

## **AC 2009-2260: COLLABORATIONS WITH NON-METROPOLITAN COMMUNITY COLLEGES**

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# Collaborations with Non-Metropolitan Community Colleges

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## Abstract

As the need for more engineers in the United States is becoming critical, the community College (CC) is becoming more important as a place to begin the nurture of more students who will choose engineering or computer science as a career. The Ira A. Fulton School of Engineering at Arizona State University (ASU) accepts about 300 transfers each year. Our research has shown that about half of these CC transfers decided on engineering or computer science (hereafter just referred to as engineering) after they were at the CC. Therefore there is great potential in working with a CC and the high school students local to that college to inform and to encourage these students to consider engineering as their major. Since women and underrepresented minority students are over represented in the CCs compared with four-year institutions, collaborations with CCs also has the potential of increasing engineering diversity.

The Ira A. Fulton School of Engineering has worked with six local metropolitan community CCs for the past six years in encouraging students to select engineering as their major and to remain in engineering. We support the transfer student through an orientation and a special center for CC students on the ASU campus. We employ successful transfer students in the center who act as resource people for new transfer students. The center also provides workshops to help transfer students. We also have an academic scholarship program (funded by the National Science Foundation: CSEMS grant # 0324212 and then S-STEM grant # 0728695) for transfer students which has resulted in a retention and graduation rate of over 90%.

This paper will discuss an exploratory program sponsored by the National Science Foundation (grant # 0836050) taken on by Fulton to collaborate with three nonmetropolitan CCs which lie 60-200 miles from ASU. At present very few students from these schools come to ASU for engineering. We will discuss the primary needs of such CCs as they attempt to build up their pre-engineering programs. Complete articulation agreements already exist with ASU for each CC in the state of Arizona. This collaboration includes a visit each semester by an ASU team to each CC. At least one of these events each year will also include high school students and their parents local to the CC. In this way, the ASU teams help the CC build up enrollment for pre-engineering as well as inform undecided CC students that engineering would be a good career choice. The paper also discusses the ways that support is given to high school and CC students through a mentoring program with engineering students at ASU. Other collaborative efforts will be discussed as well as the barriers that exist at a nonmetropolitan CC in building a pre-engineering program.

