Recruiting Underrepresented Minorities through an Engineering Summer Institute

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Abstract

As part of Arizona State University's (ASU) K-12 outreach effort to increase the number of qualified minority students entering the College of Engineering and Applied Sciences (CEAS), the Office of Minority Engineering Programs (OMEP) has developed a collaborative effort with industry to expose high school students interested in mathematics and science to the exciting and diverse disciplines of engineering.

With a growing concern for the increased competition for top technical talent, local industries are joining together with education, government, labor, and community to address the Pathway that will lead to increased transition of students from middle to high school to college to employment. The ASU OMEP and the ASU Mathematics Engineering Science Achievement (MESA) program hosted two one-week residential summer programs, over a two year period, sponsored by a grant from the GTE Foundation. The objective of the GTE Engineering Summer Institute (ESI) was to expose students to skills that would assist them in investigating and in pursuing engineering and/or technology as a study of discipline and career option, and to instill the importance of mathematics and science as tools in the development of the expanding technological industry. The ESI utilized the ASU MESA program to recruit secondary students and to explore the option of Computer Science as an academic and professional career.

The program served high school juniors and seniors with a focus on historically under-represented minority groups as outlined in the grant. Over the two year period, 62 Arizona students from across the state have participated in the ESI. The student participants studied computer basics of Microsoft Word, Excel, Power Point, HTML, and Web page development, explored all areas of engineering, interacted with CEAS faculty and students, and learned about the process and benefits of higher education and career goal setting.

The 1997 and 1998 ESI's have provided a positive impact for the university, high school programs, and industry. As a result of the ESI experience, half of the 62 participants were more interested in and more inclined to pursue or to investigate Engineering as a discipline of study and career option. This paper will discuss how collaboration with industry and university outreach programs worked together to increase the awareness of engineering and technology careers.

Introduction

Arizona, like much of the rest of the United States, needs good workers with specific skills for specific jobs that are growing in the state. The tremendous population growth over the past several years, a consistently low employment rate, and a business climate that attracts new

companies and encourages existing firms to expand, have all contributed to increasing the demand for a well-equipped workforce in Arizona. The growing concern by local industries to the increased competition for this top technical talent has not gone unnoticed. They are joining together with educators, government, labor, and community to address and implement a Pathway that will lead to increased transition of students from secondary school to universities to employment. ASU has become an active participant in this implementation.

Arizona State University is the fourth largest university in the United States with a Fall 98 enrollment of 43,732 students on its main campus. The university consists of three campus sites: ASU Main, ASU West and ASU East. The ASU College of Engineering and Applied Sciences (CEAS), located on the main campus, represents two schools: the School of Engineering, and the Del E. Webb School of Construction. The total enrollment in CEAS for the Fall 98 semester was 5,547. The underrepresented minority Fall 98 enrollment in the college was 658 (17.2%) for undergraduates, and 103 (6%) for graduate students. The female CEAS Fall 98 enrollment was 776 (20.3%) for undergraduates and 371 (21.5%) for graduate students. The Fall 98 freshman class had an enrollment of 162 full-time first-time minority students.

ASU has become an active participant of the Governer's Strategic Partnership of Economic Development (GSPED) currently being directed by the Arizona Department of Commerce. Both public and private agencies are represented on the Governor's Council for Workforce Devoelopment Policy. These members are in active partnership to develop a comprehensive plan to address the state's current and future workforce needs. Eleven industry clusters have been developed and in 1998, approximately two million dollars were allocated to the state for disbursement throughout the clusters. One of these clusters is the High Techology Industry/School-to Work (HTI/STW) program. ASU OMEP received a small grant through this cluster to support ASU MESA program activities.

The Office of Minority Engineering Programs (OMEP) at ASU was established by the CEAS to aid in the recruitment and retention of underrepresented minority students. The OMEP is embedded in the infrastructure of the Office of Student Affairs in the CEAS.[1] Specifically, the goals of the OMEP are to build a community of minority students that are academically prepared to pursue baccalaureate and graduate degrees within the CEAS and to create a climate that develops and promotes academic excellence, technical competence, and marketable skills. Furthermore, it is the goal, of the OMEP to build the foundation for life long learning that will sustain students after they leave academia and through the twenty first century. These goals are realized through comprehensive programmatic support for both the recruitment and retention of underrepresented minority students. The recruitment program targets K-12 students through the efforts of the ASU MESA program. The retention goals are supported through the Minority Engineering Program (MEP), where students can find assistance and direction in adjusting to the challenges of university life and the rigors of a technical curriculum.

