Student Funded Laboratory Exercises at Virginia Polytechnic Institute and State University

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Traditionally the methods of engineering education have been an outgrowth of the fact that engineers solve practical, physical problems. Prior to the second half of the 20th century, engineering students spent a great deal of time in labs and shops with less time in the classroom. Since then, engineering education has placed a greater emphasis on classroom instruction in mathematics and other sciences, resulting in a lessened hands-on experience for students. Within the last decade or so engineering educators have been coming to apparent consensus that the pendulum has swung too far and that there is a strong need to supplement traditional teaching with activities that give practical meaning to the equations presented in lecture (Colb 1984).

During the past five years Virginia Tech's first year engineering curriculum has changed from a largely lecture based to a more experimental approach. A significant challenge in providing these activities to approximately 1,200 students per year is paying for the materials. Over the years the Department of Engineering Education (formerly the Division of Engineering Fundamentals) has relied upon the generosity of the Student Engineers' Council to provide a large percentage of the money needed to buy supplies for these projects.

This paper discusses and details the significant contribution that the Student Engineers' Council has made to the first year engineering program at Virginia Tech over the years, including how they have raised tens of thousands of dollars each year and what freshman projects the money has supported.

Background of the SEC

The Student Engineers' Council (SEC) was formed on November 14, 1968 to expand the role of the Association for the Advancement of Engineering, an advisory committee consisting of engineering juniors, seniors, and faculty members. Since then, the SEC has grown into a large and dynamic organization that sponsors many projects for Virginia Tech's College of Engineering. The SEC brings the engineering student body together not only to benefit their individual departments but also to combine their efforts for the benefit of the entire College of Engineering at Virginia Tech.

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The Virginia Tech SEC hosts one of the largest student-run career fairs in the nation. With more than 200 companies regularly attending the event it is an invaluable resource to engineering students seeking employment, both for permanent placement and undergraduate internship and co-op programs. The SEC job fairs have provided companies the opportunity to meet the student body as a whole before the individual interviewing process starts. In turn, it also gives the students an opportunity to research which companies are looking for new graduates or undergraduates and what these companies have to offer for their future.

Last year, the SEC created a fully searchable HR-XML résumé database which is the first of its kind for a college career fair. Many companies employ this technology on their websites, requesting that the prospective hire fill out fields of information rather than just submitting a text resume. By employing similar methodology the SEC requires students to spend a little bit longer filling out the résumé drop form; these résumés can then be easily found by companies seeking a specific set of characteristics in a candidate.

SEC strives to enhance student development on a personal and professional level through various activities and projects. An important objective is to address facets of engineering education that are often neglected. Increasingly in today's society, technical competence is not sufficient for career success. Employers are searching for well-rounded professionals. As a result, traits such as communication skills, leadership skills, creativity, and the ability to work in a team environment are in high demand. Unfortunately, these skills are not often a part of the curriculum.

There are a variety of roles that the SEC plays in the College of Engineering. The SEC provides a forum that allows student representatives to speak directly with the dean, to keep him abreast of student concerns about the education provided by our College of Engineering. There is a freshman mentoring program that helps new students adjust to the rigors of the engineering curriculum, as well as the college environment. The Leadership in Engineering Conference teaches soft skills to young engineers; this voluntary 1-day conference focuses on teamwork, management, and communication. The SEC also designs and produces a day timer that is distributed to freshman engineers during the first week of class to start them on their way to the all-important skill of time-management. Each spring, there is a week-long series of activities celebrating engineering and outreach to the community during Engineers' week.

Because of the generous support of corporate sponsors, there is often a significant budget surplus. Part of this funding is used to create endowed leadership and service scholarships with recipients chosen by an SEC committee. The SEC also confers the only student-nominated faculty teaching award at Virginia Tech. This extra funding also allows the SEC to give directly back to the college: faculty members submit proposals for projects that will directly benefit the undergraduate engineering student body, and our general assembly votes on the allocation of funds.

