Combining the Freshman Introduction and General Writing Course into one Class

Dan Budny, Beth Newborg, Michael Ford and Judith Ann Brink
University of Pittsburgh, budny@pitt.edu, bnewborg@gmail.com, ford29@pitt.edu, jbrink@pitt.edu

***Abstract*- Collaborations between engineering faculty and skilled experts outside of engineering proper build strong undergraduate engineering curricula that clearly emphasize professional skills and ABET program outcomes (Criteria 3 d, f, g, h, i,). With shared goals of providing undergraduates with a rich educational experience in which research, communication and critical thinking are central to achievement and to the development of integrity in engineering, such collaborations produce an instructional program that readies students for the requirements of continuous learning and complex analysis essential to a successful, principled engineering career. This paper will describe the contributions to undergraduate engineering education that non-engineering faculty and academic departments have brought to the Pitt Experience. Through the description of the curricula and strategies developed, we hope to provide other educators in both science and engineering with useful tools to assist them in developing and/or enhancing the use of writing within their own classrooms.**

INTRODUCTION

Current ABET accreditation requirements emphasize the importance of "soft" skills in planning and achieving excellence in engineering education. What engineers need to experience and know, in addition to "hard" knowledge, is "process-oriented skills and awareness-oriented skills."[1] Process-oriented skills include "communication, teamwork, and the ability to recognize and resolve ethical dilemmas."[1] These skills are powerful when combined with awareness skills involving "understanding the impact of global and social factors, knowledge of contemporary issues, and the ability to do lifelong learning."[1] But what are the most effective ways of incorporating process and awareness-oriented practices into engineering curricula already crowded with necessary science, math, and disciplinary courses? How can engineering schools, which must ensure that their students graduate with sound hard skills, also ensure they are graduating "whole engineers" who have encountered and practiced communication, teamwork, and the ability to recognize and resolve ethical dilemmas; who are cognizant of the potentially enormous social impact of engineering; and who have skills which facilitate lifelong learning in these very areas?

For engineering schools to educate "whole engineers," they must embrace their own university's whole range of resources. Schools of engineering are parts of larger educational institutions, and, as such, have the opportunity and obligation to make the best use of the resources a whole university has to offer. Here at the University of Pittsburgh, the Swanson School of Engineering faculty and administration have worked in tandem with librarians, and with faculty from the English Composition, to develop tools and projects to educate students in process and awareness-oriented skills. To do so effectively, the Swanson School of Engineering has advocated and practiced the very skills it sees as essential to the "wholeness" that facilitates effective communication, teamwork, and responsible action. Over the past ten years we have developed, and successfully implemented "soft skills" within the English/Freshman Engineering Writing Program (E/FEWP).

Most freshmen entering the University of Pittsburgh, including those entering the Swanson School of Engineering, are required to take the University's core writing course, Seminar in Composition, and a full load of math, science, and engineering courses. To allow the Engineering departments the ability to maximize their course content coverage during the upper class years, the decision was made to move an elective into the freshman year. However, with the given freshman requirements it was impossible to add another course. Given this problematic situation - ten years ago we spearheaded a collaboration between Pitt's English Department, the Swanson School of Engineering's Freshman Program, and the Bevier Engineering Library to remove the writing course from the curriculum and instead make it part of the freshman engineering courses. We knew the School of Engineering faculty had neither the time nor the pedagogical expertise in freshman composition to develop and teach an engineering equivalent to Seminar in Composition. As a solution to the programmatic time restrictions, the composition course would become part of the fall semester's required Engineering Analysis class and the spring semester's required Engineering Problem Solving class. For this composition-within-engineering to succeed, all freshman engineering faculty had to be willing to open their classroom doors and their syllabi to the composition instructors and assignments. Composition instructors had to be willing to work within time frames and curricula different from the standard Arts & Sciences 3-credit course.

