AC 2011-2919: COMBINING THE FRESHMAN INTRODUCTION TO ENGINEERING AND THE FRESHMAN WRITING COURSE INTO ONE CLASS

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Combining the Freshman Introduction to Engineering and the Freshman Writing Course into one Class

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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 freshman engineering 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

ABET accreditation requirements emphasize the importance of "soft" skills in planning and achieving excellence in engineering education. In addition to "hard" knowledge, engineers need to experience and understand "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] What is the most effective way of incorporating this into an engineering curriculum already crowded with necessary science, math, and disciplinary courses?

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 program, 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, through teamwork that has valued a variety of skill sets, we have developed, and successfully implemented "soft skills" within the English/Freshman Engineering Writing Program (E/FEWP).

Most students entering the University of Pittsburgh, including those entering the Swanson School of Engineering, are required to take the University's core writing course, ENGCMP 0200 ,Seminar in Composition, during their freshman year. For freshman engineering students, this would require taking this intensive composition course along with a full load of math, science, and engineering courses. However, with the full complement of courses

required, 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 separate 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. Thus, faculty, librarians, and administrators from Engineering began a collaboration with faculty and administrators from English to implement a course that would allow the incorporation of Seminar in Composition goals and requirements into the freshman engineering curriculum. English Department composition faculty, drawing on the engineering expertise of the freshman engineering faculty, would develop writing assignments for this equivalent to Seminar in Composition, and would read and grade all papers written by freshman engineering students as part of the first and second semester introductory engineering courses. 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.

Through the E/FEWP, freshman engineering students are afforded the writing and critical thinking experience equivalent to the University of Pittsburgh's core three-credit freshman writing course. With the E/FEWP, from day one of their first engineering class, students are introduced to the role that information literacy and university-level writing skills can play in responsible thinking, thoughtful action, professional integrity and career success. In addition, collaboration between the E/FEWP and the Swanson School's Freshman Engineering Program advising and mentoring activities has benefited all students, faculty, and advisors involved. Through writing assignments that require students to research engineering fields and achievements, while reflecting on their own interests and experiences and goals, the E/FEWP creates a substantial picture of students' own evolving academic and professional awareness—a picture that is useful to and enhanced by significant freshman advising and mentoring.

Freshman Engineering Program

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 and information literacy in a university setting. The problem is how to create a curriculum that can satisfy all these missions.

Academic Concerns

The engineering department modified its program and created an integrated freshman curriculum [2,3] to promote a comprehensive learning environment that includes significant attention to student communication skills. The environment also employs this attention as a means to amplify students' consciousness of the academic and personal choices they make. There are two main engineering courses that are part of this curriculum: ENGR0011 and ENGR0012. The former is a required three-credit programming course with the overall goals of teaching the basic analytical, programming design as well as graphical, problem-solving, teamwork, and communication skills. ENGR0012 is a second-semester core course that

completes the computer programming portion of the integrated curriculum package. This course focuses on the following curricular goals: teach students a general-purpose programming language, promote and encourage good programming practices, and illustrate the role computers play in solving real-world engineering problems. While both courses originally covered many basic programming and problem-solving skills, they did not provide enough opportunities for written and oral presentation assignments or for effective advising.

Advising Concerns

The first-year student advising objective is to assist each student in making a smooth transition from high school to college, to aid these students in identifying their major, and to facilitate strong retention. The mentoring program within the curriculum aspires to actively involve students in every aspect of the undergraduate experience, including advising, personal decision-making, academic achievement and integrity. [4,5,6,7,8] To accomplish this, all freshman engineering students are required to enroll in the advising course, ENGR0081, which explains the university policies and procedures. In the past, this course involved more passive learning as students attended lectures on college-related matters and various engineering departments.

By incorporating writing into the integrated curriculum, the university created a new version of ENGR0081, which included small mentoring groups supervised by mentors and centered around a social or cultural activity (such as board games, sporting events, or dance in Pittsburgh) [9]

Library Concerns

The Bevier Engineering Library is one of 14 units in the Library System at the University of Pittsburgh. One of the library's goals is to present library research as a necessary skill set for successful engineers. The American Library Association defines information literacy as the ability to "recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information."[10] This includes developing search strategies, selecting appropriate literary research tools, critically evaluating the materials identified, and properly documenting sources used. Problems that future engineers will face may require knowledge and understanding from several fields outside of their areas of expertise. Graduates should have the ability to teach themselves new concepts and apply information to new and unfamiliar situations.[11] A major concern is how to introduce library skills during the freshman year.