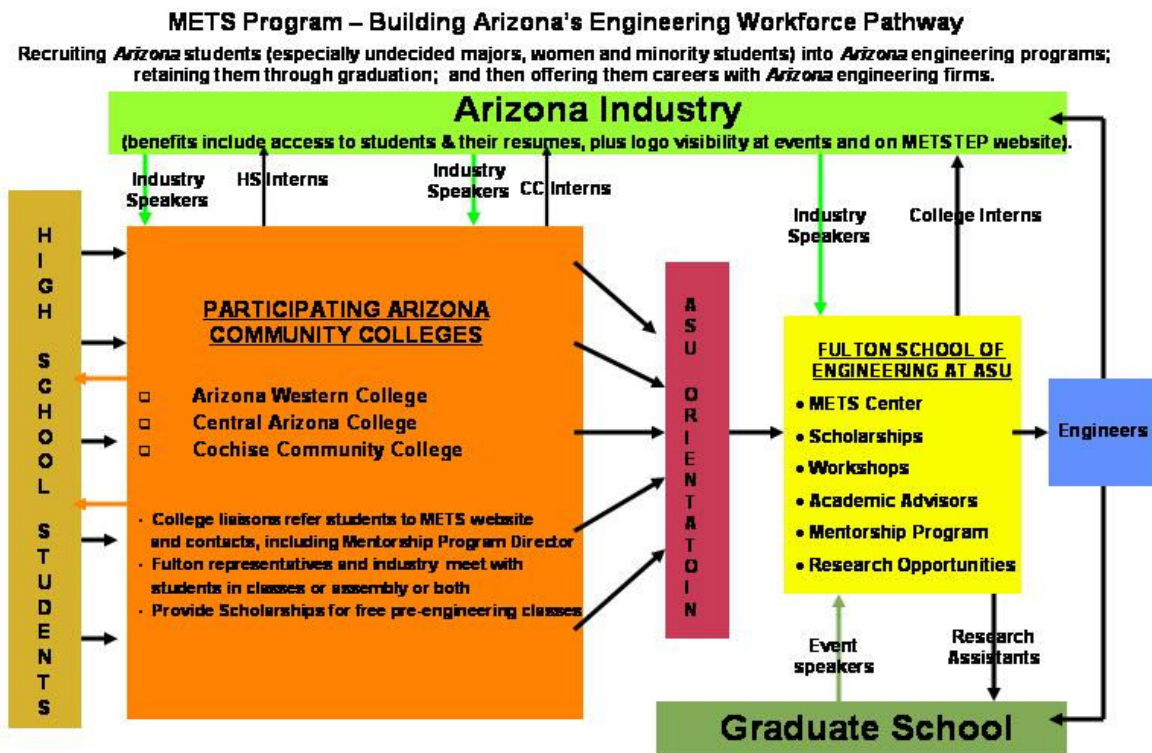
## I. Introduction

The objective of the Ira A. Fulton School of Engineering's *Motivated Engineering Transfer Student (METS) Program* is to support, encourage and motivate students (especially women and

underrepresented students) at three levels: 1) in engineering or math/science classes at the community college level, particularly in the metropolitan Phoenix area, 2) as engineering transfers to the Fulton School and 3) as successful graduating engineers. A new exploratory project funded by the National Science Foundation (grant # 0836050) is determining the effectiveness of expanding a program to *community colleges in non-metropolitan areas* across the state of Arizona by leveraging *high school and community outreach activities* with these colleges.

This effort is designed to help build a strategic supply-chain or local pathway that produces a diverse engineering workforce for our local companies by effectively connecting some of the important links in the pathway. The following diagram in Figure 1 shows the left-to-right progression of a student from high school (K-12 outreach activities), through their local community college (intro to engineering), to an Engineering Transfer Student Orientation at ASU, and finally as a student in the Fulton School of Engineering where there is a METS Center for their support. Throughout this process, Arizona’s industry is supportive, varying their

**Figure 1. Strategic Engineering-student Supply-chain for Arizona**



activity along the pathway: they donate their time to talk to high school and community college students about engineering, share information about their internships to university students, and then actively recruit the graduating engineering students to work for them. This industry is very supportive of growing Arizona’s diverse population of students to attend Arizona engineering programs, and then offering them careers at their Arizona companies.

Community colleges, both in the Maricopa County District (metropolitan Phoenix area) and across the state of Arizona (non-metropolitan areas), are the perfect institutions for Arizona's diversity of students to attend; students at the community colleges (CC) are more often first generation college students, who do not know what they want to major in, and who come from their local communities. The METS Program has successfully collaborated with faculty liaisons in the Maricopa County Community College District system to inform and to encourage students to pursue engineering. The Fulton School joined the CC faculty and industry engineers to meet with at least 300 students each semester on their campuses in a festive engineering event. A collaborative proposal was written and successfully funded through an NSF grant (proposal # 0315817). We also have an academic scholarship program (funded by the National Science Foundation: CSEMS grant # 0324212 and then S-STEM grant # 0728695) for transfer students which has resulted in a retention and graduation rate of over 92% and a yield of 26% of the graduates going on full-time to graduate school. Each semester the transferring students are invited to attend an Orientation on the ASU campus to learn about transition requirements and more about university life; between 20 and 40 students have attended this event each semester. When they come to ASU, these engineering transfer students have a place (the METS Center) to call home while they get acclimated to the campus and its resources. More than 100 students use the METS Center each semester.