In collaboration with the MESA program and as part of the ASU's K-12 outreach effort to increase the number of qualified minority students entering the CEAS, the OMEP has developed a collaborative effort with industry, engineering faculty, and community, to expose secondary students with an interest in mathematics and science, to the stimulating environment of engineering and technology. An integral part of this collaborative outreach is focused around Engineering summer programs.

ASU MESA

The ASU MESA program is an academic K-12 university intervention effort supported by local industry and the CEAS for the purpose of increasing local technical talent within Arizona. The goal of the MESA organization, which exists in eight states, is to provide globally competitive and individually competent students in mathematics, science, and engineering. MESA serves underrepresented students (African American, Mexican/Hispanic, and Native American) who have historically had low enrollments to four year institutions in math, science, and engineering. MESA accomplishes this goal through a partnership of higher education, government, school districts, industry, community organizations, and family. The partnership is dedicated to providing students with an education process that increases their interest, effective participation, and contribution to mathematics, science and engineering. ASU MESA, part of Arizona MESA and a national partner of MESA USA, an eight state collaborative, was established to assist Arizona state and the nation in achieving the MESA goals. ASU MESA is active in eight high schools and seven middle schools, and serves appoximately 600 students within the state, reaching as far Northeast and East as the Navajo Indian Reservation, and San Carlos Apache Reservation. The students that participate in this academic program are exposed to careers related to math, engineering, and science. They are encouraged daily by MESA Advisors, who are math and science teachers, to pursue curricula in high school that will academically prepare them to pursue baccalaureate degrees in these areas. In some cases, the MESA student may be the first generation of the family to complete a high school degree (sometimes even to attend a high school) or to pursue higher education. In this respect, it is essentially vital to expose these students to the university environment early and prepare them culturally and socially for the rigors they will face in the pursuit of a technical degree.

The ASU MESA Program coordinates recruitment activities that invite students to the ASU campus to attend and to participate in ECE 100, an introductory engineering assembly design class, to tour the campus, and to participate in engineering and science labs. Students participate in workshops and panel discussions with ASU students, staff, and faculty on educational and career planning, admissions, and financial aid. Students attend leadership retreats, industry tours, Saturday Science Academies, participate in local, state, and national math and science competitions (such as MESA Day, Future Cities, and Science Olympiad). ASU engineering students, referred to as MESA Liaisons, are assigned to each MESA school to work with the advisors and students on projects, tutoring, and mentoring. Industry members offer partnerships with MESA schools, sponsor tours, after school internships, volunteer as mentors, and of course sponsor summer programs. As a result of programs such as this, ASU has seen minority engineering enrollment increase from 13% to 17.2% from 1993 to 1998.

While the Arizona MESA program serves middle and high school students, the program described in this paper facilitates high school students involved in an ESI to preview an engineering curriculum. High schools in Arizona are required to provide courses with a career focus. The CEAS, with the collaboration of ASU MESA, is helping to meet this objective by providing access into the university with a pre-college experience on campus and hands-on experience.

GTE Engineering Summer Institute

In 1996, the GTE Foundation awarded a $30,000 grant to the ASU OMEP to fund an engineering residential summer program for two years. This grant helps complete the Pathway of the infrastructure of the Office of Student Affairs, which encompasses the OMEP (MESA and MEP), the CEAS Office of Recruitment, and Women in Science and Engineering (WISE) programs. This award coupled with additional grant monies allows sponsorship of summer programs, targeted for underrepresented students, for all levels of high school to college.

The objective of the Engineering Summer Institute (ESI) was to expose high school students to skills that would assist them in investigating and pursuing engineering and/or technology as a career. The 1997 five-day pilot residential ESI was opened to rising high school sophomores, juniors, and seniors within the historically under-represented student groups. The 1998 residential ESI was expanded to seven days and was restricted to rising high school juniors and seniors. Students were instructed to submit their application for admission with an official copy of their transcript (minimum 2.75 GPA needed), letters of recommendation, and a short essay on a specified topic relating to the concept of engineering or technology.