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 [9]. 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 an "open house" session sponsored by all the departments.

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 a linking of E/FEWP assignments from ENGR0011 with content and activities from ENGR0081, see Figure 1. ENGR0011 writing assignments require that students research their intended fields of engineering, discovering and analyzing what engineers in various disciplines undertake and produce as well as what the ongoing developments and achievements of various engineering disciplines are. 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

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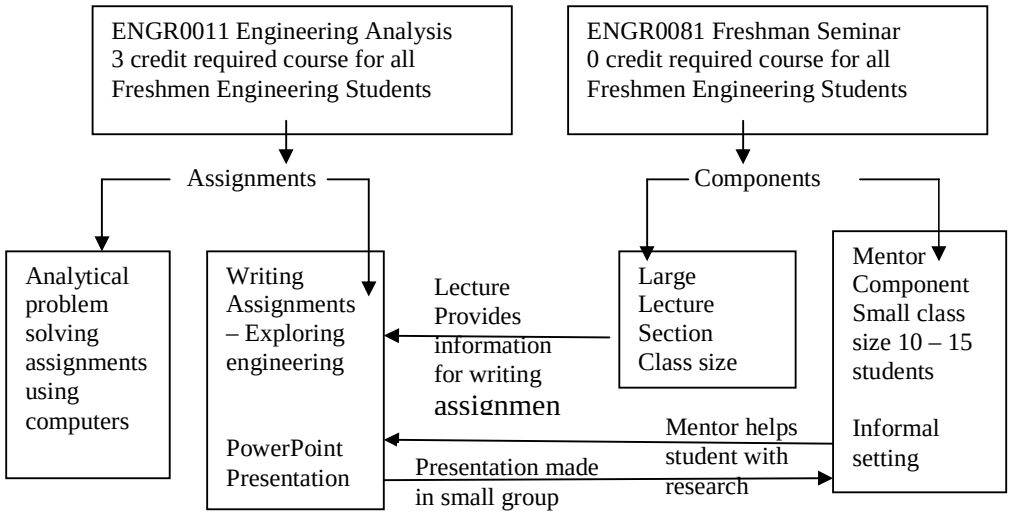

FIGURE 1 CONNECTION BETWEEN ENGR0011 AND ENGR0081

Designing and Implementing the First Semester Writing Projects

Many universities use hands on projects or various design projects to try and help students discover what engineering is and what engineers do. At the Swanson School, we used such projects 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 substantially explaining, for students, what engineers do.

In recent years, a number of writing techniques have evolved that make use of various writing-to-learn strategies within the domains of engineering, mathematics, and the sciences. [12,13,14,15,16,17,18,19,20] The use of writing in introductory classes for engineers may be an effective vehicle to help students enhance their critical thinking and problem-solving

skills. Writing can also assist students in identifying and confronting personal misconceptions. [21,22,23,24] To reach these aims, the goals of ENGR0011 and ENGR0081 were modified to provide a more personalized, more immediately meaningful experience for each student. We felt that by having the students take an active role in exploring their futures by researching and writing about their intended professions [2], we could address the various academic and advising concerns regarding communication and information literacy skills while also providing students with knowledge and experience essential to retention in engineering issues.

These writing assignments developed by English faculty in close consultation with Engineering faculty and librarians, provide one standard assignment for each writing project, with clearly defined overall standards and requirements, but each writing assignment also allows for each student to understand, through research and writing, his/her particular assumptions, evolving awareness, interests and strengths.

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 had always asked 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 faculty composed an assignment that intensified the "letter of recommendation" scenario and expectations.

Composing the letter provides the students first step in meeting the goals of Pitt's standard first semester general writing course, ENGCMP 0200, which focuses on "thoughtfully crafted essays that position the writer's ideas among other views" and of "writ[ing] with precision, nuance, and awareness of textual conventions."[25] Students have the opportunity to introduce and describe themselves in the "voice" of someone who knows them and contextualizes them in particular ways. This allows students to consider what they might like to achieve in their freshman year of study and beyond, while allowing the university to merge advising into the curriculum. Through this assignment students have an opportunity to see that it's useful for their instructors to know them on an individual basis. The letter also provides instructors and advisors with another glimpse into the students' lives.