## **II. Exploratory Non-Metropolitan Community College Effort**

In this exploratory program just begun in Fall 08, we are working with newly-established partnerships with faculty liaisons on *non-metropolitan* CC campuses, with an emphasis on women and underrepresented minority students. In developing this program we draw on our experience in working with six local CCs during the last five years. For a literature review on engineering and computer science CC transfer students see reference 1 and for more information on our work with CCs see references 2-9. An important aspect of a university/community college collaboration is to have a clear common objective: to produce more engineers with AS or AA degrees and then a BS in engineering (BSE) degrees. This means that when the university representatives are on the CC campus, they encourage the CC students to continue to study at the CC college as long as they can make progress toward an engineering degree, obtain the AA or AS, if possible, and then to transfer to the university and earn their BSE degree. High school students visiting the CC campus with their parents are encouraged by the university to attend their local CC. In this way the university can help the CC to recruit high school students. ASU offers mentoring to any high school student or CC student interested in engineering by an engineering student, usually a transfer student.

Recognizing that many CC students have not yet selected a degree program, the university can assist the CC in encouraging CC students to choose engineering or CS as a major. A good way to encourage undecided students is to have a panel of successful engineering students who were transfer students talk about their journey from the CC to the university. The most effective panel members are women or underrepresented minority engineering students who have transferred from that particular CC. A "Be an Engineer" event also includes an engineering representative to talk about the opportunities available with an engineering career, as well as an engineer from industry who can talk about engineering careers. The students are also told that an orientation session just for engineering transfer students is held each semester at ASU and that a METS Center on the ASU campus is there for transfer students for informal counseling, studying, using

computers and free printing, and socializing with other transfer students, as well as forming study groups. In addition, ASU transfer students are available at the METS Center for mentoring the new transfer students either informally or formally.

Many of the communities across the state of Arizona have a high proportion of Hispanics and are in or near Native American reservations, therefore providing the CCs with the opportunity to recruit from a diverse community of students. The project includes four steps. *First*, high school students and their parents are invited to engineering events at the local community college, co-sponsored by ASU. *Secondly*, after the community colleges' recruitment efforts, the engineering students need to be encouraged and hear again about engineering from a career standpoint at events and in classrooms on their CC campuses. Through these activities we will also reach undecided CC students who have not yet considered engineering. Encouragement is needed for each cohort of students to transfer to the university after completing their courses at the community college level. A mentorship program with college engineering transfer students is offered to all students who attend the project events. We are also providing six \$500 scholarships to each community college to encourage students to take pre-engineering courses and who intend to make engineering their major. *Thirdly*, during the transfer process, the Fulton school conducts two separate events: an Orientation Day and a Welcome Day, to help transfer students familiarize themselves with the campus and its resources. *Finally*, the Fulton school provides the transfer students with support through the use of a METS Center geared specifically for transfer students to study together and to reconnect with their CC cohorts. Since the METS Center is operated with transfer students as the staff, formal and informal mentoring is available for transfer students at all times. Workshops at the METS Center help students quickly identify the resources they need to complete their higher-level engineering course loads successfully, teach them a learning system to help them with a faster pace of classes, help them become interns at local technical companies, and finally enable them to graduate with either a Bachelor's or graduate degree as well-prepared engineers for Arizona's growing community of technology-based companies. Twenty-five \$300 scholarships for new ASU engineering transfer students (with or without unmet financial need) who complete an academic seminar series and complete the assignments should increase their retention. This academic seminar series also provides an optional one hour credit. This academic series has been very successful over the past five years for transfer students with unmet financial need who are selected for an academic scholarship program supported under the National Science Foundation CSEMS and S-STEM programs (grant # 0324212 and #0728695).

### **III. Three Non-Metropolitan Community Colleges**

The exploratory METS Program is with three community colleges and the Ira A. Fulton School of Engineering at ASU. The partnering community colleges are three new partnerships with *non-metropolitan* colleges who are eager to develop and/or implement their engineering programs (Arizona Western College, Central Arizona College, and Cochise Community College). Table 1 lists the enrollment figures for each college, emphasizing the opportunity presented by this partnership to encourage a large number of students to become aware of, consider, and finally pursue engineering.

