METSTEP: Third Year Review

Dr. Mary R. Anderson-Rowland, Arizona State University

Dr. Mary R. Anderson-Rowland is the PI of an NSF STEP grant to work with five non-metropolitan community colleges to produce more engineers, but especially female and underrepresented minority engineers. She also directs two academic scholarship programs, including one for transfer students. An associate professor in Computing, Informatics, and Systems Design Engineering, Dr. Anderson-Rowland was the associate dean of Student Affairs in the Ira A. Fulton Schools of Engineering at ASU from 1993 to 2004. Dr. Anderson-Rowland was named a top 5% teacher in the Fulton Schools of Engineering for 2009-2010. She received the 2009 WEPAN Engineering Educator Award, the 2006 ASEE Minorities Award, the 2005 SHPE Educator of the Year, and the National Engineering Award in 2003. The National Engineering Award is the highest honor given by AAES. In 2002, Dr. Anderson-Rowland was named the Distinguished Engineering Educator by the Society of Women Engineers. She has over 180 publications primarily in the areas of recruitment and retention of women and underrepresented minority engineering and computer science students. Her awards are based on her mentoring of students, especially women and underrepresented minority students, and her research in the areas of recruitment and retention. A SWE and ASEE Fellow, she is a frequent speaker on career opportunities and diversity in engineering.

Dr. Armando A. Rodriguez, Arizona State University

Prior to joining the ASU Electrical Engineering faculty in 1990, Dr. Armando A. Rodriguez worked at MIT, IBM, AT&T Bell Laboratories and Raytheon Missile Systems. He has also consulted for Eglin Air Force Base, Boeing Defense and Space Systems, Honeywell and NASA. He has published over 200 technical papers in refereed journals and conference proceedings–over 60 with students. He has authored three engineering texts on classical controls, linear systems, and multi-variable control. Dr. Rodriguez has given over 70 invited presentations–thirteen plenary–at international and national forums, conferences and corporations. Since 1994, he has directed an extensive engineering mentoring-research academic success and professional development (ASAP) program that has served over 500 students. These efforts have been supported by NSF STEP, S-STEM, and CSEM grants as well as industry. Dr. Rodriguez' research interests include: control of nonlinear distributed parameter, and sampled-data systems; modeling, simulation, animation, and real-time control (MoSART) of Flexible Autonomous Machines operating in an uncertain Environment (FAME); design and control of micro-air vehicles (MAVs), control of bio-economic systems, renewable resources, and sustainable development; control of semiconductor, (hypersonic) aerospace, robotic, and low power electronic systems. Recently, he has worked closely with NASA researchers on the design of scramjet-powered hypersonic vehicles. Dr. Rodriguez' honors include: AT&T Bell Laboratories Fellowship; Boeing A.D. Welliver Fellowship; ASU Engineering Teaching Excellence Award; IEEE International Outstanding Advisor Award; White House Presidential Excellence Award for Science, Mathematics, and Engineering Mentoring; Ralf Yorque Memorial Best Paper Prize. Dr. Rodriguez has also served on various national technical committees and panels. He is currently serving on the following National Academies panels: Survivability and Lethality Analysis, Army Research Laboratory (ARL) Autonomous Systems. Dr. Rodriguez received his Ph.D. in Electrical Engineering from the Massachusetts Institute of Technology in 1990.

Ms. Anita Grierson, Arizona State University

Anita Grierson is the Director of the METS Center in the Ira A. Fulton Schools of Engineering at Arizona State University. She guides the activities of the METS Center and oversees its staff of engineering transfer students. Ms. Grierson has over twelve years corporate experience in Program Management, Business Development, and Biomechanical Engineering, with products as diverse as air bag systems for helicopters, body armor, and orthopedic implants. She received her bachelor’s degree in Mechanical Engineering from the University of Michigan in 1990, her master’s degree in Mechanical Engineering from Northwestern University in 1994, and a master’s in Business Administration from Arizona State University in 2000.
Dr. Richard A. Hall Jr., Cochise College

Dr. Richard Hall is the dean for Mathematics, Sciences, and Health Sciences at Cochise College. Under his leadership, Cochise has implemented and grown its engineering program. The college’s partnership with Arizona State University’s Motivated Engineering Transfer Students (METS) program has been an integral part of this growth.