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

The critical importance of information literacy in engineering education is first addressed in assignment two. With this assignment, librarians help students select appropriate sources, construct efficient searches, interpret search results, and obtain identified sources. To complete this assignment, students examine the National Academy of Engineering's "14 Grand Challenges"[26] Encountering, further researching, and writing about these "Grand Challenges" introduces students to the idea of social responsibility and asks that they take a position on the role and responsibility of engineers in delineating and addressing social and environmental issues and problems. Students choose a challenge and delineate a particular topic, complete research using articles from a minimum of four trade and popular publications, and present their position on the importance of this topic to engineering, themselves, and society. With this assignment, students encounter the impact engineering can have on society, and they begin to practice making responsible arguments about significant, real-world matters.

Through the Grand Challenges assignment, students also begin practicing responsible research appropriate to academic and professional writing, as librarians introduce students to the concepts of appropriate, university-level literature research. The librarians provide information and examples that demonstrate the quality and authenticity risks of relying on web search engines or Wikis. Librarians explain the basic research steps: taking information from a nebulous form, filtering it through a database, obtaining a list of citations which match criteria, and determining how to achieve full text access.

Through the librarians' classroom instruction and accompanying support materials, students learn that "library research" does not solely encompass finding books about a subject. Rather, it is about identifying, locating, and using various types of publications including trade and scholarly journals, books, technical reports, conference proceedings, and dissertations, along with subject-specific databases such as Inspec and Compendex.

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

In this assignment, students research and analyze the field of engineering in which they intend to major. Students must show how the actual educational requirements, jobs, atmosphere, and salary ranges of a particular field are a good "match" with their own interests, goals, and particular abilities. Through writing, in detail and with concrete examples, about their own interests, activities, and achievements, while also researching and writing about educational requirements, job prospects, professional settings, working conditions, and salary ranges, students become consciously aware of the appropriateness (or lack thereof) of the educational decisions they are currently making.

Library instruction for this assignment addresses locating verified, accurate, and authoritative career information, and includes demonstrations of using the online version of the Occupational Outlook Handbook.[27] This assignment also introduces professional society websites, including organizations such as the National Society of Professional Engineers and the Junior Engineering Technical Society. The library session also provides students with an overview of the online library catalog, with particular emphasis on finding books, career guides and handbooks, which can serve as valuable sources of information on engineering careers.

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

To complete assignment four, students rewrite and expand the scope of their Grand Challenges paper from assignment 2. With assignment 4, students experience how revision increases clarity, and how additional research and contextualization yields new insight and increased impact. 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

The research goals of this assignment include introducing the concept of peer-reviewed publications and the resources for identifying them, as well as teaching more advanced

techniques for conducting searches. Students need to search within the context of engineering ethics, thus, this assignment revisits the professional societies that are most frequently the sources of such codes.

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

Students' end-of-the-semester presentations revisit, summarize, and reinforce the integral relationships between what engineering "is" (current challenges and trends, what kinds of work and compensation can be expected in particular fields, how engineering impacts society, and what are an engineer's responsibilities) and how a particular engineering degree fits within the students' interests and goals.

The purpose of this presentation is to summarize the writing assignments. The first assignment was a biography. The purpose of the paper was to get the students to think about who they are, what their interest areas are, and what are their strengths are. The second paper was an examination of a current global engineering challenge. The purpose of this paper was to have each student understand and appreciate where their intended field of engineering is headed. The third paper was a detailed investigation of a particular engineering field, and why and how a student's decision to major in this field is well-considered and appropriate The final paper continued explorations about society and engineering and how they are connected.

The purpose of the end of semester presentation is to have the student look at the big picture and complete the circle of inquiry and awareness. In their presentations, students comment on how they see the trends within an engineering area fitting with the students' own interests, intentions, and strengths. Drawing from their work on the 4 papers, students provide evidence for their emerging insights into how their plans for the future are in line with major engineering trends and challenges. Finally, students provide a convincing picture of how they, their work, and society will all come together.

