise invigorated and enthused. Encouraged to be innovative, the faculty have worked to provide a classroom environment that focuses on students learning, rather than simply teaching.

The expenses have primarily been in time and uncertainty. To undertake these tasks - particularly for a new faculty member - requires a significant commitment of time and effort. This time, researching alternatives and implementing changes, is time taken from other activities. And it is this time taken away that leads to uncertainty. Since research is an essential element in a faculty member's career, such a focus on teaching can be counter-productive to the individual; this is particularly true for tenure-track faculty.

V. Conclusions and Future Directions

The INSE undergraduate program has been in place since 1996, and our first graduate finished in December, 1998. The majority of the curricular innovations have been made within this program; as a result our observations to date are primarily anecdotal or based on student survey responses. Long-term effects have not yet been assessed, but we are currently in the process of designing a formative evaluation system which will assess our work thus far and offer suggestions for additional customization of our program to meet both the needs of our students, the needs of our community, and the needs of our internal and external accreditation committees.

While the long-term results are yet to be realized, the feedback has been positive and encouraging. We hope to encourage other faculty within the College of Engineering to use our approaches, and indeed seek to define a more global learning philosophy college-wide. Such a process should be a natural outgrowth of the College's ABET2000 initiatives.

Bibliography

1. Lohmann, Jack R. EC 2000: The Georgia Tech Experience. In *Journal of Engineering Education*, July, 1999, 305-310.
2. Engineering Criteria 2000, 3rd Edition, Engineering Accreditation Commission. Accreditation Board for Engineering and Technology, Inc., Baltimore, MD, Pub. No. 98-AB-7a, 1998.
3. Beder, Sharon. Beyond technicalities: expanding engineering thinking. In *Journal of Professional Issues in Engineering Education and Practice*, Jan. 1999, 12-18.
4. Silyn-Roberts, Heather. Using engineers' characteristics to improve report writing instruction. In *Journal of Professional Issues in Engineering Education and Practice*, Jan. 1998, 12-16.
5. Bereiter, C. & Scardamalia, M. Fostering self-regulation. *The Psychology of Written Composition*. Hillsdale, NJ: Erlbaum Publishers, 1987, 249-263.
6. Borkowski, J. and Muthukrishna, N. Moving metacognition into the classroom: 'working models' and effective strategy teaching. In *Promoting Academic Competence and Literacy in Schools*, edited by Michael Pressley, Karen Harris, and John Guthrie. San Diego: Academic Press, Inc., 1992, 477-501.

ROBIN LOVGREN
Robin Lovgren was, until recently, an assistant professor in the Industrial and Systems Engineering Program at The University of Memphis. She received her B.S. in Industrial and Systems Engineering from Georgia Institute of Technology, and an M.S. in Statistics and Ph.D. in Management Sciences from The University of Tennessee. Her newest areas of interest are her twin daughters.

MICHAEL RACER
Michael Racer is an associate professor and Director of the Industrial and Systems Engineering Program at The University of Memphis. He received his B.A. in Mathematical Sciences from Rice University, and his M.S. and Ph.D. in Operations Research from the University of California at Berkeley.

ANNA PHILLIPS
Anna Prislovsky Phillips received her B.A. in English from Memphis State University, an M.A. in English from The University of Memphis and is completing her Ph.D. in Educational Psychology, with a concentration on cognitive psychology. She has been an Instructor of composition, technical and professional writing and an inter-disciplinary instructor with the Department of Civil Engineering. Her research interests include: team teaching, learning communities and academic success; peer editing/peer feedback in composition, and underrepresentation of girls in science and engineering fields.