

ENHANCING ENGINEERING RECRUITMENT WITH K-12 OUTREACH PROGRAMS

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1. INTRODUCTION

Since prospective students do not always know what an engineering career has to offer, the recruitment of engineering students must expand into an interdepartmental effort to reach all potential candidates and educate them on what engineering is all about. Part of a successful recruitment program should include K-12 outreach to educate younger students and to encourage students in the areas of math, science, and engineering (Tougaw, 2005). This type of outreach has become very successful at Valparaiso University, as it has expanded beyond the walls of the College of Engineering into collaboration with other departments in the College of Arts and Sciences. The cooperative effort of engineering and education in recruitment of math and science students is a natural partnership.

The outreach programs sponsored by the Department of Education enhance and support recruitment of engineering students by showing K-12 students examples of successful math, science, and engineering students while encouraging them to pursue applications of math and science topics with more confidence in high school. Contact with elementary, middle school, and secondary students during field experiences and student teaching permits education students to be advocates for careers in mathematics, science, and engineering. For this contact to be most effective, education students must be well prepared in mathematics and science and they must understand that engineering is the practical application of the theories presented in mathematics and science classrooms. In addition to recruitment of students, there must be education and training of elementary, middle school, and secondary teachers concerning the career opportunities in engineering. The mystique of mathematics, science and engineering must be overcome and the excitement of discovery and control of natural forces must be emphasized. This effort includes workshops, field trips, presentations, cooperative projects, and open houses aimed at generating interest and excitement in the study of engineering.

2. OUTREACH PROGRAMS

While a single outreach program may not have a significant impact on a recruiting program, a well-organized outreach network can reach the teachers and students from many different perspectives, meeting several goals as shown below in Table 1.

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Table 1: Outreach Program Impact

Program	Source	Group Influenced	Goal
Field Experiences	Education Dept.	Students and Teachers	Provide Student Examples
Student Teachers	Education Dept.	Students and Teachers	1. Generate Interest 2. Provide Examples
Field Trips	Education Dept. and Engineering	Primarily Students	1. Opportunity to experience atmosphere and facilities 2. Provide support for teachers
Homework Help	Engineering	Students	1. Reduce anxiety in Math and Science courses 2. Provide interaction with current students
Cooperative Projects	Engineering	Primarily Students	1. Generate excitement about engineering projects 2. Provide interaction with engineering students 3. Support teachers
Teacher Workshops	Education, Math, Science, and Engineering	Teachers	1. Generate enthusiasm 2. Provide tools 3. Provide a Valpo Experience
Faculty and Alumni Presentations	Education and Engineering	Teachers and Students	1. Educate 2. Provide a good example
Open Houses	Engineering	Teachers and Students	1. Display projects 2. Generate enthusiasm 3. Provide a Valpo Experience

2.1. Field Experiences

In a typical year at Valparaiso University, education students will have over 5000 contact hours with elementary, middle school, and secondary students in 125 local schools as part of their field experiences (Tougaw, 2005). The prominence of “No Child Left Behind” and similar legislation has created an increased need for teachers who are well trained in language arts, mathematics, and science. The improved competence and emphasis in teaching mathematics and science will create more awareness in students for careers involving mathematics and science.

This is a tremendous opportunity to create interest in and advocate for careers in engineering. The students from our education program are well versed in technology, mathematics, and science and have become excellent ambassadors for careers in engineering and science. The engineering department must provide information, motivation, and support for this effort. Ultimately, this contact and the partnership between these two strong departments will provide opportunities for both departments and the students we recruit. The fact that our education students are highly motivated and have been taught to view engineering as a noble profession will enhance their ability to aid in recruiting good students to our engineering department.

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2.2. Student Teachers

Student teachers from our education department have a greater opportunity to model and represent the opportunities at our university due to their extended and close work with students in the classrooms. Student teachers in elementary and middle school classrooms need to be able to dispel fear and confusion created by the lack of understanding and knowledge of mathematics, science, and engineering. If elementary and middle school students are able to see the study of mathematics and science as exciting and enjoyable, they will be able to extend this enthusiasm to engineering as the practical application of these disciplines.

Student teachers in middle and secondary school classrooms need to develop reflective and creative lessons aimed at increasing the ability of their students to see the importance of the study of engineering and the use of higher-order thinking skills (Valpo DoE, 2004). If we are to accomplish this goal, we must first inspire and motivate our teacher education candidates to a greater appreciation for the sciences and their real-life applications in engineering. Presently, all teacher candidates at Valparaiso University are being trained in inquiry and problem-solving pedagogy in mathematics and science. Education based upon state and national standards will require teachers who can relate the theories taught in mathematics and science classes to the real life applications that students can identify. This is the role of engineering at its best.

The presence of faculty in the education and engineering departments who have cross-curricular experiences and backgrounds is a tremendous asset to this partnership. This connection is not essential but is what compelled this joint effort at Valparaiso University. The coordinator of field experiences and student teaching in the education department has many years of experience in teaching mathematics and physics. The main recruiter for the engineering department has also taught mathematics and physics. These dual resources allow for open communication and understanding of the importance of each profession and why these two departments must strongly support each other. Finding faculty and staff that have a common interest between departments is the best place to start a project like this.

2.3. Field Trips

Field trips by elementary, middle school, and secondary students to Valparaiso University's campus can be of great benefit in recruiting efforts. Nine area schools have dual credit programs that visit the education department each year. Many of these field trips are combined with a visit to the engineering department to see the excellent facilities that engineering students have to work with. Interdisciplinary efforts by the education and engineering departments are mutually beneficial as we showcase both programs and the facilities available on campus.

