IMPROVING THE TRANSITION SUCCESS OF ENGINEERING COMMUNITY COLLEGE STUDENTS TO A UNIVERSITY

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Abstract

Maricopa Engineering Transition Scholars (METS), funded by the National Science Foundation, is a collaborative project between the Ira A. Fulton School of Engineering at Arizona State University and five community colleges in the Maricopa County Community College District. The project has two main goals. The first is to increase the interest in engineering and computer science by students (especially women and underrepresented minorities) at the community colleges, to ease the transition of such students from the community college to the university, and to retain and to graduate engineering community college transfer students through events on all six campuses. The second goal is to build a model collaboration between a university and a community college system for engineering students.

This paper will describe the activities that have been implemented, including lessons learned to improve the programs. The programs include introductory “Be An Engineer” events at the community college, follow-on workshops at the University, a compact bridge/transition workshop, an orientation presentation for transition students, a mentoring program for recent and future transfers, and the establishment of a METS Center in the Fulton School of Engineering to support Fulton community college transfer students with a place to find support, to study, and to network. Additional activities at the community colleges include working with the faculty and going into the upper level math, chemistry, biology, and physics classes to talk with students and encourage them to consider engineering. Modules have been developed and are being pilot tested in these classrooms as another tool to encourage students to learn about engineering and increase interest in engineering as a career. Lessons have been learned in how to contact students for events, how to get information from the students who attend, and how to be flexible with student schedules.

The paper will also discuss the joint administration of the program with different management systems and styles in each of the six institutions in the program. Lessons have been learned in constructing a functional management structure, in scheduling faculty and staff from the institutions to participate in the activities, and in scheduling professional engineers for panels.

Key Words: Collaboration, Community College, Transfer Student, Transition Student, Underrepresented Minorities, Women
I. Introduction

Maricopa Engineering Transition Scholars (METS), funded by the National Science Foundation (NSF), is a collaborative project between the Ira A. Fulton School of Engineering at Arizona State University and five of the ten community colleges in the Maricopa County Community College District (MCCCD). The project is a response to the shrinking numbers of students choosing engineering as a career and to the rising minority populations in the United States. Public community colleges enroll about 10% more underrepresented minority students (URM) than public universities and about 65% of the 400 community transfers each fall into the Ira A. Fulton School of Engineering at Arizona State University (ASU) are from a community college. Over half of these community college transfers only decided on engineering after they were enrolled at the community college. Therefore, there are many potential, qualified engineering students at the community college who have not yet decided on their major. The METS project has two main goals. The first is to increase the interest in engineering and computer science by students (especially women and underrepresented minorities) at the community colleges, to ease the transition of such students from the community college to the university, and to retain and to graduate engineering community college transfer students through events on all six campuses. The second goal is to build a model collaboration between a university and a community college system for engineering students.

The background on the METS collaboration has been previously described. Conversations and partnering took place for nearly two years before the project was funded and launched in the summer of 2003. ASU and MCCCD were ideally positioned to pilot a model collaboration by enrollment and campus resources. Both MCCCD and ASU have decades of experience in serving underrepresented students and both have received outside funding to support programs to increase the recruitment, retention, and graduation of URM students. Each of the five MCCCD colleges has academic advisors to assist students with career choice and transition to four-year colleges and universities. Each of the five community colleges in the METS project has programs of awareness about engineering or programs that can encourage mathematics and science. The enrollment and retention of women and URM students in the Fulton School of Engineering have increased steadily since 1991. Community college students experience many changes when they transfer to a large four-year university: it is like being a freshman all over again. In this project each of the community colleges is very different and operates autonomously, so programs cannot simply be duplicated from one community college to another. The stakeholders, some of the challenges of building a collaboration model, and the project evaluation design and quantitative measures of effectiveness were described in a previous paper.

The METS program is designed with many opportunities for women and underrepresented minority students to get the information they need to be successful in pursuing a career in engineering. The METS program shows students: a glimpse of what engineering is, what engineers actually do on the job, how to connect with other transfer students, introduces them to various ASU departments and personnel in a Workshop/Bridge at the beginning of the semester, an orientation to the METS program and what it offers them by participating in it. Students who have transferred become mentors to new transfer students as part of the Get a Mentor/Be a Mentor program, and most importantly show them a place where they can connect with other
transfer students and get help from the METS staff at the METS Center. These METS activities are components that have advanced the METS program and given us valuable insight about what new transfer students need when they come to the Fulton School of Engineering at Arizona State University.