The Composition Program has a strong commitment to university-level illiteracies; the challenges and outcomes of developing a Seminar in Composition equivalent for freshman engineers that would be taught from within the freshman engineering curriculum was intriguing to composition faculty, especially those faculty who had experience with professional writing. Thus began the E/FEWP, a dynamic, collaborative program that continues to significantly contribute to educating whole engineers.

FRESHMAN ENGINEERING AT THE UNIVERSITY OF PITTSBURGH

The Freshman Program at the University of Pittsburgh has an academic and an advising component. The mission of both components is to create a first year experience that promotes the student's continued pursuit of an engineering degree. Part of the Engineering Library's mission has been to work with freshmen in order to give them a solid orientation to library research in a university setting. The problem is how to create a curriculum that can satisfy all these missions.

Academic Concerns

The Engineering School solution to this academic concern and to meet the mission of introducing teamwork by using cooperative learning created an integrated freshman curriculum [2,3]. In addition to providing a different learning environment, it is also promoting the students' communication skills. However, even with this type of instruction, the traditional engineering problem solving course does not provide enough opportunities for written and oral presentation assignments. Thus, there is a need for students to gain additional writing experiences within the curriculum.

Advising Concerns

The main objective in first year student advising is to assist each student in making a smooth transition from high school to college; a secondary objective is to aid first year engineering students in identifying their major. The School of Engineering's award winning mentoring program aspires to address the need of involving the whole student in their degree program [4]. The goal is to include advising within the academics so the program meets the needs of the students.

Library Concerns

The Bevier Engineering Library is one of 14 libraries in the University of Pittsburgh's University Library System. The library has approximately 65,000 books, 76,000 microforms, and over 1,000 journal titles. Extensive electronic resources are also available to support the teaching and research of faculty, students, and staff. It is a goal of the Engineering Library to present library research as a necessary skill-set for successful engineers. Real world problems that engineers of the future will face may combine knowledge and understanding from several fields outside of their areas of expertise. While it is not reasonable to expect engineers to have mastery over all subjects, it is reasonable to expect them to be able to find and analyze relevant information as needed. Engineering graduates should be able to teach themselves new concepts and apply information to new and unfamiliar situations. This ability is listed in ABET guidelines as an objective for a competent engineer. [5] Unfortunately, it is common to hear junior and senior students say they do not know how to conduct research within the literature of engineering. Introducing library skills during the first semester demonstrates the fundamental importance of these skills in engineering education.

ENGINEERING 0081 - FRESHMAN SEMINAR

ENGR0081 is a course that explains the university policies and procedures to the students. It is required for all freshmen engineers [11]. It is a zero credit class, however the freshmen are graded pass/fail based on attendance and participation.

In the past this course was a typical introduction to engineering where once a week the entire freshman class would get a lecture on the different fields of engineering. The typical syllabus was an introduction session, followed by eight separate presentations by the different departments within the school of engineering, a study skills session, presentations by the Co-op and study abroad programs, a session dealing with spring semester registration and a "open house" session sponsored by all the departments.