Each college has established a program or an idea that needs the support of this partnership to provide the pipeline for its student output. The long-term goal is to be able to determine the

**Table 1. 2008 Enrollment figures for the participating Community Colleges**

	<b>AWC</b>	<b>CAC</b>	<b>Cochise</b>
<b>Number of students</b>	6701	5032	4573
<b>Ave. number of students enrolled in STEM classes</b>	1193	1905	1577
<b>Ave percent of women enrolled in STEM classes</b>	57%	59%	56%
<b>Ave percent of Native American students enrolled in STEM classes</b>	0.4%	14%	0.97%
<b>Ave percent of Hispanic students enrolled in STEM classes</b>	10.5%	68%	26.5%
<b>Ave percent of African American students enrolled in STEM classes</b>	0.4%	18%	6.5%

merits of the various programs and then to leverage these best practices to the other partnering colleges. The colleges and some of their programs are described as follows:

**Arizona Western College (AWC), Yuma, AZ (non-metropolitan community college)**

**Liaison – Rakesh Pangasa, Ph.D.**

Over ten years ago, Dr. Pangasa attended a two week summer program (sponsored by NSF HRD 98 72818) at ASU for faculty and counselors from community colleges and high schools to learn about engineering in order to help encourage students to consider engineering and computer science. The participants spent a week learning about the various engineering majors and then spent a week developing engineering modules that could be introduced in mathematics and science classes at the respective high schools and community colleges. Based on his experience at ASU, Dr. Pangasa has now developed a pre-engineering curriculum at Arizona Western (Community) College. He has developed a program with the local high school such that junior and senior students take community college courses for credit while in high school and thus are able to graduate with an Associate Degree in engineering within one year after graduating from high school. Each year, Dr. Pangasa has brought or sent potential community college transfer students to ASU for an orientation. In the past, ASU student members of the Society of Hispanic Professional Engineers have spent part of their holiday break speaking at the nearby Yuma High School about the opportunities in an engineering career. However, no “official” ASU engineering delegations had ever visited Arizona Western. AWC is a 3.5 hours drive from ASU.

This project is strengthening this supply chain by having an ASU delegation of faculty, staff, and successful transfer students (from Arizona Western, if possible) visit Arizona Western each semester to inform undecided students, encourage students thinking about engineering, and to help in the transition of potential ASU engineering transfer students. The event will include high

school students and their parents, as well as undecided community college students in a “Be An Engineer” Event. The ASU delegation will also speak to students in higher mathematics and science classes. It is expected that industry representatives will also help with the event. We know from personal testimonies that these visits are very helpful in giving students the courage to continue in engineering and to actually transfer to a large university, ASU.

*Key Programs at AWC that this exploratory project will leverage and/or implement to develop a strategic supply chain of engineering students:*

- Active collaboration with the Yuma Proving ground
- Support from the AWC engineering advisory Committee
- Presentations at local high schools

### **Central Arizona College (CAC), Casa Grande, AZ (non-metropolitan community college)**

**Liaisons – Jeffrey Bunkelmann, Ph.D. & Clark Van Gilder, recent hire to teach and work with engineering students. CAC is an Hispanic-Serving Institution**

This community college is deeply interested in developing a pre-engineering program as well as in building transfer bridges between their students and the Ira A. Fulton School of Engineering. The school now regrets having closed their engineering program seven years ago and are taking steps to reactivate the program. The college recently invited high school students and their parents interested in engineering to an Open House on the campus and were delighted with 70 responses. In this project, ASU engineering reps and student role models will visit the college each semester in such events with both high school students and their parents and students already at the community college. The event will include visits with community college students who are enrolled in math and science classes who will be released to attend the event in order to maximize the impact of the visit by ASU. We anticipate that several of the industries represented on the advisory board will also participate in the event to show the students that there are internships and job opportunities in Arizona for engineers and computer scientists.