In addition to a PowerPoint, students create a poster based on the above assignments. The students present the PowerPoint and poster in their small ENGR0081 seminar. This provides an initial experience in presenting their scholarship before a group. At this point in the semester, students have also drawn from their writing assignments to create a personal website, which also covers their interests and how those interests fit with their educational trajectory and with current engineering trends and challenges. Throughout the semester, ENGR0011 instructors introduced the required software for the word processing and formatting, for web design and publication, and for PowerPoint and poster presentations. Through these various modes of presenting ideas, students experience the processes and potential impacts of communicating in three formats: traditional paper, a website, and public speaking presentations with PowerPoint presentation and posters.

Connecting this Assignment to the Engineering Course

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.

Design and Implementation of the Second Semester Writing Projects

The ENGR0012 writing assignment is preparing a formal written paper for publication and presentation at a freshman conference scheduled at the end of the term. The theme of student papers must relate to topics covered in their physics, chemistry, calculus, or engineering classes. Thus, students relate their papers to their chosen field of engineering with a focus on the design, development, and/or function of a device; applications and public policy issues; or applications and social issues. The goals are for students to understand and engage in best research writing and communication practice, introduce them to the kinds of professional practices inherent to a professional situation such as a conference, and continue to help students select the best field of engineering for their interests and goals. In addition, students work in pairs. This is a practical necessity for conference scheduling and it provides students with further intensive teamwork experience.

Throughout the second semester conference paper project, students are exposed to all aspects involved in the preparation of a formal paper for publication. These aspects include: 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 introduced at the close of the first semester, then re-introduced at the start of the second semester, with additional instruction in the first writing step in the conference paper process: composing a successful abstract. The purpose of having students prepare an abstract is threefold. First, the preparation of an abstract gives students a sense for how the abstract submission process is handled for a professional conference. Second, it provides students with the incentive to choose a topic for their papers early and to doing appropriate research. Third, writing an abstract that will be evaluated and accepted or

"rejected" provides students with experience in how to describe a major research and writing project and how to convince an audience that they have a reasonable plan-of-action for the successful completion of that project. The abstract requires, then, that students continue to hone their understanding of how to research and write about a particular topic within a "big picture." E/FEWP faculty have developed extensive materials to familiarize students with practices that will lead to a successful "first step" abstract, and engineering librarians continue to enhance searching and resource evaluation skills via online guides and hand-on assistance.

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A web-based electronic format is used for submission of abstracts. Once the submission process is completed, all abstracts are reviewed by the E/FEWP faculty. Approximately one week after the submission of their abstracts, students are informed (electronically) that their abstracts have been accepted. The abstract review also allows the engineering instructors/conference coordinator to prepare a preliminary conference schedule and to make sure the paper topics are consistent with the call for papers. Some students are asked to revise their abstracts because the abstracts did not initially demonstrate sufficient control of an appropriate topic and/or of the research and organization needed to pursue the topic. As part of the abstract-writing process, students receive instruction on increasingly sophisticated search techniques and specialized databases.

Further Steps in the Freshman Conference Paper Composition and Review Process

After all students have written and submitted an abstract, and had their abstracts accepted, they proceed to write an annotated bibliography, which ensures students continue to do necessary research while demonstrating their understanding of the usefulness and validity of particular sources. An "annotated outline"—essentially a somewhat detailed design plan for the conference paper—follows the annotated bibliography. Each team's annotated bibliography, outline, and each team's draft of the conference paper is reviewed by E/FEWP faculty, and by conference session chairs and co-chairs, and by 2 peer freshman students.

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. For students to have the experience of having a review by various kinds of readers, and to assist with students' understanding of the role and practices of professional engineers, these sessions are chaired by 30 alumni and other volunteers who are practicing engineers in the Pittsburgh area. These session chairs serve as "technical" reviewers for the students' papers. Chairs regularly meet with students to review the strength and accuracy of the technical material in the students' papers. Upper-class engineering students serve as session co-chairs. These co-chairs help to keep students on task, review all students' papers, and "fill-in" for the chairs when professional obligations prevent meetings with students.

This value of a multiple-reviewer approach has been widely documented; the value for Swanson School freshmen is evidenced by the well-written, sophisticated conference papers most students ultimately produce for the conference. While E/FEWP faculty review for focus, cohesion, coherence, style, grammar and format chairs and co-chairs concentrate on the quality and precision of technical explanation and documentation. The peer review allows students to see, first-hand, how other students have addressed structural, content, and

technical tasks, and requires that they address their fellow students work with maturity and clarity.