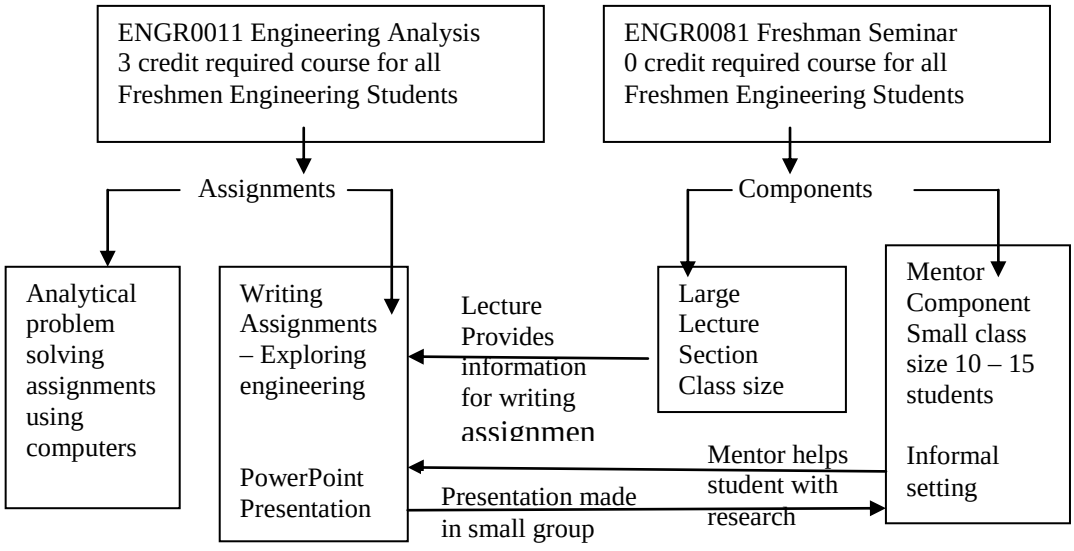

FIGURE 1 CONNECTION BETWEEN ENGR0011 AND ENGR0081

By student accounts, the program was "very cold" and the students' lack of respect for the course resulted in them ignoring most of the material presented in the sessions. In the Fall semester of 2001, a new ENGR0081 was enacted and linked to the first semester Engineering Analysis course ENGR0011. By linking the academic and advising courses, ENGR0081 would now be a course in which lectures would provide information needed by the students to complete assignments in other courses.

The syllabus of the ENGR0081 lecture sessions looks basically the same under both the new design and the old design. The major change is the integration of the curriculum where we link assignments from ENGR0011 into ENGR0081, see Figure 1. The ENGR0011 assignments are a new extensive writing and communication across the curriculum component, where students are required to research their field of engineering. Thus, the lecture component of ENGR0081 now has an academic component, and the students have a reason to listen to the various presentations given throughout the seminar. Sessions that students previously claimed were "boring" have been reoriented to contribute to mentoring group activities and to the "hands-on" research and writing assignments that comprise a significant, essential and graded element of the ENGR0011 Engineering Analysis course

DESIGNING THE FIRST SEMESTER WRITING PROJECT

At many universities they use hands on projects or various design projects to try and help students discover what engineering is and what engineers do. We even used this procedure for years to try and help students discover what engineering is all about. However, we were not pleased with the projects nor did we feel they were accomplishing the goal of explaining what engineers do. Thus, the goals of ENGR0011 and 0081 were modified to provide a more personalize experience for each student. It was felt that by having the students take an active role in exploring their future by researching their profession and writing a research paper [2], we could address the various academic and advising concerns regarding communication skill development and retention in engineering issues. Table 1 is a copy of the handout provided to the students that describes the details of the project. Thus, this project allows the ENGR0011 course the opportunity to introduce the required software for the project, work on improving the student's communication skills, allow the advising concerns to be addressed, and introduces the library skills.

IMPLEMENTATION OF THE LIBRARY RESEARCH PROJECT

The Engineering librarians and English department designed the assignments to expose the students to resources that the student would need to utilize throughout their undergraduate program as well as the literacy skills that would continue to serve them as professionals.

Assignment #1 Presenting Myself: Recent Past, Present, and Near Future, 400-450 words

To gain a sense of their students' background, interests and accomplishments, the mentors in ENGR0081 ask the freshmen students to write letters of recommendation about themselves for an imaginary engineering scholarship. As the E/FEWP faculty, began developing the program's curriculum, they immediately saw the usefulness of this peer mentoring exercise. The E/FEWP staff composed an assignment that intensified the "letter of recommendation" scenario and expectations.

Composing the Letter of Recommendation provides students with a first step in meeting Composition Program goals of composing "thoughtfully crafted essays that position the writer's ideas among other views" and of "writ[ing] with precision, nuance, and awareness of textual conventions." . Students have the opportunity to introduce and describe themselves in the "voice" of someone who knows them and contextualizes them in particular ways. Composing the Letter of Recommendation allows students to consider what they might like to achieve in their freshman year of study and beyond; allows students to consider what, in their recent pasts, led to their choice of going to the University of Pittsburgh Swanson School of Engineering; and allows students to understand the usefulness of their instructors' coming to know them on an individual basis. What began as an informal mentoring exercise was collaboratively developed into an engineering/composition experience rich with potential personal and academic learning outcomes.