*Key Programs at CAC that this exploratory project will leverage and/or implement to develop a strategic supply chain of engineering students:*

- Participate in CAC Engineering Open House events with high school students and their parents
- Visit with upper math and science students to help build their pre-engineering program

### **Cochise Community College (Cochise), Sierra Vista, AZ (non-metropolitan community college)**

**Liaison – Richard “Bubba” Hall**

This project is in perfect timing with the recent progress made at Cochise College in developing an engineering program. Cochise has developed the foundations for its Running Start Academy. Essentially, they created a pipeline opportunity for local high school juniors to start down a path to acquiring an associate’s degree in engineering. The plan is for these students to be able to

take classes both semesters of the junior and senior years of high school and to be able to complete their degrees the following year at Cochise. After that, Cochise would like to have a connection made to the universities where they will be readily admitted. These students, while in high school, will be enrolled in engineering courses that follow the Project Lead the Way curriculum. It is their hope that they can articulate these courses so the universities will readily accept them for transfer as intro level engineering courses.

Cochise also recently got approval and hired a full time engineering instructor/program coordinator. More importantly, the interest of local students and their parents have been overwhelming. They already have had 75 parents express interest in getting their children enrolled in this year's Academy. Things are moving at Cochise College and the timing is perfect for ASU to help support this pipeline for their students.

Throughout this project, an ASU delegation will make a visit each semester to the campus with ASU faculty, staff, and successful transfer students to meet with the high school students and parents, undecided community college students, and community college students already committed to a career in engineering.

*Key Programs at CCC that this exploratory project will leverage and/or implement to develop a strategic supply chain of engineering students:*

- Meet with students and parents in the newly formed Running Start Academy
- Encourage the new full time engineering instructor/program coordinator
- Inform undecided students, encourage engineering students, and assist with the transition of engineering transfer students to ASU.

#### **IV. Creating the Partnerships**

ASU worked successfully with six of the ten Maricopa County Community College District (MCCCD) schools. Liaisons had been identified at each of the independent colleges, as well as a representative from the MCCCD's office. A collaborative proposal had been written and successfully funded through an NSF grant (proposal # 0315817) for two years. The funding was stretched to three years and then with support from the university and local industry the METS Center has continued to be open and staffed. Although collaboration stills exists with some of the local CCs, these CCs have primarily turned their attention to recruiting more high school seniors for engineering since their numbers in this area have been down somewhat in the last few years. Each of the ten non-metropolitan CCs in the state of Arizona, spread throughout the state geographically, was contacted about their interest in a partnership to encourage more students to study engineering and computer science. A couple of the colleges are more technology and technician inclined, with no real basis for an engineering major. Other schools are interested, but lack the faculty, staff, and interest to support such an effort at this time. A fundamental step in forming a collaboration is to identify the right person at each CC who supports the collaboration and has the authority to make the decision to participate or has access to the person who can.

To help understand and to determine the nature of the pre-engineering program at each CC, a survey was developed and sent to each liaison. The survey asked for the CC's vision for a pre-engineering program, what staff were involved in a pre-engineering program, a breakdown of the total student population by gender and ethnicity, the total number of students in pre-



engineering/CS classes, including the percentage of women and underrepresented minority students, and how many miles drive their school was from the university.

A major point of early discussion between the university and the CCs was how a partnership could help to advance both the goals of the CC and those of the university. Since the Arizona non-metropolitan CCs range from about a one hour's drive to 3.5 hours or more, no university had previously come to the CCs to seek a collaboration. Understandably, the CCs were cautious to work with a university. A common fear from CCs is that the university feels superior and wants to take advantage of them by recruiting students away from the CC. This fear is understandable since ASU in recent years has put an emphasis on increasing their freshmen class and is building enough residence halls so that all freshmen can live on campus. This is a departure from the past since ASU has typically been a commuter school with 80% of its students being commuters.