Dr. Phil Blake McBride, Eastern Arizona College

Dr. John H Bailey, Eastern Arizona College

Dr. John H. Bailey is the engineering instructor at Eastern Arizona College and he has been there since 2006. Prior to joining EAC, Dr. Bailey was the engineering coordinator at Prince George’s Community College in Largo, Md. Previously, he worked as a consulting engineer at ARINC, Inc in Annapolis, Md. He has B.S. and M.S. degrees in Electrical Engineering from Rutgers University, and a Doctor of Science in Operations Research from George Washington University.

Dr. Rakesh Pangasa, Arizona State University

Prof. Clark Vangilder, Central Arizona College

In 1985, Clark Vangilder entered the Navy and became a nuclear submarine propulsion plant operator, serving for approximately six years. Vangilder has acquired degrees in Mathematics and Physics, and taught both subjects at the college level since 1998. Vangilder has been a professor of Physics at Central Arizona College since 2008. To promote and establish a new theory of learning, Vangilder began working on earning his Ph.D. in Cognitive Psychology in September 2011.

Dr. Russell Cox
METSTEP: Third Year Review

Abstract
This successful National Science Foundation supported five-year STEP program has come a long way in three years. Built upon several years of working with urban community colleges (CCs), this program was built primarily on a one-year preliminary study of a large university working with three rural community colleges. Specifically this program has a university and five non-metropolitan CCs working together to increase the interest, retention, and graduation of students in engineering and computer science who, before this program, had never interacted with university faculty and students. Females and underrepresented minority students are especially encouraged through this program. A large emphasis is also placed on having the students go directly to graduate school upon receiving their BS or BSE. The program includes scholarships for upper division transfer students from these five schools. The program is also supported by two NSF S-STEM grants which provide scholarship money for urban upper division transfer and non-transfer students, as well as scholarship money for four semesters of graduate school for students who have graduated through the program. In addition, this past year, urban transfer students were supported with scholarship money provided by a Women & Philanthropy group.

Major accomplishments are outlined, with an emphasis on the work that has been accomplished in the last year. The challenges that remain and future plans are also discussed.

I. Introduction
The need for more engineers in the United States has been known for several years. This need drew more public attention in June 2001 when President Obama put out the call and set a goal for at least 10,000 more engineers to be graduated each year in the US.\textsuperscript{1} At the end of August 2011, President Barack Obama’s Jobs and Competitiveness council made an announcement to help this short-term goal: more than 40 major companies agreed to double the number of engineering internships to help universities improve their retention rate of engineering students.\textsuperscript{2} The National Science Foundation joined this effort in September of 2012 by announcing a cooperative effort with the President’s Jobs and Competitiveness (Jobs Council) “to help increase the annual number of new B.S. graduates in engineering and computer science by 10,000”.\textsuperscript{3} This announcement came in the form of a Dear Colleague Letter requesting proposals for a “Graduate 10K+” grant for support up to $2.5M. The proposals were to be similar to the NSF STEP program already in place. Collaborations among two- and four- year institutions that smooth the transition to baccalaureate degrees were encouraged for the “Graduate 10K+”.\textsuperscript{3}

The first author started working with transfer students during the 2002-03 academic year with an academic scholarship program for upper division engineering students funded through an NSF S-STEM grant (#0123146) at Arizona State University (ASU). Of the first 23 engineering students
in the program, 12 were transfer students. This ratio showed that there was a need for a specific program for transfer students. The next year, with a second NSF S-STEM grant (#0324212), an upper division program was put in place just for transfer students. These programs have continued to present.\(^4\)\(^-\)\(^9\) The first author also began collaborating with local community colleges with NSF support in 2003 (#0315817). The “Collaborative Research: Maricopa Engineering Transition Scholars (METS)” program ran from 7/1/2003 to 6/30/2007.\(^10\) During this time liaisons were identified at six of the 10 Maricopa County Community College District (MCCCD) schools. “Be An Engineer” events were held at each of the Community Colleges (CCs) with ASU engineering and computer science faculty, staff, and students encouraging CC students to consider engineering and to encourage them to transfer to ASU’s Ira A. Fulton Schools of Engineering which includes computer science. In this paper, “engineering” shall include both engineering and computer science (CS). Open houses and orientation meetings were held at ASU for potential transfer students from the metropolitan Maricopa CCs. During this time a Transfer Center room was established to make new transfer students feel more at home at a large university.