The publicity of the ESI is an essential element to the recruitment of interested and qualified applicants. The ESI was advertised in the ASU MESA Summer Academic Enrichment Programs brochure and the CEAS quarterly newsletter, Full Circle. The brochure outlining summer programs offered by ASU MESA was mailed to not only all Arizona MESA schools, but all Arizona school counselors and science and math department chairs. The CEAS Office of Recruitment, Women in Applied Sciences and Engineering (WISE), along with the Coalition of Engineering Minority Societies (CEMS) student organizations, which includes the National Society of Black Engineers (NSBE), Society of Hispanic Professional Engineers (SHPE), and the American Indian Science and Engineering Society (AISES) disseminated information and brochures during their recruitment visits to local high schools.

Program Structure

The program agenda was designed to allow students exposure to classroom time for project design, various engineering disciplines, and interaction with university faculty and students. The 1997 program period covered four days of classroom instruction. The ’97 participants evaluation of the program noted that more days and time should be allotted. Therefore, the 1998 program structure incorporated two more days and extended the instruction time to six days. A formal orientation was held for students and parents on the first day of the institute. Students and parents were given the opportunity to meet one another, as well as the CEAS staff, instruction team, and student resident assistants who would be interacting with them throughout the week.

In the mornings, students were exposed to several engineering departments and centers through labs or tours such as Chemical, Bio-Medical, and Materials Engineering (CBME), Mechanical /Aerospace (MAE), Civil & Environmental (CEE), and Center for Innovation in Engineering Education (CIEE). An industry tour to the Arizona Department of Transportation (ADOT) Traffic Signal Operation Center gave students a visual confirmation of how essential computers and technology are to their safety on the Arizona roads and highways. Workshops were facilitated by both CEAS faculty and university staff on the principles of team building, the

process and benefits of higher education, career goal setting, and on leadership and interviewing skills. Afternoons consisted of classroom instruction. The ESI students were introduced to the computer basics of Microsoft Word, Excel, Power Point, HTML, PhotoShop, and Web page development (including Java and Java Script). A design project was implemented to allow the students to apply the skills learned.

The design project required students to design and to develop a team web page, individual web pages, and a team notebook on a specific assignment. The 1997 project required the students to perform a timed study on a production line within an imaginary company. The objective was to allow students to complete an engineering design project from concept to final design. Students were divided into six teams. They simulated a paper hat factory and each team member had their own responsibility in the production process. For example, one student did the initial folding, while another colored and placed a security sticker on it. Some team members watched and collected data for analysis. Each team completed a timed study experiment, then incorporated the computer skills learned to document, to input data on a spreadsheet, to calculate results, and to develop and share their findings on the team web page. The team Web page for the 1998 project was to be on an existing business or corporation. Teams were instructed to gather information for the page through interviews of company representatives in person and/or e-mail, usage of Internet research, or library visits. Upon completion of the research, the page developed was to include original text composed by the team members on the company's mission, goals, product output, history, and personnel. Company logos were to be created by the team or modified from the existing company logo. Several companies (local and national) were chosen by the ESI Instructors and Project Coordinator from which teams could select. The schedule incorporated an industry interview day where students had the opportunity to practice their interviewing skills with their chosen industry representative. Interviews were completed in class. Five local industries sent volunteers to the campus to interact with the ESI students.

The student individual pages were to include, but were not limited to, background information, special interests of the students, highlights of the week, and ASU experiences. This was their time to have fun and to be creative. This page was than linked to the Team page. Team notebooks were to include table of contents, minutes and agendas for team meetings, notes on designated labs and workshops, word documents on the interview or research process of their selected industry, and copies of both the team's and team members' individual web pages. Notebooks were turned in at the end of the week for grading. Each section of the project was allotted a specified number of points. The overall team with the highest points won first place.

In the evening the ESI students visited the ASU Physics and Astronomy Planetarium and constructed pre-engineering projects with the CEAS engineering student counselors. For relaxation, the students had access to the Student Recreation Center to engage in swimming, basketball, and soccer. They also attended a movie off campus.