Assignment #2, Current Challenges and Issues in Engineering: My Point of View, 850-950 words

Information literacy is defined by the Association of College and Research Libraries (ACRL) as the set of abilities requiring individuals to "recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information." These abilities are essential to the process and awareness-oriented skills that are important for the whole engineer to acquire. Pitt's comprehensive course description for Seminar in Composition states that "As a step toward college-level critical literacy, this course is designed to help student writers become more engaged, imaginative, and disciplined composers, better equipped to handle complex subjects thoughtfully and to use sources responsibly." To emerge from the freshman engineering year with the discipline and responsible practices of university-level literacies, it was essential to include research activities and researched-informed writing in the E/FEWP assignments. Without library collaboration, the E/FEWP staff could not have included the information literacy learning and experience that are part of a successful "whole engineering" writing curriculum.

For Writing Assignment #2, students examine the National Academy of Engineering's "14 Grand Challenges for Engineering in the 21st Century" (found at http://www.engineeringchallenges.org/). Students choose a challenge and delineate a particular topic relevant to that challenge. Students then do research from contemporary sources—a minimum of 4 articles from trade and popular publications, from the past 5 years—related to that topic. Based on their research relevant to this challenge/topic, students present their own position on the importance—to

engineering, to themselves, and to society--of this particular challenge.

Assignment #3 Engineering and Me—Why I Want to Be What I Think I Want to Be, 900-1100 words

For Assignment #3, students research and analyze the field of engineering which most interests them—presumably, the field in which they intend to major. Students research professional societies in this field; working atmospheres, conditions, and salary ranges for engineers in this field; and jobs and job opportunities in this field. Another essential research component of the paper is the student's research into his or her own interests and best capabilities. "Research" into the student's own past—through childhood and through the high school years—provides details about what kinds of work, study, and play have been most engaging to the student. These research details, along with details provided by more conventional research into particular fields and jobs, allow students to articulate well-supported insights about their career decisions.

Assignment #4: Engineering Challenges, Ethics and Education: My Point of View, 1200 words

For Writing Assignment #4, students return to the challenge/topic they wrote about in Assignment #2. Assignment #4 presents an opportunity for students to increase the effectiveness of their overall descriptions of the challenge/topic, while also requiring that they analyze the challenge/topic in terms of engineering ethics and engineering education. Drawing on research into engineering codes of ethics and further research into the challenge/topic itself, students now articulate the relationship of the topic to particular codes and tenets of engineering ethics. Also required is reflection on the very act of spending time researching, thinking and writing about this challenge during the freshman year of an engineer's education.

Assignment #5: Summary Presentation: Completing the process by presenting your findings

For this assignment students make two power point presentations that will be given in their small seminar section. The first presentation is the traditional ppt file with multiple slides. The second is a poster presentation. Each traditional presentation is approximately 5 minutes long, with a minimum of 6 -10 slides.

The purpose of this presentation is to summarize the writing assignments. The first assignment was a bio. The purpose of the paper was to get the student to think about who they are, what are your interest areas and what are their strengths. The second paper was a trend in engineering. The purpose of this paper was to have each student look into the future and try and predict where their field of engineering is headed. The third paper was a detailed study of the present area of engineering they are interested in. The final paper was about society and engineering and how they see the two connected.

The purpose of this presentation is to have the student look at the big picture and complete the circle. How do you see the trends taking you into an area that fits your interest area. Why do you think the present working conditions in engineering fit into your goals and how your future plans are in line with what the trends are showing. Finally explain how your, society and work will all come together. When the students complete this power point presentation, they are then required to create a poster.