At the end of this program we looked forward to broadening our scope to include non-metropolitan CCs. Arizona has 9 rural CCs and 2 additional metropolitan CCs in the state outside of the MCCCD schools. All 21 of the CCs and the three state universities, of which ASU is one, are linked together in a credit equivalency agreement and guide. Therefore, to consider working with CCs a little further away (45 minutes to over 3 hours one-way) seemed reasonable. To explore the feasibility of working with non-metropolitan CCs, we secured a small grant from NSF (#0836050).\(^11\) The funding lasted from 9/1/08 to 8/31/11 to support an initial partnership with three non-metropolitan CCs: Arizona Western, Cochise College, and Central Arizona. This new program was called Motivated Engineering Transfer Students (METS). We kept our METS acronym, but the “M” now stood for “Motivated” rather than “Maricopa”. We found very committed liaison leaders in each of these three new schools. We still continue our collaboration with the Maricopa Colleges.

Based on the success of our preliminary year with the three non-metropolitan CCs, we were funded for five more years of work with these schools with the addition of two more non-metropolitan CCs, Eastern Arizona and Mohave.\(^12\)\(^-\)\(^14\) The funding came through an NSF STEP grant (#0856834). The targeted students are enrolled in mathematics, engineering, and science courses at the five targeted Arizona CCs and their local high school (HSs). The partner CCs were selected because (1) they possess a significant pool of untapped engineering talent (a high percentage of women and underrepresented minorities) and (2) they have enthusiastically embraced our vision to reach out to students to attract them to exciting engineering careers. The METS project goals were to develops a supply-chain of high quality engineering students by 1) supporting the CCs’ HS student outreach activities, 2) supporting the CC engineering courses by providing materials, tutoring, local engineering speakers, and tuition scholarships, 3) conducting “Be an Engineer” events on the CC campuses to CC students and local HS students and their
parents, 4) following up with classes/workshops/seminars - exploiting time-tested techniques, assignments, as well as one-on-one and group mentoring - for all participants either via live broadcast or videotape, 5) providing an engaged community of mentors (with extensive experience and commitment) for all students, as well as remote tutoring and mentoring via phone, email, or Blackboard, 6) hosting an Orientation at ASU specifically for engineering transfer students, 7) managing a Fulton Transfer Center where engineering transfer students and their CC cohorts can study together and get the support needed to survive, and 8) working with (especially new) transfer students for success and learning through a “career shaping” academic scholarship workshop program.

III. METS Program Accomplishments

This project’s greatest strength is the passion and enthusiasm of the school leaders in helping more CC students learn about engineering, to choose engineering as a career, to help the students make a smooth transition to a university, and to support them after the transfer. ASU is enrolling more engineering transfer students in general and from the target colleges.

There has been a quite steady increase of upper division transfer students since Fall 2008 with a slight decrease in Fall 2011 and then a large increase in Fall 2012 as seen in Table I. The increase in upper division transfer enrollment is 183.5% from Fall 2008 to Fall 2012. The

<table>
<thead>
<tr>
<th>Term</th>
<th>Lower Division</th>
<th>Upper Division</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2008</td>
<td>77</td>
<td>109</td>
<td>186</td>
</tr>
<tr>
<td>Fall 2009</td>
<td>50</td>
<td>178</td>
<td>228</td>
</tr>
<tr>
<td>Fall 2010</td>
<td>66</td>
<td>268</td>
<td>334</td>
</tr>
<tr>
<td>Fall 2011</td>
<td>86</td>
<td>237</td>
<td>323</td>
</tr>
<tr>
<td>Fall 2012</td>
<td>91</td>
<td>349</td>
<td>440</td>
</tr>
</tbody>
</table>

Table I. Number of Lower and Upper Division Transfer Students in Engineering (excluding construction), ASU.