Staff Participants

The program was staffed daily with the project coordinator, three student instructors and six student residential assistants. The instruction team, under the direction of the project coordinator and engineering faculty advisor Dr. Barry McNeill, developed and implemented curriculum for the classroom project. The student staff was composed of ASU engineering students. The

instruction team consisted of upper division undergraduate Computer Science students. The residential assistants represented various disciplines and were members of CEMS. These students were responsible for implementing all evening activities and supervision of participants during the evening.

Discussion

The student feedback following the one-week residential ESI was very positive. Students completed an overall program evaluation. Out of the 62 students who have participated in the ESI, 53 completed the evaluations. Participants were asked to rate facets of the program on a scale of 1 to 10: 1-2 the lowest, 3-4 below average, 5-6 average, 7-8 above average, and 9-10 the highest. Both the 1997 and 1998 ESI students rated the "General Program Structure" between above average and high. Over the two years, the students' comments on what they liked most and least about the institute has been consistent. The challenge of the design project, industry tours, the patience and congeniality of the student instructors and counselors, learning how to work in teams, interaction with industry, exposure to CEAS research labs, faculty, and students are all rated very favorably. After a week, they felt less intimidated by the engineering faculty and university. The least liked elements of the ESI vacillated between a week not being long enough for the 1997 ESI to too much class instruction time for the 1998 students. The 1998 participants considered the allotted six days sufficient project time. They commented that several more days would have been fantastic to explore Computer Science more in depth and to have more time in engineering labs with engineering faculty and students.

The consistent rating of above average and high for all the elements of the institute by the ESI students validated that the institute was an extremely valuable experience for them. Students indicated that the opportunity to investigate the university and CEAS on a more day-to-day level assisted them in making the decision to attend an institution of higher learning. The labs and presentations with engineering faculty, graduate students, and the associate dean provided an introduction to the options available in the diverse CEAS curriculum.

Overall, out of the 53 respondents, 32 ESI students indicated they were more interested in pursuing or considering engineering because of the institute, 13 were maybe, 6 were undecided, and 2 were not interested. The students who responded maybe, undecided, or not interested listed their alternative fields of study as Physics, Architecture, Astronomy, and Microbiology, all very strong science and mathematics based fields of study.

Interacting with engineering students who have similar or the same academic and/or cultural experiences gave them the confidence and insight that they could pursue engineering or a science based curriculum. There appeared to be a comfort level developing in the ESI students that college and engineering were an attainable goal. Students noted that another profound highlight of their ESI experience was that they could work in conjunction with others with whom they are not familiar and comfortable, such as all Native American, African American, and Hispanic students. The students learned that their common and ultimate goal was team success and academic achievement.

The presence of the ASU engineering students is a major strength for the MESA program and to the success of the ESI. The university students have an opportunity to serve as role models and mentors to the next generation of engineers.

Conclusion

The first five day ESI program was an excellent pilot. OMEP had not facilitated a summer program for K-12 for several years. The positive response from the '97 participants through their evaluation validated our course of direction and influenced the curriculum development for the following year. At the suggestion of the '97 ESI, the length of the program was extended to six days and incorporated more classroom instruction and hands-on time with the computers. This extension allowed the students sufficient time to absorb the information being disseminated. Two of the '97 ESI participants returned in '98 and indicated their satisfaction in the increased computer lab time.

The curriculum for the 1999 ESI will continue to focus around the basics of web page development, but will also expand to include elements of multimedia and computer modeling. The request for more hands-on science and pre-engineering design projects with CEAS faculty and students will be honored.

The need for individuals with technical competencies is expected to remain at a high level as we move into the new millennium. However, matriculation at colleges and universities is not keeping up with the demand. The demand for diverse individuals with engineering and/or technical backgrounds vastly exceeds the supply and the enrollment of students in these programs remains far below the number needed by industry. ASU has a continuing commitment to provide quality education for all students and openly seeks every opportunity to expand efforts to assist them. The continuous exposure of engineering to secondary students is a major step in meeting the demand and moving into the twenty-first century. The presence of summer programs such as the GTE Engineering Summer Institute is a vital element supporting the educational goals needed by our future workforce.

References

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