II. METS Program Components

The METS program components for Fall 2003/ Spring 2004 consisted of nine units as follows:

a) “Be an Engineer I” at Maricopa colleges is the centerpiece recruitment event at Maricopa colleges to interest students in pursuing a career in engineering.

b) “Be an Engineer II” at ASU is a follow up event at the end of each semester which allows potential and new transfer students to meet engineering faculty in their labs and gain insight into engineering research at ASU.

c) METS Workshops for Survival Strategies are held throughout the semester targeting potential and new transfer students, but anyone is welcome to attend.

d) METS Student Mentors is an opportunity for new transfer students to be assigned a peer mentor. The student mentor assigned is a student who has attended ASU for at least one semester.

e) METS Pilot Workshop/Bridge for new transfer students is held in early summer to assist students in locating student resources at ASU such as: parking, how to find your classes, scholarships, tutoring, the CEDAR center, and the bookstore.

f) METS Orientation to new transfers gives students information about the METS program and how it can assist them as they transfer to a four-year engineering degree program. The orientation session, held during the week before fall classes, helps students to become aware of issues that affect new transfer students and is followed by a tour of the engineering buildings. A panel of ASU engineering students also shares their experiences.

g) The METS Center is for students to support each other, study, work in study groups, and receive mentoring from METS Staff.

h) Engineering Modules to be used in the targeted classrooms were developed to help promote interest in engineering and to show how it is tied to mathematics and science. As part of the METS program, we have a follow-up event, at the end of each semester at ASU.

i) METS Classroom visits are made by the METS co-directors in community college mathematics and science classes to interest students in engineering and computer science and to make the students aware of the METS program and its events.
We now look at the METS’ project activities to increase the interest in engineering and computer science by students (especially women and underrepresented minorities) at the community colleges.

III. METS Program Components Details

A. “Be An Engineer!” is the centerpiece initial METS event on each of the MCCCD campuses. Be an Engineer (BAE I) events are held at each of the community college sites and offer community college students an opportunity to meet with engineers from local industry and with ASU engineering students. The events provide time for networking, industry product demonstrations, a panel discussion, and a question and answer session. The BEA I event is the first of several METS events to create a “student pathway” that enrolls students (especially women and underrepresented minorities) in Community College (CC) engineering programs, retains the students in engineering through their transition to ASU (should they choose ASU), and graduates these students from the ASU Fulton School of Engineering. Additionally, once the students are in the Fulton School of Engineering, they are encouraged to learn about research, to get a research or internship position, and to consider continuing their engineering or computer science studies into graduate school.

The five participating MCCCD campuses are Chandler-Gilbert CC (CGCC), Estrella Mt. CC (EMCC), Glendale CC (GCC), Mesa CC (MCC), and South Mt. CC (SMCC). At each of the five MCCCD schools, each semester, BEA I events are held to generate interest among current Community College students to consider engineering as a career and to enroll in community college engineering courses or prerequisites for these courses. The event is actually a recruitment event to engineering. We want to create interest in engineering as a potential career, especially among women and underrepresented minority students, and to coach their parents and extended families, who often attend the event with the student. These events provide students and parents with an opportunity to network with professionals, faculty, staff, and students from both ASU and the particular CC and thus help close the gap between institutions. Both mathematics and science community college instructors often attend.

The events showcase a panel of engineers from the community, an engineering faculty member from ASU, and the CC engineering faculty member. In addition, advisors, financial aid/scholarship coordinators, and engineering students attend from both ASU and the CC. More than 400 interested students per semester have been able to participate in these events, by networking with engineers active in local industry and taking part in hands-on activities. More than 50 different engineers have participated, representing over 15 local industries.

All students, as they entered through the main door for a BEA I event, were greeted by one of the METS co-directors, and handed several things: An event agenda, a pink Student Information form, a blue Event evaluation form, and a copy of the METS bookmark (which included information on how to contact the METS directors). They were asked to sign in for the event. Students were given ASU Folders containing an ASEE magazine - a recent student recruitment issue - and ASU information.
Each recruitment event was set for approximately two hours. Figure 1 shows a typical agenda for a "Be An Engineer!" event. The event begins with networking by the students with the engineers and with engineering students from ASU. The industry engineers are asked to each staff a table, bring an industry product to demonstrate, and involve the student participants in a hands-on opportunity. Research shows that the information stays with the student longer if there is purposeful and guided hands-on participation at some level. Students circulated between tables set up for each industry engineer, for each engineering faculty member, for engineering students, for an ASU financial aid representative, and for advisement, usually a representative from both ASU and the CC. Table displays were set up on financial aid, scholarships, and advisement.

Usually student-engineering contests were held outside in front of the event site, which helped attract students to the event. It included hands-on contests such as robotic maze, solar ovens, catapult launches, and bridge design by MCCC engineering students. There also were two tables for CC student projects (bridges) at one event, which received a lot of student attention, especially with the contest to see which bridge would support the most weight.