number of lower division transfers to ASU in engineering is holding quite steady. Our message when we visit a CC is to encourage students to stay at the CC until they can no longer make progress in their engineering program. When the students have taken all of the courses that will transfer for an engineering degree, they are then encouraged to transfer to a four-year engineering program. Through a joint ASU/CC effort, “METS Pathways” will soon be available which will list all of the courses that a student can take at their CC that will transfer for a particular engineering major, what courses can be taken at ASU and double counted towards a CC Associate Degree and a university BSE degree, and what additional courses need to be taken at ASU for a Bachelor’s degree. This information will greatly help direct students and advisors at both the CC and the university.
The increase in the number of student transfers from our target colleges is seen in Table II. By looking at fall semester transfer enrollments, we see that the number of transfer students has increased from 9 per year in 2008 to 27 in fall 2012 for a 200% increase. A small number of students transfer in the spring semester each year. Undoubtedly the ASU visits to these five colleges have also encouraged students to go into engineering who chose to transfer to another school. Common reasons for this are: relatives who live near the school providing a free room, reduced tuition at a particular school, being raised to attend another school as part of family tradition, and the addition of an on-line upper division engineering program by another university at one of the CCs. Students going into this last program will have to spend at least one year in residence at the university, but that cost is much less than having to spend two or three years at a university campus.

<table>
<thead>
<tr>
<th></th>
<th>Arizona Western College</th>
<th>Central Arizona College</th>
<th>Cochise College</th>
<th>Eastern Arizona College</th>
<th>Mohave Community College</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2008</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Fall 2009</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>Fall 2010</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>Fall 2011</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>19</td>
</tr>
<tr>
<td>Fall 2012</td>
<td>4</td>
<td>10</td>
<td>5</td>
<td>6</td>
<td>2</td>
<td>27</td>
</tr>
</tbody>
</table>

Table II. Number of Fall Engineering Transfer Students (excluding construction) from Five Non-Metropolitan CCs 2008-2012.

Although some of the schools did not keep track of engineering majors at first, the number of students choosing engineering as a major has increased at each school. At Eastern Arizona, the number of engineering majors has more than doubled in the past couple of years. The increase in students from Central Arizona may be partly due to the fact that the school is only 45 minutes away from ASU so students who were attending Central could attend classes at ASU without moving.

We have followed through and continue to work on all of the goals that we set for the project. We are working with high school students. We have visited high schools local to all of the CCs except for Central Arizona. We have participated in High School Days at some of the CCs. We have also interacted with Running Start students at Cochise (high school students taking mathematics classes at the CC). We are doing research on what there is about engineering that interests or does not interest high school and CC students. This is important work because most high school students know very little about engineering and/or have myths about engineering that prevent them from exploring engineering as a possible career. Many undecided CC students have a lack of knowledge or misunderstandings about engineering as a career.¹⁵

Included in the project is scholarship money that each CC can award to engineering students at their school. Some CCs are using their scholarships to encourage students to take an Introduction to Engineering course. As a requirement of the scholarship, students make a visit to ASU to see our engineering facilities and to meet our staff. CC students are impressed and have
a chance to correct myths by talking with successful transfer students from their CC. ASU also has scholarship money in this grant to support students from the five targeted schools when they transfer to ASU. Scholarships of $4,000 per academic year are available to these targeted students who meet the criteria. The minimum qualifications include: upper division standing in engineering, full-time, transfer engineering students with at least a 3.0 GPA, unmet financial need as determined by FAFSA, and US citizen, permanent resident, or refugee status. Each semester that students receive the $4K scholarships, they are required to take an Academic Success and Professional Development class. The number of these targeted transfer scholarships awarded each year at ASU has increased as can be seen in Table III. Historically, in our other scholarship programs, we have been able to award 60% of the scholarships to females, underrepresented minority students, or students who were both. This has become somewhat difficult as a large increase from one of the targeted schools included very few females. Females and underrepresented minority students made up 50% of the 2012-2013 METS scholarships.