With 5 reviewers for each paper, students come to appreciate and understand how different readers respond to their writing and how to negotiate and process multiple kinds of comments perspectives towards and optimally effective paper. Students are also further exposed to the expectations and practices of advanced engineering students and professional engineers in their chosen fields. As students are learning about the steps that must be taken to produce a substantive research paper with extensive technical content, they are also learning about the particulars of their intended majors, and about how engineers approach educational and professional tasks and responsibilities.

Revision of Papers for Conference Proceedings

Once students' initial conference papers have been reviewed, they are required to revise those papers and (as required with assignments #2 and #4 from the fall semester) to add significant additional content. Students utilize the reviewers' comments boost the clarity, precision, and authority of their writing on their chosen topic. Students must also use what they have learned about writing and revision to effectively address a "change order" requiring that their papers also address the significance of sustainability to their topic. This "change order" adds another dimension to students' understanding the contemporary challenge faced by engineers in all fields.

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 are quite apprehensive about the prospect of preparing a lengthy, formal paper. Most students have never been given a writing assignment of this magnitude before. Although the students have written 4 relatively short papers in ENGR0011, the task of a longer paper which has considerable technical reporting requirements seems quite daunting. In addition, many students initially express anxiety regarding the fact that they were also being asked to present their papers orally. Comments from students suggest that, as they initially faced the project, they felt they would never be able to fill either a 6000 word paper or a 10-minute presentation. In reality, once students have completed their written papers and had prepared their materials for presentation, most find that they had to work diligently on refining focus on constructing effective presentation summaries, or they would have an overly long paper and too much material to fill the 10-minute time slot! The benefits for students thinking and writing skills are numerous as they move continuously learn and enact effective processes for communicating in various formats with various time and content requirements.

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. An understanding of the intricacies of the literature research process is an integral component of any academic pursuit. 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.

Observations

As the purpose of the project was to focus on the academic, advising, and library concerns, we use these areas as our assessment guidelines. The main academic concern was students' writing abilities. In the past 10 years, approximately 4,500 students have completed the E/FEWP integrated writing curriculum. The grades for the first writing assignment in the fall semester have consistently averaged in the B- to C+ range. The final conference paper grades have always increased to an average grade of A-. As a result, the English department now waves the Seminar in Composition course for engineering students because the writing component in the freshman year is meeting or exceeding the goals of a standard first-semester writing course, thus addressing the main academic concern.

Grades, however, are not the only measure of success. ABET criterion three [28] posits a number of required soft skills: an understanding of professional and ethical responsibility; an ability to communicate effectively, the broad education necessary to understand the impact of engineering solutions in a societal context; a recognition of the need for and an ability to engage in life-long learning; and a knowledge of contemporary issues.[28] The various writing assignments and presentation formats allow us to address every one of these criteria in one course, an impossibility in a traditional freshman curriculum. Criterion six suggests programs should have interactions with industrial and professional practitioners. The student conference papers include an evaluation by practicing engineers. During the last two years,

the local chapter of the American Society of Civic Engineers has reviewed every civil engineering paper and given an award for the best paper at the conference.

By including the library staff in the entire process we also addressed significant issues of research skills and information literacy. The library staff's assessment of the students' ability to utilize the library facilities has demonstrated that students are learning the procedures needed to perform independent research. This skill will be very useful to the students throughout their college experience and beyond as they pursue life-long learning opportunities.

The final goal of the project was helping each student successfully select his or her major early in the college experience. During summer orientation students are asked what major they will purse. Fifty percent are undecided and 50% believe they know their chosen field. In March, students must select a major to register for classes. The writing assignments provide the needed information to help the undecided 50% select a major. Data also show that over half of the other students changed their minds between August and March; thus, the writing impacted more than 75% of the freshman class in deciding their final major. One reason for this success is because the students now have writing assignments directly related to the content of the lectures in the ENGR0081 seminar course. We now find that a once very passive learning environment now actively engages the students.