Engineers from local industry demonstrated products and engaged the students in conversation about engineering as a career. Over 15 Phoenix-area companies participated, with engineers in bioengineering, computer engineering and computer systems engineering, mechanical engineering, chemical engineering, aerospace engineering, materials science engineering, environmental engineering, and industrial engineering.

The program began with a welcome to the students and volunteers. Both of the METS co-directors spoke, and greeted the attendees, then an MCCCD representative spoke about the METS program, and how it can help students. Next the ASU faculty member spoke and added a bit more about what it can mean to be an engineer. At many of the events, the CC engineering faculty member gave a slide presentation on that campus’ engineering program.

An engineering panel followed, with each panelist asked to say a little about their background on the first round. This panel included professional engineers from industry and ASU engineering students and always included a good representation of women and underrepresented minorities. On the second round each was asked for advice. Then several questions were taken from the audience (e.g. How is engineering as a career for women?) Other typical questions included: How hard was it for you to get through school? and Are there really good opportunities for someone like me? Questions on financial aid and scholarships were always asked. The panel portion of the program lasted approximately 40 minutes.

After the panel discussion was the wrap-up, with more one-on-one questions of students and engineers, and door prizes handed out. Door prizes included half-pound chocolate bars with occasionally an industry-donated cell phone or gift certificates to McDonald’s.

The METS co-directors gave closing remarks and CC thank-you gifts were passed to each of the industry volunteers.
**B. “Be An Engineer II”** As part of the METS program we have a follow-up event, at the end of each semester at ASU. All students who attended a BAE I event are sent an invitation to attend. The Be an Engineer (BAE) II event focuses on showing the student what engineers do by having them meet engineering faculty in their labs. The students who attended get an opportunity to see engineering design, development, and testing of the research that the faculty member is actively pursuing. The BAE II event is to welcome the new transfer students to ASU, introduce students to ASU advisors and ASU engineering faculty, and for the METS staff to let students know that they are available to assist them find resources in a university environment. Students are exposed to technical activities as well as see technical demonstrations by ASU faculty, staff and students. The BAE II events include both a presentation and demonstration by ASU faculty and staff in their engineering discipline which includes: Material Science Engineering demonstrating the properties of materials, i.e. Nintenol wire, magnetic properties of gems, superconductivity; Bioengineering, a discussion of properties of artificial tissue as a suitable biomaterial to have the same properties of cells in the body, students made hydrogels a component of artificial tissue which is similar to goose or silly putty toys; and Civil Engineering gave students an opportunity to look at materials which are used to make rubberized asphalt which reduces noise on our local Maricopa freeways and samples were given to students to be used as paper weights. A student panel of engineering students who have attended a community college and successfully transferred into engineering at ASU share their insights and answer questions for the students who are preparing to transfer into engineering at ASU.

Students give feedback on the BAE II event by completing a questionnaire at the end of the event. Selected questions and student responses are summarized below which gives the METS staff insight to what new community college transfer students need as they transition to a university in engineering.

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| First 40 minutes | Networking; hands-on activities at tables  
Hand out METS evaluation forms  
Sign in students |
| 5 minutes | 1-2 door prizes given out  
Pizza is served |
| 5 minutes | Greetings from METS coordinators, MCCCD representative. |
| 20 minutes | Welcome and Engineering overview; CC engineering faculty, ASU faculty speaks  
1-2 door prizes given out |
| 40 minutes | Panel discussion; engineers, ASU students  
Questions from audience members |
| Last 10 minutes | Wrap-up of event  
Get evaluation forms from students  
1-2 more door prizes given out |

Figure 1. Typical Agenda for an MCCCD “Be An Engineer!” Event
Q1- What did you learn at the Be an Engineer II event
   - How METS can help transfer students adjust to the university
   - That ASU professors really care about students.
   - That your GPA after you transfer starts from zero.
   - That ASU is big and engineering is accessible
   - Good tutoring programs
   - That I made the right career choice
Q2- What is your favorite activity at the BAE II event
   - ASU student panel
   - The demonstration by ASU professor
   - ASU student panels because it gave me a feeling on how ASU works with students
   - The student panels were very informative
   - The technical demonstrations
   - The demonstrations in labs
Q3- What would you change about the BAE II event
   - Bring in former ASU engineering graduates so they can discuss activities involving their career choice.
   - Have ASU advisors and Financial Aid please!
   - Longer time for ASU student panel
   - Nothing
   - How do different engineering programs relate to other programs
   - Nothing

The students who attend the BAE II events in Year 1 get introduced to the METS staff, have a tour of the METS Center, and have made the first step in establishing relationships in the Fulton School of engineering at ASU. The METS staff encourages students to continue to build relationships with faculty and staff while attending school to receive career mentoring in their field of engineering.