Engineering is all about hands-on problem solving and the SEC provides another forum for that. Beyond the obvious benefits of such programs, these events give students the opportunity to work on event planning, product design, team management, group cooperation, and a variety of other skills better learned outside the classroom. Such activities foster a sense of unity not often

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found in the simultaneously isolated and competitive aspects of the engineering departments. Because classes are designed to teach students how to be a mechanical engineer, a chemical engineer, a mining engineer, there is a great deal of division between the majors. To some extent, the SEC dissolves this barrier, bringing students of all disciplines together as engineers and fostering a sense of belonging. In a group that serves as an umbrella organization over all the student engineering societies, the SEC has the potential to reduce this divisiveness even further. By fostering communication and common interests between students in different fields, the SEC can better prepare students for their future careers in which they will regularly work with people from all different disciplines.

In the future, we anticipate the SEC facilitating significantly more interaction between students, faculty, and administration throughout the College of Engineering. Communication is crucial to the success of any project, and the college stands to benefit greatly from this camaraderie. In coming years, the SEC will continue to make improvements to our programs, adding new ones as the circumstances arise, and expanding those currently in place. Because the SEC maintains the infrastructure necessary to offer our sponsors tangible benefit, we will probably continue to be well-funded. It is through the support of our corporate sponsors that we are able to do so much within the college and hope to be able to do even more in coming years.

Background of the Department of Engineering Education

Until the fall of 2001, all freshman engineers at Virginia Tech were general engineers in the Division of Engineering Fundamentals (EF) and took two introduction to engineering classes (EF1015 and EF 1016) through the division. The topics were traditional in content with EF 1015's comprising ethics, the engineering profession, problem solving, programming with MatLab, statics; material balance; electricity; and energy. The EF1016 topics were also traditional with design theory, graphics theory, freehand sketching, computer graphics using AutoDesk's Mechanical Desktop, and a final design project. Both courses were taught in a 32 seat classroom with an instructor's computer and 16 monitors. A combination of PowerPoint slides, overhead transparencies, and a conventional blackboard was used - essentially a traditional lecture format.

A pilot program (Goff and Connor 2001) was implemented in the fall of 2000 that provided a number of hands-on activities in the EF 1015 course. All materials were provided by the SEC. Two instructors and eight 32-student sections participated. The results were positive. When compared with students in a traditional setting, the pilot program students were significantly more excited about engineering and their perception of learning was significantly greater (Connor and Goff 2001). The activities were designed to be conducted within the normal lecture time and, hence, of short duration (15 minutes), illustrative of the current topic of instruction, and inexpensive. Another major goal of the project was to have the students work in teams. Typically data was collected as a team in class with the calculation of results and study questions assigned as homework.

Over the last few years, first semester students have also been assigned two or three, SEC funded, "McGyver" projects in the first semester. For these assignments students are given a small toolbox filled with simple tools, and miscellaneous objects such as paint stirrers,

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mousetraps, straws, batteries, a motor, and tie straps. They are required to take these various objects and tools and create, as a group, their own designed solution to the assignment.

A hands-on component has been used in the EF1016 course also. Each student spends one or two classes during the semester engaged in a hands-on activity related to print reading and measurement. Last year, each student also participated in a fuel cell activity were a team of four students set-up, ran, and analyzed a small scale fuel cell. It is also very common for the instructor in 1016 to assign as their major group project the ASEE design competition activity.

Last year, the Division of Engineering Fundamentals became the Department of Engineering Education. One development related to this change is the recent award of two NSF grants to the department (Connor et al. 2004) to continue and expand its hands-on, activity based, curriculum. The past and future contributions of materials and tools by the SEC are essential to successful implementation of these grants.

History of the SEC's Contribution

Virginia Tech's Student Engineers' Council (SEC); the student-run organization has given nearly $220,000 to the College of Engineering in the past six years. In addition, it has awarded an average of six $1,500 awards annually to engineering student groups to attend or to host conferences, or to assist in expenses for a national design competition. These awards represent approximately another $90,000 in the past six years. And they confer three endowed scholarships annually, each one with a principal value of $25,000.