Each component of the research project included a statement of purpose (or learning objective) so the students would understand why they were doing this work. Research/Resource Guides for each assignment were designed by the library staff in order to supply the students with additional guidance to the resources they would need to consult. The individual research assignments were to be due each week in order to 1) keep students on a schedule 2) allow the students to progressively build upon their research skills and 3) assist the mentors by limiting the occurrence of unrelated questions, thus enabling them to focus their feedback to the students

Connecting this assignment to the Engineering Course

The Academic Program Director created a Web site for the ENGR0011 course where he posted all course related instructions and support materials for ENGR0011 and ENGR0081 including all of the materials for the integrated Library Research Project. As part of the ENGR0011 course requirements, the students are required to create a personal web site. All of the content from the writing assignemnts was modiified so the students would also post their findings on their web site.

Within the library, the librarians and staff met to discuss the project. A binder containing the Library Research Project was kept at the front desk of the Engineering Library. All of the library staff became familiar with the project; they were aware of which assignment the students would be working on in any given week, as well as the resources students were being asked to access and use. The same basic operating system was undertaken at the University Writing Center, where all the faculty and staff were aware of the assignments.

THE ENGINEERING 0012 COURSE

Engineering 0012 is a second-semester course in the required core for engineering students at the University of Pittsburgh. ENGR0012 covers the computer programming portion of the integrated curriculum package and has four main curricular goals:

1. teaching students to program a computer using a general-purpose programming language;
2. teaching students to design programs using a "top-down" approach;
3. promoting and encouraging good programming practices; and
4. illustrating the role computer programming plays in solving real-world engineering problems.

Open-ended homework projects related to these topic areas are assigned. Here students have several options and must make efficient choices in order to solve the problem(s) at hand. These projects are intended to challenge students' judgment and creativity as well as their problem-solving abilities In addition, this course continues the writing component by requiring students to write a research paper.

DESCRIPTION OF THE WRITING

Early in the semester, students were informed that one of the key components of the course would be the preparation of a formal written paper for publication and presentation at a conference to be held at the end of the term. The theme for papers relate to topics covered in the fall or spring semester of their Physics, Chemistry, Calculus or Engineering classes, and is also linked to their chosen area of engineering. The key idea is to related the paper to: Bio, Civil, Chemical, Electrical, Computer, Industrial, Materials, or Mechanical Engineering, and the design, development and/or function of a device, applications and public policy issues, and applications and social issues. The concept is to expand the curriculum integration by having students merge material from their core courses with material they had learned in their introduction to engineering seminar courses. The hope was that the writing assignments would help the students select the best field of engineering for their interest area. In addition, because of the large class size 360 students) all papers were required to have two co-authors.

Throughout the semester, students were exposed to all aspects involved in the preparation of a formal paper for publication. These aspects included: responding to a call for papers, submitting an abstract, being notified of the acceptance of their abstracts, conducting the necessary research, preparing and submitting a paper for review, conducting a review, and receiving and utilizing the feedback to prepare a final paper. Each of these items are further described and illustrated in the sub-sections presented below.

The Call for Papers

The conference call for papers is distributed at the beginning of the semester via the class web page. The purpose of having students prepare an abstract was threefold. First, the preparation of an abstract gave students a sense for how the abstract submission process is handled for a professional conference. Second, it provided students the incentive to choose a topic for their papers early and to begin to focus on the research aspects of the project. Third, based on the first few years of conference experiences, it was obvious that many students had never been asked to prepare an abstract before. Many students were challenged to effectively summarize a paper they have not yet written into a 150 – 200 word abstract. Thus, this task required the students to think within the "big picture".

To assist the students in the development of their abstract, the English faculty developed research guidelines to help the student write their abstracts. It was also discovered that the students lacked the necessary library skills needed to properly research their topic to write an effective abstract. Thus, the library staff developed a digital tour of the library and posted guides to help the students with their research.