When the METS program began, each student that qualified could be offered a scholarship. We are now receiving more applications than we can award scholarships. Some of these students then take the Academic Success and Professional Development Class and can earn $300 twice by successfully completing the class. We discovered during the Exploratory METS Project that $300 is enough money to entice transfer students, especially new transfers, to take a class that is good for them. Students who complete one or two semesters of the Academic Success class usually do very well academically and many are awarded a $4K scholarship the next year. Table IV shows the number of $300 scholarships that have been earned through the METS program.

<table>
<thead>
<tr>
<th>Scholarship Year</th>
<th>Females</th>
<th>Males</th>
<th>Minority: (Black, Hispanic, Native American)</th>
<th>Non-Minority</th>
<th>Total For Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009-2010</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2010-2011</td>
<td>3 (23.1%)</td>
<td>10 (76.9%)</td>
<td>0 (61.5%)</td>
<td>5 (38.5%)</td>
<td>13</td>
</tr>
<tr>
<td>2011-2012</td>
<td>3 (21.4%)</td>
<td>11 (78.6%)</td>
<td>10 (71.4%)</td>
<td>4 (28.6%)</td>
<td>14</td>
</tr>
<tr>
<td>2012-2013</td>
<td>4 (16.7%)</td>
<td>20 (83.3%)</td>
<td>9 (37.5%)</td>
<td>15 (62.5%)</td>
<td>24</td>
</tr>
<tr>
<td>Total</td>
<td>10 (19.6%)</td>
<td>41 (80.4%)</td>
<td>27 (52.9%)</td>
<td>24 (45.1%)</td>
<td>51</td>
</tr>
</tbody>
</table>

Table III. Number of ASU METS $4K Scholarships at ASU by Year, Gender, and Ethnicity

<table>
<thead>
<tr>
<th>Scholarship Year</th>
<th>Females</th>
<th>Males</th>
<th>Minority: (Black, Hispanic, Native American)</th>
<th>Non-Minority</th>
<th>Total For Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009-2010</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2010-2011</td>
<td>3 (27.3%)</td>
<td>8 (72.7%)</td>
<td>1 (9.1%)</td>
<td>10 (90.9%)</td>
<td>11</td>
</tr>
<tr>
<td>2011-2012</td>
<td>14 (28%)</td>
<td>36 (82%)</td>
<td>17 (34%)</td>
<td>33 (66%)</td>
<td>50</td>
</tr>
<tr>
<td>Fall 2012</td>
<td>5 (9.4%)</td>
<td>48 (90.6%)</td>
<td>17 (32.1%)</td>
<td>36 (67.9%)</td>
<td>53 (Fall only)</td>
</tr>
<tr>
<td>Total</td>
<td>22 (19.3%)</td>
<td>92 (80.7%)</td>
<td>35 (30.7%)</td>
<td>79 (69.3%)</td>
<td>114 (100%)</td>
</tr>
</tbody>
</table>

Table IV. Number of ASU METS $300 Scholarships by Year, Gender, and Ethnicity

The enrollment in the Academic Success and Professional Development Class has been growing steadily each fall when most of the new transfers enter engineering. During the last couple of years, the enrollment in this class has suddenly ballooned. The enrollment for the past several
semesters has been 98, 107, 121, 134, and then 179 for Fall 2012. In Fall 2012, 89 students were new to the class and 60 of these were transfer students new to the university. Of the 179, only 84 of the students had scholarships from one of these programs and therefore the other 95 students were in the class for some other reason. The reasons behind this sudden increase in enrollment are discussed in another paper. The 84 Scholarship students, each receiving $4,000 for the academic year, were required to take the course. These 84 students include 22 NSF STEP transfer students from the targeted non-metropolitan CCs (#0856834), 35 students in an NSF S-STEM scholarship grant for transfer students (#0728695), and 27 students on scholarship from an NSF S-STEM grant for non-transfer students and graduate students who graduated through the program (#1060226). The additional 95 students were primarily in the course due to positive word of mouth or because they were advised to take the course as a substitute for a freshman orientation course required of all new students. Additionally, some students had been sent to the course by their advisors to help them with their academics. The course has been effective in helping students academically and with time management through the use of the “Guaranteed 4.0 Plan” by D. O. Johnson and specific assignments. Starting in Spring 2013, the course changed from one credits to two semester credits. The students requested the change and it is warranted by the amount of required work in the course.