The council, which sponsors a number of services for engineering students each year, receives no funding from the university. Instead, the majority of its budget stems from fees companies pay to attend the SEC-run Engineering Expo, a two-day career fair held each fall. In recent years more than 200 companies have attended each Expo, with as many as 50 companies on a waiting list, making it one of the largest student-run events of its kind in the country.

In 1997 the Expo's success prompted the SEC advisor to suggest that the council use the Expo revenues for philanthropic purposes. The students agreed, and they issued a formal call for funding proposals from engineering faculty members, administrators, and students. They decided the primary guideline was that the funds would go to areas benefiting the largest number of engineering students. Therefore, the EngE Department, in its role of freshman engineering education, is a major recipient of funding.

Since then, the group has awarded $191,000 to several areas within the college, including the Student Assistance Center, the Frith Freshman Design Engineering Lab, the virtual corporation, the Freshman Engineering Program, a specific freshman design project, renovations of engineering classrooms, the student mentoring program, and more. These are areas used by most of the students, so the SEC is able to see the results of their philanthropy.

Funds generated from the Expo support other student services. Each year, the SEC awards the Torgersen Leadership Scholarship, which goes to two rising seniors in the college. In 2001, the SEC was able to fund two of these since the endowment had doubled in size since the SEC was

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created in 1985. The SEC also created a third $25,000 endowed scholarship, the Nathaniel Gebreyes Scholarship, named after its 1981 chair who died in an automobile accident.

In addition, the SEC distributes free organizers to all freshman engineering students. The organizer includes a weekly calendar, information about Virginia Tech and the college, tips on surviving the freshman year, and testimonials from other students. The purpose of the planner is to help ease the transition from high school to college and to help students decide which branch of engineering they might want to pursue. It is also used as a tool for introducing time management in the freshman engineering courses.

A summary of the SEC's contributions to the College of Engineering is summarized in Table1.

Table 1
SEC Contribution Summary

Amount	Year	Purpose
$20,000	1998	Equip the College's Student Assistance Center (SAC)
$10,000	1998	Support for the Freshman Design Engineering Laboratory
$10,000	1999	Multimedia enhancements for a lecture classroom
$10,000	1999	Personal Rapid Transit System prototype
$12,000	2000	Hands-on kits
$8,000	2000	Chairs for the engineering classrooms
$3,500	2001	Student Assistance Center computers
$15,000	2001	Hands-on kits (McGyver box)
$1,500	2001	Classroom display
$46,000	2002	Technology upgrades to classrooms
$2,000	2002	Enhance the engineering classroom environment
$2,000	2002	Startup funding for a Freshman Engineering Association (FEA)
$1,000	2002	Welder and supplies for the Freshman Design Engineering Laboratory
$15,000	2003	Tutoring center wages
$1,000	2003	Freshman Engineering Lecture Series
$5,000	2003	Restock hands-on kits (McGyver box)
$10,000	2004	Freshman Engineering Lecture Series
$5,000	2004	Ware Lab General Hardware Fund
$4,300	2004	Equipment for the fuel cell experiment

Conclusion

Virginia Tech's Student Engineers' Council has a long history of successful fund raising through its annual career fair and generosity to the College of Engineering. Its contributions of nearly a quarter of a million dollars to the college has created three endowed scholarships, enhanced classroom environments, provided seed money for a freshman engineering association, and provided wages for peer tutoring services.

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The SEC's contribution to the Department of Engineering Education has been critical in bringing hands-on experiences to 1,200 freshman engineers annually and provided funding to bring distinguished speakers for the freshman engineering lecture series. In addition to providing money for the initial purchase of hands-on supplies, the SEC has provided money for their replacement and enhancement. This money has been instrumental in the department's curriculum reforms.

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