Through many conversations the three CCs named above believed that we are in this together. The more CC students that receive a BSE is also a success for the CC. Recently the President of ASU has set as a goal the increase of the present number of transfer students each year at 5,000 to 10,000 in the next five years. Most of the 5,000 transfer students are from the MCCCCD. Very recently the President of ASU and the Chancellor of MCCCCD signed an agreement to work together on producing more engineering students with BSE degrees. As a part of that agreement, ASU will encourage students to stay at the CC for their AA or AS degrees. If engineering students are not able to make further progress in their engineering studies then hopefully students will be able to complete an AA/AS at ASU on their way to a BSE, but the CC will get the credit for the AA/AS degree. In this way the goals of both the CC and the university can be advanced.

Of course, a major step in forming a collaboration is funding to support it. After determining what financial support was needed for an exploratory project, a proposal was submitted to the National Science Foundation and funded (grant # 0836050). Writing the proposal included making sure that the objectives of this project fit the objectives of the funding that we sought. We tried to write the proposal carefully and to explain the project well. We had to discuss and think the project through to match the work of the project with a proper budget. Since the CCs were not used to working with a university and working with proposals to NSF, it was important to identify the research and grant personnel at the university and the CCs and to have them all work closely together. We learned that it is very important to understand the difference between partnerships and sub-awards and how to submit the budget for each.

## **V. Getting Started**

To get the project going, we planned to have a two-hour workshop visit to each of the four campuses of the three CCs each semester. The first meetings were planned by the ASU program director and the CC liaisons by phone and email. In retrospect, a visit by the PI and Director to each of the campuses before the first workshop might have been useful. The liaisons from two of the CCs were able to attend the Fall 2008 meeting of the ongoing Industrial Advisory Board that has been helping to support the METS Center and program at ASU and to provide representatives to the Be an Engineer events which were held at the CCs. We were able to make visits to three campuses for two of the CCs. Due to an error in the budget the money was not yet approved for the CCs in the fall and one CC did not want to hold events until they knew the money was available. We will try to make two visits to this school during the spring semester.

We learned that the audiences were quite different for each visit. The first campus visit was almost entirely with potential CC students and their parents, while the second campus visit was almost all with current CC pre-engineering students. The third visit was with a combination of average current CC pre-engineering students and adult learners with strong community ties in the community. Due to these ties, it is unlikely that they will go beyond an AA/AS degree because it would necessitate a move. See Table 2 for a summary of the visits.

**Table 2. Summary of Fall 2008 CC Visits**

<b>Community College</b>	<b>Driving Distance to University</b>	<b># of attendees</b>	<b>Demographics</b>	<b>Comments</b>
<b>Central Arizona College – Superstition Mountain Campus</b>	<b>1 hr.</b>	<b>25</b>	<b>High School Students and Their Parents</b>	<b>These pre-engineering families needed more general information on Engineering careers and education and fewer specifics on the transfer process.</b>
<b>Central Arizona College – Signal Peak Campus</b>	<b>1 hr.</b>	<b>40</b>	<b>Traditional Community College Learners</b>	<b>The Be An Engineer event was well received and met the needs of the audience.</b>
<b>Arizona Western College</b>	<b>3.5 hrs.</b>	<b>40</b>	<b>Mixed Traditional and Adult Learners</b>	<b>Traditional learners were well served by the event, but the path to a BSE degree for adult learners with strong community ties was not clearly explained by our presentation.</b>

## **VI. Accomplishments, Challenges, and Lessons Learned**

During the first semester of this program, an Advisory Board member gave \$10K to the program to provide additional lap tops for the METS Center, scholarship money for transfer students for two semesters, and travel money for additional trips to non-metropolitan CCs. The Academic Scholarship Program for transfer students offered an optional one hour credit for attending the six seminars in a semester and doing the assignments which are designed to retain the students, enlarge their vision of engineering, and to encourage them to go on to graduate school. The credit option also served as an additional incentive for transfer students, with or without unmet financial need, to take advantage of the \$300 scholarship offered through this program for participating in the seminars.