C. METS Workshops for Survival Strategies are held throughout the semester targeting potential and new transfer students, but anyone is welcome to attend. The purpose of the workshops is to introduce new transfer students to information and resources at ASU to help students to be successful including: time management survival skills for busy students, networking skills and communication skills by connecting undergraduate students in engineering with: graduate students in engineering, engineers in industry, and engineering faculty and advisors encouraging students to interact with them on a regular basis. There were a total of 5 workshops for the Fall 2003 and Spring 2004 semesters, with each repeated the same week. During the first year of the METS program, an academic scholarship program for transfer students in the Fulton School of Engineering called the Collaborative Interdisciplinary Research Community/METS (CIRC/METS) was also begun with funding from the National Science Foundation. To accommodate the schedules of the students, each workshop was held twice in the same week each semester. Refreshments were served and evaluations were done with each meeting. The CIRC/METS students were assigned homework and required to complete a portfolio. Additional details are CIRC/METS have been detailed in another paper.6
The workshop topics for 2003-2004 are shown in Figure 2.

<table>
<thead>
<tr>
<th>Workshop No.</th>
<th>Fall 2003 Meeting Topic</th>
<th>Spring 2004 Meeting Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Time Management</td>
<td>Career Services at ASU</td>
</tr>
<tr>
<td>2</td>
<td>Connecting with your ASU Advisor</td>
<td>ASU Faculty Research</td>
</tr>
<tr>
<td>3</td>
<td>Connecting with ASU faculty</td>
<td>Networking with ASU graduate students</td>
</tr>
<tr>
<td>4</td>
<td>Pursuing a Graduate Degree</td>
<td>Networking with Industry engineers</td>
</tr>
<tr>
<td>5</td>
<td>Student Discussions</td>
<td>Student Discussions</td>
</tr>
</tbody>
</table>

**Figure 2. Fall 2003/Spring 2004 METS Workshops at ASU**

The METS co-Directors are available to support and to encourage students to network with ASU faculty, staff, and engineering graduate students at the METS Workshops. This is another step in building solid relationships in their field of engineering. An important part of being prepared as an engineering professional is to be given opportunities to receive mentoring from peers, engineering graduate students, faculty, and staff to prepare students to learn about mentoring so they are prepared to mentor new transfer students. The METS staff encourages students who have participated in the METS or CIRC/METS programs for at least one semester to then help new transfer students by volunteering in the METS program.

**D. METS Student Mentors** is an opportunity for new transfer students to be assigned a peer mentor. The student mentor assigned is a student who transferred from a community college and has been at ASU for at least one semester. The student participation is shown in Figure 3.

<table>
<thead>
<tr>
<th>No. in Mentor Program</th>
<th>Fall 2003</th>
<th>Spring 2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASU Student Mentors</td>
<td>**</td>
<td>9</td>
</tr>
<tr>
<td>ASU Student Mentees</td>
<td>**</td>
<td>9</td>
</tr>
<tr>
<td>Maricopa Student Mentees</td>
<td>**</td>
<td>35</td>
</tr>
</tbody>
</table>

**Figure 3. Student Participation in METS 2003/2004 Mentoring Program**

The ASU Student Mentors were assigned one ASU student mentee (a new transfer student) to meet with on campus and no more than five Maricopa student mentees (students still at Maricopa community colleges to contact by email or telephone).

The METS Student Mentors attend a one hour training session to which is to inform them of what is expected as a METS Student Mentor, outlines their duties and responsibilities as a peer mentor, and defines the behavior of a good student mentor. The METS mentees also attend a short training session which informs them of what is expected as a METS Student Mentee, outlines their obligations to the METS Student Mentor, and defines the behavior of a good student mentee. The first meeting of the Mentor and Mentee begins with an icebreaking activity, followed by a discussion and writing a contract of what the Mentor and Mentee each expect of the other, and signing of either the METS Mentor contract or the METS Mentee contact with the METS co-Director. The session ends with refreshments of pizza, cookies, and beverages.
The Mentors and Mentees are to meet a minimum of once each month on campus and inform the METS co-Director of how the relationship is progressing. Either the mentor or the mentee may request a to be re-assigned as part of a no-fault termination if a positive relationship is not developing.

It has been difficult to get feedback from both Mentors and Mentees on how the relationship is going. It seems that students are reluctant to share anything about the relationship either positive or negative. The mentor/mentee relationship has been described as “personal” and only a few students share information when asked in a questionnaire about experiences as a Mentor or Mente. However, several of the mentoring pairs have sent a copy of their emails to the METS co-director.