A web-based electronic format was used for submission of abstracts. Once the submission process was completed, all abstracts were reviewed by the course instructors. Approximately one week after the submission of their abstracts, students were informed (electronically) that their abstracts had been accepted. The abstract review also allowed the instructors to prepare a preliminary conference schedule and to make sure the paper topics were consistent with the call for papers. Some students were asked to revise their abstracts because their initial topics did not parallel the conference theme closely enough.

Conducting the Necessary Research

Students began writing smaller research papers during their first semester Problem Solving Course (ENGR0011). As part of this assignment, students were instructed on the use of the library, how to format a research paper, and how to give an oral presentation. Thus, ENGR0011 was used as the preparation for the conference assignment that was part of the second semester course ENGR0012. An important lesson that was learned with the writing assignment is that students need continuous feedback.

After the abstracts are submitted, the ENGR0012 faculty initially reviewed the abstracts to establish the conference sessions. Students are then required to submit an extended outline and annotated bibliography of their papers. This material is given to the session co-chairs and English faculty, who then meet with their students to discuss the paper outlines.

Receiving Reviewers' Feedback

All students' papers were subjected to a formal review process. With approximately 160 papers to be presented, the conference makes use of 3 time slots with approximately 10 concurrent sessions during each slot. This results in approximately 30 sessions with 6 papers presented per session. Because of the large number of papers to be presented it is not possible for one person to perform all the associated review tasks. To address this issue, approximately 30 alumni volunteers from the Pittsburgh area together with approximately 30 peer mentors are solicited to act as co-chairs for each session. These individuals also served as technical reviewers for the papers to be presented in their sessions. In the beginning student co-chairs were not used. However, it was found that the alumni volunteers could not always meet the entire semester long commitment. Thus, there would be sessions in which students did not always get the necessary feedback they needed throughout the semester. Thus, upper class engineering students have been added as co-chairs.

The co-chairs are responsible for reviewing these submissions for technical content. After the first draft of the paper is submitted, a second meeting with the students to discuss the reviewers' comments is then held. In addition to being reviewed by the co-chairs, each paper is also reviewed by a faculty member in the English department. The reviews conducted by the English faculty members focused on writing style, form, and grammar. A peer review process is also included. The usefulness of this approach has been widely documented. Each paper has two authors which means that each paper is peer reviewed by two students. In summary, this process produced 5 independent reviews, one from a faculty

member in the English department, one from an alumni, one from a peer mentor and two from students.

Revision of Papers for Conference Proceedings

Students utilize the reviewers' comments to prepare final copies of their papers. The revision process was also used to introduce the concept of sustainability. During the revision phase, a new requirement is added to the paper that requires every paper to include a one page discussion of the impact the paper topic has on sustainability. This "change order" now accomplishes the task of having every student consider sustainability as it relates to their field and not just to green construction.

THE CONFERENCE

It is not possible to hold the conference during regular class time because of the sheer size of the conference. Thus, the conference is held from 8 am to 4 pm on a Saturday near the end of the spring semester. The conference also awards best papers for each session, and best overall conference papers. The best papers are given a cash award.

FEEDBACK FROM STUDENTS AND STAFF

Near the beginning of each semester, the students were quite apprehensive about the prospect of preparing a formal written paper. Most students had never been given a writing assignment of this magnitude before. Although the students have done some writing when they were enrolled in the foundation course, ENGR0011, the task facing them seemed quite daunting. In addition, many students expressed anxiety regarding the fact that they were also being asked to present their papers orally. Comments from students suggested that they felt they would never be able to fill the 10-minute time period allotted them for their presentations. In reality, once students had completed their written papers and had prepared their materials for presentation, most found that they had too much material to fill the 10-minute time slot! Thus, the real challenge faced by most students was the condensation of their papers into a 10-minute presentation. Each and every student author was, however, successfully able to present their papers within the given time period.