Largely due to the Academic Success and Professional Development class, we have about 95% retention to graduation with our scholarship students and over 50% of both transfer and non-transfer students going directly to graduate school to earn a Master’s or PhD degree in engineering or CS. Nationally less than 20% of all engineering graduates go right on to graduate school. It is good to remember here that ALL of the scholarship students have unmet financial need and historically at least 60% are female and/or underrepresented minority students. As we are now growing the non-metropolitan CC scholarship program we to have these same graduation and graduate school percentages hold true.

Building engineering programs at the CCs has been rewarding. Mohave CC added engineering to their major options during the 2011-2012 academic year. They hired a full-time professor to develop an engineering program for the first time. “Introduction to Engineering” was taught in Spring 2012 for the first time at Mohave to 10 students. Central Arizona plans to add an Associate Degree for Engineering next year. This will help students who wish to earn an Associate Degree at the CC, but do not want to have to take a lot of general education courses required for an Associate of Arts (AA) degree in the state of Arizona. Many of the general education courses do not transfer into an accredited engineering program. Students with an AA degree may still have more than three years or more of work to get an accredited engineering degree at a four-year school. The other CCs, Cochise in particular, have been helpful with the sharing of materials and the encouragement to offer engineering classes even though the enrollment is small to begin with. Cochise offered mathematics and engineering classes independent of enrollment when they started to expand their engineering program and now has good enrollments in all of their mathematics and engineering classes. As a part of this project,
Cochise has added instructors in engineering and engineering-related classes. The ASU Associate Dean for Academic Affairs, a member of the Arizona Transfer Credit Committee, has helped Mohave in giving advice for getting their courses approved for transfer.

Although we thought that we would reach non-metropolitan CC students through Engineering Days (since this had worked quite well for local CCs), we soon learned that captive audience classrooms at non-metropolitan CCs work much better for getting the message of engineering to their students, most of whom know very little about engineering. Invited meetings, even with the offer of food, did not work well at the rural CCs. We have been able to win over math, science, and engineering instructors to give us more than just a few minutes of time in their class once a semester. After the instructors heard our message to the students of how important math and science classes are and see the enrollment increasing in their STEM classes, they are usually quite welcoming the next time we visit.

We are visiting each community college at least once each semester. Since four of the five colleges are more than three hours from ASU, we try to cover as many classes in one day as possible – sometimes nine or more. It is a long day, but well worth the effort in increasing the students’ understanding about engineering studies and careers. We were the first university to make visits for engineering to these schools and are constantly finding students who have myths about engineering or know very little about it and are excited to talk to engineering faculty from a university. We have learned that if ASU makes a visit to a CC shortly before the CC takes a van of students to ASU, the number of students interested in going is increased. We now try to schedule the CC visit each semester before the CC students of that school visit ASU.

The CCs have been very supportive in bringing students to ASU each semester and each CC has been encouraged to require that their scholarship students make a visit to ASU. In fact, the number of visiting students is large enough from our five target schools that we have them come on two separate days so that we have a better opportunity to talk with students individually.

When the CC students come to visit, we have transfer students with each major available to take the CC students on a tour and to sit with them in the Center for lunch. We also try to have transfer students from each of the visiting schools on hand to talk to the students. CC students are advised to make an appointment with a departmental advisor during the ASU visit.

In addition, we continue to host visits from the local Maricopa County Community Colleges District (MCCCD), as well as to visit their campuses. The CC campus events “Be An Engineer” Days still continue after they were initiated through previous NSF grants.

The METS Center is growing. There were over 300 students enrolled in the Center for Fall 2011, up by 64% from Fall 2010. Nearly 400 students used the METS Center during the 2012-2013 academic year. Beginning in Fall 2009, every student who wished to use the Center was required to re-enroll each semester, rather than just register once. The change was made to assure up-to-date contact information was available for each student. Our usage numbers cannot realistically
climb higher than the current 40-45 students per day because of space capacity. We have made our conference room available by reservation for study groups. The Center holds workshops (in addition to the Academic Success Class) and the Director puts out a weekly newsletter to METS enrolled students. This newsletter has a topic of the week and reminders of future meetings and opportunities.