Overall comments to the ASU co-Director and reviews of the emails are positive about the mentoring program. It seems that students who participate in the mentoring program continue to progress successfully in their engineering program.

**E. METS Pilot Workshop/Bridge** for new transfer students is held two weeks before classes begin. The workshop is to give new transfer students basic information that is usually shared when students are a Freshman. Students who are transferring from community college often don’t take advantage of programs that are geared for new college students. Since students who have attended a community college aren’t new to college, they think they can pick-up information, as they need it. The pace is faster at a university and students are spending valuable time learning how to navigate the university system this is a disadvantage for the new transfer student. Thus the workshop includes information on: how to find resources at ASU, i.e. parking, how to find your classes, scholarships, tutoring, CEDAR center, finding books at the bookstore. Most often community college students ask about how to find a job on campus while attending school and how do I find a job after I graduate. This Workshop included a speaker from ASU Career Services to give the new transfer students an overview of the services offered to them as a student. Also, a speaker who performs Freshman Orientation gave a brief talk on programs available to help new students at ASU. There were two METS Workshop/Bridges sessions in Year One in which approx. 50 students attended.

**F. METS Orientation** for new transfers is a one hour program to orient them to the resources of the METS program. It is designed to make students aware of issues that affect them as they transfer to an engineering program at a university. The orientation session is held during the week before classes, so that students will become aware of the resources of the METS program such as: student mentors, the METS Center, the METS staff, the METS co-Directors, which can help them during the transition process. There is an open discussion with a panel of ASU engineering students who transferred from a community college to an engineering program at ASU. At the end of the orientation session there is a tour of the METS Center.

**G. The METS Center** is a “home-base” for new transfer students to connect with other transfer students who are attending ASU. It is a place where students support each other and encourage each other to persist in and obtain their engineering degree. The community college students connect with one another easily because they have a common experience having previously
attended a community college. They make friends and bring other students to the METS Center to study as a group. The students have access to the METS co-Director located in the METS Center area. In the first three weeks after transferring to ASU, students who frequently visit the METS Center connect with the METS co-Director on a regular basis every 1-2 days to ask questions or just say Hi. As students become comfortable in the university culture, their visits to the METS Center begin to decline. Yet several students visit the METS Center almost daily for the entire 1st semester they transfer to ASU. Several students have shared that if the METS Center didn’t exist, they don’t know where they could go on campus to meet other transfer students.

H. METS Engineering Modules
The METS team has created modules of engineering-related learning activities that community college instructors can access to engage their students’ interest. The purpose of these modules is to offer engineering-related learning activities that can be utilized in currently taught curricula, and can help such instructors build interest in engineering. Each activity features an engineering problem set in the context of a STEM (Science, Technology, Engineering, Math) subject taught in the Maricopa County Community Colleges. A best practice dictum suggests that educators “encourage discovery and hands-on, constructivist learning” when teaching STEM subjects to women and underrepresented minorities.

Chosen modules were based on activities successfully used by STEM instructors, and considered suitable to advance the established curriculum. The first two modules have been introduced in a CC general physics class: 1) Bridge Design, and 2) Building Towers.

In the Bridge Design module, students work together in groups with an assignment to design and build a small bridge using a supply of Lego blocks, which requires collaboration and the use of a design process. The unit is intended to emphasize the design aspect of many engineering jobs in which several factors must be weighed and balanced to reach a useful solution.

The Building Towers module is meant to be a fun exercise in working on engineering teams, while competing to accomplish a goal. Teams compete to build a freestanding paper tower that supports a Styrofoam cup on top, constructed only from paper and tape provided in class.

I. METS Classroom visits
Currently enrolled Maricopa students were actively recruited from math, science, computer science and engineering classes (typically prerequisite courses for Fulton Engineering courses) on the Community College campuses to attend the “Be An Engineer!” events. Targeted students are enrolled in any of the following: college algebra, trigonometry, pre-calculus, Calculus I, II and III; General physics I and II; Fundamental chemistry; Introduction to computer science; and General biology I and II. While currently enrolled CC students are our primary audience, we have also reached beyond this primary group when the opportunity has been presented. For example, when high school students or at-risk students come to look over and tour a community college campus, they are told of the opportunities available to begin an engineering or computer science major at the community college. They are also told of the support and resources available through the METS program to help them through these majors to graduation.
During each semester, and in conjunction with pre-registration time, METS co-directors visited a number of targeted STEM (Science, Technology, Engineering and Math) classes at the 5 MCCCD campuses participating in the METS project. By agreement among the 5 MCCCD METS Liaisons, these targeted courses are the following: College algebra, Trigonometry, Precalculus, Calculus I, II and III; General physics I and II; Fundamental chemistry; Introduction to computer science; and General biology I and II.