The College of Engineering also hosts groups of Project Lead the Way Classes from area high schools to bridge the gap between the pre-engineering concepts they are being taught with those they will encounter during their first year of college in engineering. Students attending field trips have the opportunity to experience demonstrations in areas such as the Scientific Visualization Lab, Manufacturing Lab, Fluids Lab, Soils Lab, Material Testing Lab, and computer labs. A Senior Project advisor also meets with them to demonstrate a few example projects that they could expect to accomplish before graduating with a degree in engineering.

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2.4. Homework Help Programs

In 2005, the Verizon Foundation partnered with Valparaiso University's Office of Admission and College of Engineering to offer a homework help program to area high school students called the Valpo HomeworkChat. This program provides an online chatroom that students can visit to receive help from a tutor on math and science homework. This program is currently staffed entirely by engineering students with the hope of expanding to include math, science, and education students. This program not only provides a service to the community but also creates a link to Valpo college students.

Programs like this one are also greatly needed by the students today. If a student experiences difficulty in a math or science class in high school without receiving assistance, the student will decide math and science is too hard for them and discard the thought of any careers associated with them. In reality, they may only need someone to take the time to explain a concept to them that is holding them back.

2.5. Cooperative Projects

Organizations like For Inspiration and Recognition of Science and Technology (FIRST) Robotics also provide outstanding opportunities to connect with high school students. This ten-year-old competition is designed to show students that many opportunities within the technological field that are interesting and new involve aspects such as engineering, math, science, and invention. When area high school students decided to build a robot for this competition, it became a very exciting outreach project for our faculty and students. While a local business provided financial support, we provided 2 faculty and 15-20 students to provide academic support while working along side the high school students on the robot project.

2.6. Teacher Workshops

Summer session workshops for elementary, middle school, and secondary teachers that emphasize problem solving and inquiry pedagogy to create excitement for and pedagogy in the teaching and learning of mathematics and science have been offered over the last seven years. These workshops are joint efforts by faculty representing education, mathematics, science, and engineering departments. These workshops have had excellent results as presented at last year's A.A.S.E. conference. These teachers have returned to their classrooms with new enthusiasm and tools for teaching mathematics and science as vital and exciting activities by emphasizing practical applications of these disciplines in engineering projects. The direct link between the study of mathematics, science and technology to the practical applications in the real world are strongly emphasized.

Workshops and demonstrations in robotics, fiber optics, environmental studies, technology, holographic environments, problem solving, science inquiry, and the roles of science and engineering in the real world have been presented both on campus and off site. These workshops exhibit the departmental facilities and commitment of faculty to the recruitment and education of their students.

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2.7. Faculty and Alumni Presentations

Presently, many of the faculty in the education, mathematics, science, and engineering departments are asked to make classroom presentations concerning their expertise in local elementary, middle school, and secondary classrooms. These presentations are excellent opportunities to create enthusiasm and interest in practical applications of mathematics, science, and engineering. Education presentations requested involve problem solving, critical thinking, oral and written communication of ideas, curricular alignment, current research in teaching and learning, and reading comprehension (Valpo DoE, 2004). Engineering presentation topics requested include areas like nanotechnology, structures, manufacturing, surveying, and engineering careers.

We have also found that our engineering alumni provide an excellent resource for this type of presentation. They provide more geographic flexibility as well as additional contacts to reach a wider group of students. Their educational and career-related experiences make them great speakers in the classroom. They can give the students a clear view of the field of engineering while sharing their own work experience on the job. Engineering alumni are also eager to talk to secondary students about the incredible possibilities of an engineering career.

2.8. Open Houses

Offering the public opportunities to visit on campus facilities is also an important recruiting tool. It offers them the opportunity to have a student experience and know what kinds of opportunities our students have. One example of this is featured open houses of new technology like the Scientific Visualization Lab. During evening open houses, the public has the opportunity to experience a full-featured array of applications in virtual reality, featuring several of the programs the University uses in undergraduate education. The public will see three-dimensional electromagnetic fields, explore bigger-than-life anatomy models and 12-foot high DNA molecules. Visitors will also have the chance to experience some recreational virtual reality applications as well, including playing 3D Pong and CAVE Quake. Valpo professors and students are on hand to answer questions and give tours.

This same concept can be used for a Senior Project Design Expo. An event like this not only offers seniors the opportunity to display and explain their work, but it also gives the public an opportunity to visit the College of Engineering and see samples of students work. When prospective students attend this event, they can spend time with Valpo students and also get a sampling of projects that young engineers can accomplish.

3. CONCLUSION

Current research and data point to a severe shortage of post secondary graduates in mathematics, science and engineering in the United States (Dagget, 2005). Undergraduate and graduate schools must address this shortage with every tool available. Interdepartmental cooperation should be utilized to address the misconceptions and fear of the study of engineering that exist as a barrier to enrollment in undergraduate engineering programs. Strong partnerships need to be

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formed with education departments to allow for the representation of engineering programs as exciting, alive, and based in real world applications. The huge access that education faculty and students have to elementary, middle, and secondary schools must be utilized to eliminate the perception that the study of mathematics, science, technology, and engineering is theoretical and only for people interested in abstract and hypothetical settings. The benefit to education and other programs is that they will gain students with much stronger communication, problem solving, higher-order thinking, and analytical skills (Tougaw, 2005).

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