Formal mentoring programs have not gone well for students still at the CC. The CC students may request an ASU transfer mentor, but usually do not respond to the mentor assigned. Perhaps at the time of an ASU visit a mentor sounded like a good idea, but later the interest dwindled. However, the informal mentoring that is done by the transfer student workers in the METS Center, as well as the METS Director, PI, and co-PI, has gone very well. A structured mentoring program was implemented during the Fall 2012 semester with first and second semester transfer students in the Academic Success Class required to identify an “older” volunteer transfer student mentor. The volunteer mentors and the mentees each earn credit towards their 10 hours of volunteer work per semester that is required by the Academic Success Class. Also a closed “facebook” was tried with Central Arizona to promote dialogue between CC and ASU METS students. Although there was some success, we are still working to better the mentoring of students. Both the PI and the METS Director have had several students come to them with problems, asking for advice. We have been able to help in most cases, but have also sent students to the University Counseling Center for assistance.

The transfer students have been encouraged to do internships and research projects. Co-PI Dr. Rodriguez has led the research team effort. Eleven of the 13 transfer scholarship students in the 2010-2011 year have had internships or a Fellowship to cover all expenses. For example, a Cochise student, who graduated in EE from ASU, is now supported by a Fellowship Program while he works on his PhD. A Central Arizona student has a highly coveted undergraduate SMART Fellowship to cover his expenses.

An extensive website is being developed. Many features are already online and additional features are in process. Over 136 “critical questions” have been initially identified by the PIs and students. The students were asked to pick their top twenty questions. From this we found the top five questions selected by each group according to gender, ethnicity, and academic class standing.18,19 The questions are available through our METS website:

http://mets.engineering.asu.edu/events.html

The goal of making transferring easier to ASU from the CCs, is being enhanced by the activities first of the ASU Community Partnership Office and now by the University Curriculum Office. They are addressing problems that we identified early on. “METS Pathways” are being developed for each ASU engineering and CS major for each CC to show exactly which classes taken at that CC count for the ASU engineering major and what courses can be taken at ASU for the engineering degree and at the same time transferred back to the CC for the student to earn an
Associate Degree. As mentioned earlier, the Arizona Associate Degrees at CCs include many education credits that do not count toward an engineering degree and the CCs do not offer all of the engineering courses required for the first two years of the ASU curriculum. These METS Pathways will not only be very valuable to the potential transfer student, but also for CC and ASU counselors to help guide students.

The PI and co-PI write recommendation letters for the students to be accepted into a 4 +1 program at ASU, Graduate School at ASU and elsewhere, for scholarships, and for Fellowships. The 4+1 program at ASU has been very helpful in encouraging students to go directly to graduate school since, if accepted into the program, the students can take two or three approved courses that will double count in their Bachelor’s and Master’s degree programs. Over 50% of the scholarship students with our S-STEM scholarships have gone directly to graduate school. We hope to match that rate with non-metropolitan transfer students.

There are twenty-one publications related to this grant. Most of them were presented at national conferences. The PI and co-PI of the CIRC/METS and ASU METSTEP grants were invited to present an hour workshop on how to build comparable programs between two-year and four-year schools at the national AAC&U Next Generation STEM Conference in November 2012. They were also invited to give a 90 minute workshop in early 2013 at a national NISTS meeting for participants interested in building collaboration programs between CCs and universities. In March 2013, they gave a 90 minute invited workshop on the recruitment, retention, and graduation of transfer students at an NSF STEP grantee conference.

IV. METS Challenges

The three hour plus drive to four of the schools will always be a challenge. However, the PI and co-PI have arranged their schedules so that Wednesday is a good day to drive to one of the schools. The 12 hours plus day is exhausting, but worth it in terms of the students reached. We visit as many classes as possible, and perhaps a high school, during the day. In addition, Cochise CC has two campuses and Mohave has three, which are 60 miles apart. In this case we visit two different campuses each year. We received evaluation forms from about 300 students from Fall 2012 visits.