The primary reasons for visits to individual classes are to recruit students to engineering, to follow up with students after “Be an Engineer!” events, and to educate STEM instructors about the events and about the engineering program on their campus. Each instructor was contacted individually, and asked for 10 minutes of class time to provide a brief overview of engineering and to distribute information on engineering and METS.

During each class visit, the students received a sheet about METS and about the good reasons to take engineering courses (as in Figure 4) and the engineering class schedule for that campus. This handout also included information on the next campus METS events. An information form is also handed out which asks for the student name and email address. Interested students who gave their email address on a completed form are then informed about future METS events.

<table>
<thead>
<tr>
<th>Reasons to be an engineer:</th>
<th>Engineering Field</th>
<th>Arizona Starting Salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Job Satisfaction</td>
<td>Aerospace</td>
<td>$48,285</td>
</tr>
<tr>
<td>• Varied Opportunities</td>
<td>Bioengineering</td>
<td>$46,707</td>
</tr>
<tr>
<td>• Challenging Work</td>
<td>Chemical</td>
<td>$51,967</td>
</tr>
<tr>
<td>• Society Impact</td>
<td>Civil</td>
<td>$40,395</td>
</tr>
<tr>
<td>• <strong>Good Salaries!</strong></td>
<td>Computer Science</td>
<td>$52,649</td>
</tr>
<tr>
<td>• Prestige</td>
<td>Computer Systems</td>
<td>$53,649</td>
</tr>
<tr>
<td>• Technological Discovery</td>
<td>Construction</td>
<td>$45,000</td>
</tr>
<tr>
<td>• Creative Thinking</td>
<td>Electrical</td>
<td>$49,863</td>
</tr>
<tr>
<td>• Professional Environment</td>
<td>Industrial</td>
<td>$47,759</td>
</tr>
<tr>
<td>• Professional Environment</td>
<td>Mechanical</td>
<td>$48,511</td>
</tr>
</tbody>
</table>


Figure 4. One figure used on the handout given to students during the classroom visits, to encourage them to consider pursuing a career in engineering.

III. Coordinating METS Events Collaboratively

*Advertising METS Events* is done collaboratively by MCCD and ASU. A coordinated publicity campaign for advertising the “Be An Engineer!” events used various MCCCD outlets, such as campus newsletters and Web sites, posters, flyers passed out by science, technology, engineering, and mathematics (STEM) instructors, and announcements by STEM instructors on each campus. Flyers were sent to thousands of the targeted students at the five participating colleges. Parents and family were invited to attend in the invitations mailed to students’ homes. Additionally, flyers were sent to the MCCCD faculty, posters were posted on the campuses,
websites were used for advertising, and local newspapers were notified by college publicity staff with news briefings.

**Scheduling METS Events and Meeting Arrangements – Food, Space, People** also were done collaboratively. The METS liaisons at each community college suggested dates for the BAE I events when the times were convenient for staff and facilities were available. The dates were then considered by the other METS staff as to the feasibility of ASU students, faculty, and staff being able to attend on the suggested day and time. Schedules for faculty and students are different at each institution, with some times being more heavily scheduled at some institutions than at others.

Students are more likely to attend an event, and bring their family, if refreshments are offered. Refreshments for BEA I events are geared to students: pizza, cookies, water, iced tea and lemonade. The BEA I events took place on the CC campuses, in a centrally located space large enough to accommodate activities, tables, and over 100 attendees. The space available was differently arranged at each of the five MCCCD campuses. Events held at ASU had the advantage of the availability of the use of the METS Center for small meetings. A close-by seminar room was usually available, although sometimes a classroom needed to be reserved for large gatherings.

Attendees at BAE I events included students and their parents. The parents in attendance asked questions at the financial aid and the advisement tables, and generally got involved in the events. Initially, it was a challenge to locate local engineers who would be willing to volunteer their time at these events. To mentor women and minority students at these events, we wanted ideally for some of the volunteer engineers to be under-represented minorities. The first minority engineer volunteer was located through the local professional SHPE chapter through a contact found in an Internet search. The first contact with a women engineer was made through the local professional SWE Section. After the initial contacts, local engineers have been very kind and helpful, and have talked to co-workers to provide engineers for other events. In addition, several of the engineers initially contacted in this way have become METS industry representatives on the advisory council.

Extensive handouts and folders were given to METS event attendees at each event. The information included details on the METS organization, but in particular, information on engineering and sources of additional engineering information on the Internet.