We have a good start on getting to know and on learning how to work with the liaisons of each campus. We received good evaluations from students and parents who attended the workshops. After talking with two students who did not rate the visit and presentation very high, we learned that these were adult learners who were disappointed because we did not offer any way that they

could obtain a BSE degree other than moving. Since these students were well embedded in their community, moving is not an option. Several students that we met on our visits are now being mentored by ASU transfer students. All of the students who attended the Be An Engineer events were invited to the Transfer Orientation held at ASU in December and will be invited again for the May Transfer Orientation.

Due to the time commitment to travel the long distance to some of the colleges, we have difficulty getting university students who can travel for most of a day to participate. University engineering and CS students often have very light class loads on Fridays, but CC students do not have any classes on Friday and so these commuting students are not on campus on Friday. The CCs have a majority of their classes on Tuesday and Thursdays. Similarly, the ASU students have quite a few classes on Tuesdays and Thursday. It was also difficult for the PI to go on each visit due to her Tuesday/Thursday teaching schedule. Due to the time to travel to the CCs, we plan to have longer and more extensive future visits than just one two-hour workshop.

We had difficulty submitting the correct request for the CC financial support in the grant. It has been a difficult process to get information and the actions needed from each CC to correct the error through a Supplemental Request. This issue has been resolved and subcontract money is now available to the CCs to pay for food and materials for Be An Engineer events held at the CCs and for transportation to ASU for the liaisons and students.

We learned that we need to bring a very versatile program to the CCs so that we can adapt to the audience. By spending more time on the campuses, we will be able to better meet the needs of all of those who are seeking information about engineering.

## **VII. Evaluation of CC Visits**

In general, the three visits were considered successes. The visits were the first for the university team to each of the schools and we became better acquainted with the liaisons. Comments from the students verified that the messages that we gave were of value to the students. Following are some comments from high school students contemplating engineering as a major:

- “The presentations reassured me that this is the way I want to go in life.”
- “realized there (are) a lot of engineering majors”
- “I learned that mechanical engineers do a whole lot more than I previously knew about”
- “I have learned there are many ways to go with engineering”

The following are comments from traditional CC students:

- I learned that ...“engineering has a lot of different fields”
- I learned that “you don’t use math all of the time”
- “didn’t know how many choices in the field and applications”
- “I learned how and what it takes to be successful”
- “Guest speakers had a lot of relevant information”
- “...it gave me motivation to keep on going...”
- “almost everything they talked about, I didn’t know”
- Favorite activity was “asking questions to people who have done it”

- “everything was perfect”
- I learned “not to fear math”
- I learned ‘what materials engineers do’
- My favorite activity was ‘learning what path engineers take’

Since we are aware that many potential engineering students do not know about some of the smaller areas of engineering such as industrial, materials, environmental, etc., we try to include information about these areas in our presentations. The comments above verified that the information was valuable to the students.

### **VIII. Solutions and Possible Solutions**

For the spring semester, the PI’s teaching load was reduced due to her research expenditures and so travelling to the CCs without missing a class will be easier for the spring. Since undergraduates have a difficult time finding large time slots to travel to the CCs, perhaps we can use some engineering graduate students who were once transfer students to assist in our visits. Research clearly shows that role models within about 5 years of age of the potential engineering student will have the most influence. Another role modeling possibility may be to video tape successful CC engineering transfer students and show the video to the students at the CC. The CC students should be able to relate to a video of a successful woman or minority transfer student from their CC. With the future support of ASU’s Global Outreach we will develop these interviews into a Webcast format so that students who cannot attend the scheduled events are able to access the information on their own time.

By visiting mathematics and science classes, as well as Intro to Engineering classes, and an open seminar on Be An Engineer, we will be able to visit many more undecided students. We need to be prepared with a very flexible presentation that can be tailored to our audience on the spot and to allow time for questions.

We hope that in the future we may be able to be instrumental in getting on-line engineering courses available to students that we met who are not able to move near a university.

We look forward to a successful spring semester while making an extended visit to each of the three CC schools.

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