This active, multi-faceted learning environment would not be possible without ongoing collaboration among faculty from various academic areas. From its inception, E/FEWP required administrative support from various university areas and hands-on intellectual and pragmatic partnership among faculty from the Freshman Engineering Program, the English department, and the University of Pittsburgh Library System. The dean of Arts and Sciences, the dean of the Swanson School of Engineering, and the chair of the English department saw the benefits of supporting a program that would maintain rigorous standards for university-level writing while neither requiring the addition of 25 or more individual Seminar in Composition classes nor inserting another three-credit course into an already crowded freshman engineering curriculum.

The deans and the English department chair also recognized the less immediately practical, but equally significant potential achievements of a program that would enact the best of writing-across-the curriculum theory. The E/FEWP would allow students to further their knowledge about engineering (and about themselves in relation to the field and associated majors), while developing their communication and information literacy skills. Ideally—and the E/FEWP strives to meet and maintain these ideals—no academic area would "suffer" from combining research, writing, engineering, and advising. Students, faculty, advisors, the Schools of Engineering and Arts & Sciences, the English department, and the University library system would all benefit from the combination of literacies, skill sets, and areas of expertise necessary for a successful, integrated program.

Too often, writing-across-the-curriculum ideas that look promising on paper do not maintain momentum in practice because the "home" faculty, while valuing research and communication skills in theory, ultimately have difficulty providing the necessary time for best writing instruction, processes, and practices. English faculty involved in writing-across-the-curriculum initiatives are often frustrated by the lack of time and support home faculty can or will give to writing instruction and experience. In the case of the E/FEWP, from the start engineering faculty demonstrated their investment in this cross-curricular initiative by

working closely with English faculty to alter curricula to allow for optimal results. Early in the process, English, engineering, and library faculty established a practice of meeting regularly to work on scheduling and on academic and intellectual possibilities. When students see engineering and English faculty together in their classrooms, they observe first hand, how each academic area supports the other and how each faculty member has equal interest and authority.

A program such as the E/FEWP need not be exclusive to collaboration between engineering and English. For such a program to work within or between schools, what is needed is for administration, faculty, and advisors to recognize that they will benefit, along with each school, discipline, or area. Yes, budgetary and scheduling exigencies can be usefully addressed by combining courses. Yes, students can benefit tremendously by seeing hard skills, soft skills, life skills, quantitative skills, and communication skills as part of a successful academic and professional whole. Both faculty and advisors involved have much to gain, professionally and intellectually, from such collaboration. Working with colleagues from different disciplines and areas promotes valuable new perspectives on one's own discipline and leads to professional insights and opportunities that simply would not exist without experiencing, first-hand, the methods and knowledge bases of other fields.

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." [29]. 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.

Through collaboration both faculty and students were enriched by tapping into the multiple intelligences resident within the university as a whole. By integrating research and writing into an engineering curriculum and classroom, students also observe and gain first-hand

practice on how research and writing are essential components of being responsible, well-educated, capable students and engineers. Particularly during the freshman year, students can find that their coursework seems distant from the "real world" work they imagine they will be doing closer to or after graduation. Including research and writing on engineering majors, jobs, trends and issues in the students' first year experience can allow them to feel they are seeing and understanding the "real world" of engineering, which can be difficult to represent in a freshman physics or calculus course. To quote Sara Sabol, a Swanson School of Engineering undergraduate: "The kinds of papers you write in your freshman year give you an opportunity to explore so many topics and issues. Doing research and writing the papers allows you to understand what all 'engineering' can mean. It makes you more secure about the choices you are making."

References

[1] Shuman, L., Besterfield-Sacre, M., McGourty, J. 2005. "The ABET 'Professional Skills'—Can They be Taught? Can They be Assessed?" *Journal of Engineering Education.* 94:1 (41-55)

[2] Al-Holou, N., Bilgutay, N.M., Corleto, C., Demel, J.T., Felder, R., Friar, K., Froyd, J.E., Hoit, M., Morgan, J., and Wells, D.L., "First-Year Integrated Curricula: Design Alternatives and Examples." *Journal of Engineering Education*, vol. 88 n. 4, October 1999, pp. 435 - 448.

[3] Pendergrass, N.A., Kowalczyk, R.E., Dowd, J.P., Laoulache, R.N., Nelles, W., Golen, J.A., Fowler, E., "Improving First-year Engineering Education." *Proceedings of the 1999 Frontiers in Education Conference, San Juan, P.R., November 1999.*

[4] Dan D. Budny, "The Freshman Seminar Assisting the Freshman Engineering Student's Transition From High School to College," American Society for Engineering Education 2001 Annual Conference, Albuquerque, NM, June 2001, pp. 1-7.