On a questionnaire given students near the end of previous semesters, students were asked to describe their overall impressions regarding the conference paper assignment. Typical student responses included:

- *I've never written a technical paper like that before. The topic was much more involved and required you to really understand what you were writing about.*
- *I thought this was a difficult assignment that taught me a lot and was worth doing. It was a lot of work, but after doing it, I felt like I learned a lot. I never had to write a technical paper before and I'm happy that I can now say that I wrote a conference paper.*
- *I learned a lot about a subject that I would not otherwise have learned about. I had never written one of this magnitude, or that required so much in-depth research. We were allowed to pick the topic - which was nice.*
- *I have never written any form of technical paper at all. At first, I was not very excited about the idea of writing such a paper, but I did feel that I had a very valuable experience. I feel that I have learned so much - beyond physics principles. I also appreciated you forcing us to do rough drafts, so I was able to pace myself and put more effort into it than I otherwise would have.*

At the conclusion of the conferences, it was clear that the students felt that all of the time, energy, and hard work they had devoted to the preparation for the conference had paid off. Many expressed that they had experienced a fairly steep learning curve on both the content covered as well as the rules and regulations they were required to follow as they prepared their formal papers. In addition, many students expressed gratitude for the opportunity they were provided to participate in such a formal and professional activity.

We also got feedback from the faculty teaching the second year courses in the various departments. As one faculty member stated, he was "blown away by the quality of the writing of his students compared to previous years". We discovered that one of the main reasons the writing of our undergraduates had been so poor was because they didn't know how to utilize library resources to write a research paper. The results we are getting continue to support the concept that if you teach them how to do it, they will improve their research and writing skills.

SUMMARY AND CONCLUSIONS

All these efforts demonstrate the value of collaborations across the whole university. The English Department, the Library, and the Engineering faculty have all contributed their time and expertise to assisting engineering faculty instruct the whole engineer. Such collaborations allow engineering faculty to focus on engineering instruction while incorporating professional skills training into their courses in a way that is coherent and smoothly integrated.

We define a whole engineer as one who "sees the whole picture. He or she sees not just the structure, but the entire environment; not just the device, but its ongoing impact on users; not just the process, but the contribution of that process beyond the factory door. In engineering education, we need to make sure students see engineering as part of the whole of life, not just as a set of technical proficiencies." Programs such the Swanson School of Engineering's E/FEWP contribute significantly to the "soft" skills that promote whole-picture-whole-engineer vision and action. Such programs cannot exist without contributors from across a whole educational institution valuing and learning from one another's proficiencies, languages, and literacies. To see our work in terms of composition theorist and teacher, Peter Elbow: had we not been willing to articulate our experiences and to hear one another's words, our programs, departments, schools, and we ourselves, would have been "radically impoverished." Instead, through collaboration, we find ourselves and our

students enriched by tapping into the multiple intelligences resident within the university as a whole.

All aspects of the assignments, allowed students the opportunity to link the active process of writing to sound, scientific content. In addition, these activities allowed students to demonstrate their understanding of a topic or set of topics using their individual learning styles. This activity also provided the instructors with an additional assessment tool outside of the limits of more traditional assessment measures.

The underlying premise is that all students, no matter what their gender, cultural, or demographic backgrounds, can learn! In a recent report on its review of undergraduate education, the Advisory Committee to the National Science Foundation's Directorate for Education and Human Resources concluded that "… while K – 12 programming can expand the pool of those interested in pursing careers in SME&T [Science, Mathematics, Engineering, & Technology], it is at the undergraduate level where attrition and burnout can be most effectively prevented. What we in SME&T education must do is to concern ourselves with *all* students, not just those who historically have been represented in science, mathematics, engineering, and technology. Such a breadth of concern has important educational benefits as well, as it will force us to think more about how individuals learn and recognize what research has made clear: that there are differences in learning style which profoundly effect achievement.

Writing has proven to be an effective way to assist students in articulating their thoughts. In addition, the opportunity to research and then write about a topic of personal interest can allow students a chance to demonstrate their understanding in a way traditional assessment measures do not permit. Hence, the application of a writing component into a course for majors as well as non-majors has enormous potential within both science and engineering communities.

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