We had hoped to interact more with parents of high school students to help them encourage their child to consider engineering as a career. A meeting held at Central Arizona with much publicity yielded only a few participants. Eastern Arizona has brought in 70-85 local high school students along with a few parents to their campus the past two years and we have had two ASU METS reps talk to the students during their lunch time. At least 75% of these students were minority students. During a recent ASU campus visit, a CC PI brought along a parent with his son and a friend to learn more about engineering.

It is difficult to count how many engineering “majors” are in the pipeline at any CC. Some of the CCs do not have an engineering major or an Associate Degree that is just engineering. Even
if the school does have an Associate Degree in engineering, many CC students interested in engineering do not declare the engineering major nor earn this degree. They take CC classes and then transfer to a four year school to get their engineering degree. With the addition of the Associate Degree in Science/Engineering at some of the CCs, we should be able to have a better idea of how many students are actually interested in pursuing engineering.

Although it is inevitable, through our efforts, CC students are becoming interested in engineering, who do not transfer to ASU. It is a shame that only if the student actually transfers to ASU do our efforts count. It would be very helpful if CCs had a system that tracks where their students go and what they major in after they leave the CC.

The scheduling for real-time webcasts between ASU and the CCs has not worked due to the differences in the times that classes start and are offered. Classroom visits are better than invited meetings for people “interested in engineering.” Even the promise of food does not bring many students out to such general engineering meetings.

A challenge for the CCs is to be willing to offer courses related to engineering even if there are not enough students to “make” a class as usually defined. At one CC, the institution has not committed to run class sizes below 7 for economic reasons. Their critical engineering classes have not been offered. To develop an engineering program the students need to know what courses will be offered each semester. Recent changes in administration however, present a new opportunity to address this issue with the hope of obtaining commitments to endure low enrollment for a few years in order to establish the presence of the program. A new degree program is being crafted and hopefully the school will pledge to tolerate low enrollment to get the program started right. Cochise College is a good example of a school which did this. After offering engineering courses even though the enrollments were low, the engineering students came and now Cochise has good attendance in all engineering-related courses.

At least one of the CCs had some long-running shortcomings in producing reliable data. The required reporting to NSF was a welcomed catalyst for quick changes. Delays and errors in data formulation were an issue in the past that has seemed to mostly evaporate at this point.

During the METS project there have been major administrative changes at four of the five CCs. Administrative changes have made continuity difficult at times and one school got a slow start because of this. At this point each school has a dedicated and committed lead and at least one supportive administrator at their own institution. The meeting each fall with the internal board of school leads has proved invaluable. The annual spring meeting with leads and the head academic administrator from each school has also proved to be very valuable with supporting good communication and sharing of ideas. An External Advisory Board also attends the spring meeting. An external evaluator attends both the fall and spring meetings.

A continual challenge is to obtain continued funding for scholarships and the METS Center at ASU. The METS Center is at capacity. As the program has become known in the CCs, more
qualified students are now applying for the scholarships than we have available. Although the program can continue without scholarships, the financial support is sorely needed by most of the students attending CCs: unmet financial need is a major reason for students to attend a CC. This past year we obtained additional funding from the ASU Women & Philanthropy group to support scholarships for upper division transfer students at ASU.

V. Summary and Future Plans

In general, we believe that the METS collaboration is going well. The number of engineering students is growing at the university and at each of the targeted five non-metropolitan CCs. An engineering program has been established at the one non-metropolitan CC which did not have one at the beginning of the project. We would like to expand our efforts and include two additional nonmetropolitan Arizona CCs, one of which is in the process of establishing an engineering program.

We are breaking down some of the myths that CC students have about engineering and ASU. We are seeing some CC students transferring to ASU after they first transferred to another school due to low tuition, because they later learned that the good engineering program major they expected to find there does not exist. Some students listen to several talks about engineering and make more than one visit to ASU before finally deciding that they wish to pursue an engineering major at ASU.

We want to improve our communication with the CCs by doing special video conferencing at times that work for the CC. We had hoped to telecast the Academic Success and Professional Development classes to the CCs, but the ASU times do not work for the CCs.

With the committed and passionate professors we have in the project, we know that we will continue to do good work.

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