**IV. METS Program Year One Summary**

Four of the METS events were begun in Fall 2003 and a fifth component was piloted in Spring 2004. The attendance at these events is given below in Figure 5. A total of 500 students attended BAE I events during Fall 2003 and Spring 2004. A total of 80 students attended the BAE II events at the end of the Fall 2003 and Spring 2004 semesters.

The METS Center was open for the beginning of Fall 03 and has been fully functional since the end of Fall 2003. Visits to the classrooms were begun in Spring 2004. The METS Bridge Program and METS Fall Orientation were held for the first time during summer 2004. A total of
22 METS and 10 CIRC/METS events have been held during Summer 2004 and Fall 2004. A total of 45 METS and 20 CIRC/METS events are planned for the 2004/2005 academic year.

**METS ACTIVITIES TO ADVANCE PROGRAM GOALS (2003/2004)**

<table>
<thead>
<tr>
<th>NO. EVENTS</th>
<th>METS EVENT</th>
<th>LOCATION</th>
<th>NO. ATTENDED FALL 2003</th>
<th>NO. ATTENDED SPRING 2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>METS Bridge Program</td>
<td>ASU</td>
<td>***</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>Be an Engineer I</td>
<td>MCCD</td>
<td>100</td>
<td>400</td>
</tr>
<tr>
<td>2</td>
<td>Be an Engineer II</td>
<td>ASU</td>
<td>70</td>
<td>10</td>
</tr>
<tr>
<td>20</td>
<td>CIRC/METS Workshops</td>
<td>ASU</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>5</td>
<td>METS Mentoring</td>
<td>ASU</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

**36 METS Events Total Year 1**

Figure 5. Summary of METS for Year 1 (Fall 2003/Spring 2004)

V. Lessons Learned

Since we encountered greater difficulty than expected to involve ASU Engineering faculty in off-campus activities (due mainly to their many on-campus activities), the “Be An Engineer II” activity on the ASU campus at the end of each semester, again targeted primarily at the CC student audience, proved to be a wise follow-up meeting. This follow-on activity to the Maricopa events was held at the new METS Center on the ASU-main campus. This event gave students the opportunity to get into FSE engineering labs and hear first-hand about current FSE research to gain a better perspective on what engineers actually do.

Each CC campus is different – and the ASU campus is different from all the CC campuses. Consequently, each “Be An Engineer!” event has a different tone, depending on the campus where it is organized and held. For example, to mail invitations to students targeted at a particular CC campus involves interaction with that campus’ mailroom, and knowledge of the policies in place on that campus with regard to bulk mailing – such policies differ according to campus. So do policies regarding room reservation, ordering of food, and placing of posters around the campus. These differences provide challenges as well as opportunities for the individual character of the campus to be appreciated.

Different personnel were involved in the organization of METS events at each campus. At one campus, the personnel involved the CC METS Liaison, with help from CC faculty and the CC SHPE club, and by Maricopa and ASU METS. The event took place in the Student Union on the CC campus. Some of the extra events were different at each campus – some campuses had engineering contests, some campuses had an engineering faculty member who wanted to do a...
slide presentation, and one campus incorporated a portable planetarium into its activities accompanying the engineering recruitment event.

VII. Evaluation

Gathering information from the students who attended the Be An Engineer Event, in particular, proved to be a challenge, especially due to the large number of students who attended. The students were first asked to complete an information form and later an evaluation form before they left. Students were encouraged to turn in their information form before they could get the refreshments, but many did not complete the forms. Door prizes were given throughout the event. Students received tickets for the door prizes by completing the information and evaluation forms. Although the door prizes helped, we still might only receive half of the evaluations. An almost sure solution was finally used for the events.

All students, before they entered through the main door for a Be An Engineer event, were greeted by one of the METS co-directors, and handed several things: An event agenda, a pink Student Information form, a blue Event evaluation form, and a copy of the METS bookmark (which included information on how to contact the METS directors). They were asked to sign in for the event. Students were given ASU Folders containing an ASEE magazine - a recent student recruitment issue - and ASU information. Students were asked to fill out the 2 forms (pink/blue), and were told if they returned forms they would get tickets to participate in the Door Prizes. The students were then not allowed to enter the event until they had signed in and completed the information form. Since this can cause a bottleneck, especially if an entire class has been excused to attend the event, attempts will be made to get the forms to the instructors of such classes before the event so the students can turn in the form and enter the event quickly. Obtaining the email address from the information form is especially important to notify the student of future METS events.

Students rated these events as Excellent to Very Good (92%). They enjoyed talking with the engineers during the initial networking period, and flooded the ASU engineering students with questions during the panel discussion.

The first instructor to use the in-class modules commented on the trouble to fit the modules into the current MCCCD subject outline for General Physics, since no formal physics was required to use either of these modules. He also commented that there were some technical “bugs” to be worked out in both modules. However, the written comments from the students, and from the instructor, showed the students enjoyed the modules and had a lot of fun with them.