[5] E.L. Boyer, College: The Undergraduate Experience in America, Harper & Row Publishers, 1987.

[6] A.W. Chickering and Associates, The Modern American College, Jossey-Bass Publishers, 1981.

[7] L.C. Coburn and M.L. Treeger, Letting Go: A Parents Guide to Today's College Experience, Alder & Alder, 2003.

[8] C.A. Tomlinson, The Differentiated Classroom: Responding to the Needs of All Learners, Association for Supervision and Curriculum Development, 1999.

[9] D.D. Budny and C. Paul, "Integrating Peer Mentoring Into the Freshman Curriculum," Proceedings 2004 IEEE/ASEE Frontiers in Education Conference, Oct. 2004, Savannah, GA.

[10] American Library Association, Presidential Committee on Information Literacy, Final Report, American Library Association, 1989. http://www.ala.org/ala/mgrps/divs/acrl/publications/whitepapers/presidential.cfm.

[11] Honora Nerz and Suzanne Weiner, "Information Competencies: A Strategic Approach," *2001 ASEE Annual Conference Proceedings,* http://www.asee.org/conference/search/00510_2001.pdf.

[12] P. Connolly and T. Vilardi, *Writing to Learn in Mathematics and Science*, Teachers College Press, 1989.

[13] Joan Countryman, *Writing to Learn Mathematics: Strategies That Work*, Heinemann Educational Books, Inc, 1992.

[14] T.L. Hein, "Using Student Writing as a Research and Learning Tool," *AAPT Announcer*, Vol. 27, No. 4, p. 29.

[15] T.L. Hein, "Writing: An Effective Learning Tool for Non-Science Majors," *AAPT Announcer,* Vol. 29, No. 2, pp. 114.

[16] W.L. Kirkland, "Teaching Biology Through Creative Writing," *Journal of College Science Teaching,* Vol. 26, No. 4, pp. 277-279.

[17] W.J. Mullin, "Writing in Physics," *The Physics Teacher,* Vol. 27, No. 5, pp. 342-347.

[18] R.E. Rice, "'Scientific Writing'– A Course to Improve the Writing of Science Students," *Journal of College Science Teaching,* Vol. 27, No. 4, pp. 267-272.

[19] J.E. Sharp, B.M. Olds, R.L. Miller, and M. Dyrud, "Four Effective Writing Strategies for Engineering Classes," *Journal of Engineering Education,* Vol. 88, No. 1, pp 53-57.

[20] K. Walker, "Integrating Writing Instruction Into Engineering Courses: A Writing Center Model," *Journal of Engineering Education*, Vol. 89, No. 3, pp. 369-374.
[21] T.L. Hein, "Using Writing to Confront Student Misconceptions in Physics," *European Journal of Physics*, 1999, No. 20, pp.137-141.
[22] T.L. Hein, "Writing in Physics: A Valuable Tool for Other Disciplines," *The Teaching Professor*, Vol. 1, No. 10, pp. 2-3.
[23] S. Tobias, *They're not Dumb, They're Different: Stalking the Second Tier,* Research Corporation, 1990.
[24] S. Tobias, in Paul Connolly and Teresa Vilardi (Eds.), *Writing to Learn Mathematics and Science*, Teachers College Press, 1989.
[25] University of Pittsburgh Introductory Seminars and Workshops in Composition website, http://www.english.pitt.edu/composition/seminars.html.
[26] National Academy of Engineering's "14 Grand Challenges", http://www.engineeringchallenges.org/.
[27] Occupational Outlook Handbook (OOH), United States Department of Labor, Bureau of Labor Statistics, 2010-11 Edition, http://www.bls.gov/oco/.
[28] ABET requirements, http://abet.org/Linked%20Documents-UPDATE/Criteria%20and%20PP/E001%2009-10%20EAC%20Criteria%2012-01-08.pdf.
[29] Elbow, P. 1991. "Reflections on Academic Discourse: How it relates to Freshmen and Colleagues." *College English.* Vol. 53, No. 2, pp.135-155.