The METS general evaluation combines both quantitative and qualitative methods through data warehouse tracking, written surveys, and interviewing. From the ASU data warehouse we extracted MCCD transfer students since fall 1996. The students are tracked in two ways: 1) by number of entrants and 2) by program retention and completion. Two indices have been formed to measure change over time: 1) the entrants’ index is constructed from five years (Fall 1996 to Spring 2001) and 2) the success index is constructed from Fall 1996 to Spring 1999. The success index measures students still in engineering programs or graduates of such programs. These general indices were formulated for nonminority women, minority women, nonminority males,
and minority males. Although it is too early to measure the impact of the METS events on the number of entrants, of those retained, and those graduated, the 2003-2004 entrants’ data are showing a slight increase in minority males and females. The success data are currently exceeding the expected. Each new student attending Be an Engineer Event is asked to complete a background survey. To date over 500 surveys have been completed. One of the major needs and also cited barriers by over 70% of the students is paying for their education. Interviews conducted so far have been with the METS partners, ASU engineering counselors, and students planning on pursuing an engineering degree. Initially, the METS partners were very optimistic about what would come of this project. They will be interviewed again in February. The ASU engineering counselors’ interview shed light on the fact that transfer students are inclined to “swirl” more than students who initially started at ASU. That is transfer students will continue to take courses at a community college because of cost or scheduling. Twenty potential transfer students were interviewed and over 60% of them that they were choosing engineering because they liked mathematics and science and were exciting about using these disciplines in problem solving and of course they were attracted to the salary-levels in the engineering fields.

VII. Conclusion and Summary

The METS staff always works to the idea of continuous improvement. In future semesters we will work to increase the number of hands-on activities for the students and to find new ways of fostering a friendly competition to draw students to the events. We will work always to increase the number of students in attendance, in order to have the best chance of encouraging enrollment in engineering courses by women and minority students.

The METS Center is drawing many community college transfer students who did not know about METS until they either wander into the office or are referred by other transfer students. Many of these students are drawn to the Center to feel at home at ASU and to be with others who are going through the same transitions that they are. Having a mentor to show the way and a career mentor through METS is very helpful to the students in addition to an academic advisor.

References


Bios

MARY R. ANDERSON-ROWLAND is an Associate Professor in Industrial Engineering and previously served as the Associate Dean of Student Affairs in the Fulton School of Engineering at ASU from 1993-2004. She was named the SHPE Educator of the Year 2005 and was selected for the National Engineering Award in 2003, the highest honor given by the AAES. In 2002 she was named the Distinguished Engineering Educator by the Society of Women Engineers. An ASEE Fellow and Senior Life member of SWE, she is a frequent speaker on the career opportunities in engineering, especially for women and minority students.

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WILLIAM GUERRIERO is Dean of Instruction at Chandler-Gilbert Community College. He previously served as Vice President of Instruction and Dean of the Business Division at Monroe County Community College (Michigan) and has held a variety of administrative and instructional positions in two-year colleges since 1981. Mr. Guerriero's current responsibilities at Chandler-Gilbert include nine academic divisions, instructional and administrative computing, learning resource and assistance centers, and curriculum.

BASSAM H. MATAR is a faculty member and coordinator for the engineering program at Chandler-Gilbert Community College (One of Maricopa Community Colleges District). Bassam has been teaching engineering classes at MCCCC full time for the past 14 years. He was named Motorola Educator of the Year 1999 and received the National Institute for Staff and Organizational Development award in 2000. He has served as P.I., as co-P.I., and as developer for several NSF grants.

DONNA M. ZERBY is the METS co-director at the ASU campus. Zerby previously served as Program Coordinator, Sr. for WISE Investments, an outreach program to interest middle school and high school young women to pursue a career in engineering. Zerby previously taught courses and has been advising and mentoring students for 14 years at Maricopa and private colleges. Zerby worked for 8 years as a bioengineer in local industry.

ELIZABETH E. CHAIN is the MCCCD co-director for METS. After time as Associate Professor in electrical engineering, Elizabeth gained industrial experience in semiconductor manufacturing, then moved to adjunct faculty at Chandler-Gilbert Community College where she teaches courses in mathematics, physics and engineering. She joined the METS team in 2003.

DEBRA L. BANKS, PhD, METS Evaluator and former Director of Evaluation and Assessment for CRESMET (ASU), is now the Director of Outreach and Operations for Innovative Tailor Made Training and Technology (ITTT) in Berkeley, CA. She has been evaluating major school reform and technical programs for 14 years. She has served as a co-PI for several grants including METS.