
AC 2011-2193: STEP GRANT CHALLENGES AND RESULTS:

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Dr. John H Bailey, Eastern Arizona College

Dr. John H BAILEY (Jack) is the Director of the Eastern Arizona Community College METSTEP program. Jack is the engineering instructor at Eastern Arizona College. He joined Eastern's faculty in 2006, after teaching at Prince George's Community College, in Largo, MD. Prior to his teaching career, Jack was a Technical Director at ARINC, Inc, of Annapolis Maryland, an engineering consulting firm. Jack earned BS and MS degrees in Electrical Engineering from Rutgers University, and a D.Sc. degree from The George Washington University in Operations Research.

Ms. Anita Grierson, Arizona State University

Anita Grierson, AZ State University ANITA E. GRIERSON is the Director of the METS Center in the Ira A. Fulton School of Engineering at ASU. She is now in her third year of guiding the activities of the METS Center and overseeing its staff of primarily transfer students. Ms. Grierson has over 10 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 Bachelors Degree in Mechanical Engineering from the University of Michigan in 1990, her Masters degree in Mechanical Engineering from Northwestern University in 1994, and a Masters in Business Administration from Arizona State University in 2000.

Dr. Rakesh Pangasa, Arizona Western College

PAKESH PANGASA is the PI of the Arizona Western College METSTEP program. After practicing industrial R&D management in cement, concrete, and construction industries for 14 years at the Cement Research Institute of India, he switched, in 1986, to teaching, training, and consulting. Since then he has been engaged in teaching mathematics and engineering at Arizona Western College and has taught

at all the three state universities in Arizona. He has also taught undergraduate and graduate students in business administration, information systems, operations management, and strategic management for Northern Arizona University and for Webster University at their campuses in Yuma, Denver, Vienna and Shanghai. He has also worked as commissioning engineer for FLSmith training operators at a few plants of American Electric Power, and as Senior Computer Systems Analyst for Yuma proving Grounds on Future Combat Systems Software Interoperability. In his efforts towards motivating high school students to explore engineering, he has launched the first Yuma community robotic team for regional competition. His research interests and passion include building strong relations amongst academics, research and industry. He earned his Bachelor's Degree in Chemical Engineering from Panjab University in 1971, and Ph.D. in Industrial Engineering from Indian Institute of Technology (IIT) Delhi in 1986.

Prof. Clark Vangilder, Central Arizona College

Clark VanGilder, Central Arizona College CLARK VANGILDER is the PI of the Central Arizona Community College METSTEP program. Clark is a former Naval Nuclear Propulsion Plant Operator prior to receiving a Bachelors Degree in Mathematics from Grand Canyon University in 1995 and a Masters Degree in Physics from Arizona State University in 2004. Central Arizona College hired Clark in 2008 to take over the Physics program as well as resurrect the pre-engineering program in conjunction with two separate grant opportunities, one including the exploratory STEP grant that has evolved into MET-STEP. The introductory design course has been articulated in that time frame and successfully conducted four times now. Additionally, Clark has created new coursework in engineering programming (numerical methods) that are presently in articulation, with more courses in the works with an aim to creating an engineering associates degree program.

Dr. Phil Blake McBride, Eastern Arizona College

PHIL MCBRIDE is the PI of the Eastern Arizona Community College METSTEP program. Phil has taught chemistry at Eastern Arizona College since 1991. He served as Science Division Chair from 2004-2007 and has served as Dean of Instruction since January of 2007. He supervises the divisions of Science, Mathematics, Nursing, and Fine Arts, oversees the Discovery Park Campus, and coordinates the Summer School and College for Kids program. He has served as the Arizona Science Teachers Association Region V director for the past 6 years and currently serves as the Membership Secretary. He is also a member of the American Chemical Society, Two-Year College Chemistry Consortium, and the National Science Teachers Association. In 2008, he was awarded the Rocky Mountain Region College Educator Award for Excellence in Teaching from the American Chemical Society. He has been instrumental in helping find means for K-12 teachers to attend professional development conferences in science. Phil is currently preparing a summer science camp for high school students this year in an effort to excite students about science and lead them to further their education in a STEM field. He is an annual presenter at the Tri-County Teachers Academy workshops. Phil has presented papers at numerous chemistry conferences across the nation and is a strong advocate for STEM education wherever he goes. Phil received a B.S. in Education with a major in Chemistry from the University of Arizona in 1986, a Masters Degree in the Teaching of Physical Sciences in 1989 from Northern Arizona University, and in 2003, he received his Ph.D. in Chemistry with a dual emphasis in Organic Chemistry and Chemical Education from Miami University.

Dr. Richard A. Hall Jr., Cochise College

RICHARD (BUBBA) HALL is the PI of the NSF Cochise Community College METSTEP program. He is the Dean of Mathematics and Science at Cochise College. He has worked with the ASU METS program since the Fall of 2007 to build a pathway for Cochise College engineering students to Arizona State. Under his supervision, Cochise College has developed an Associate of Science degree in Engineering along with introductory and programming courses for engineering. Dr. Hall also plays an important support role in the Running Start program. Most importantly, a team of math, science, and engineering instructors has been formed to help lead all engineering efforts at Cochise. JoAnn Deakin, Feng Yang, and Kristy Ritter have all played important roles in the progress made up to this point.

STEP Grant Challenges and Results: Motivated Engineering Transfer Students From Non-Metropolitan Community Colleges

Abstract

In Fall 2009, a National Science Foundation (NSF) STEP grant award (# 0856834) was made to support a collaboration between a Research I University and five rural (non-metropolitan) community colleges (CC). The grant followed a smaller NSF grant (# 0836050) which supported the exploration of a four-year school working with three rural CCs.

This paper will first look at the enrollments of transfer students in engineering and computer science at the university for the past seven years. Large increases have occurred in the past two years. An analysis of the smaller transfer enrollment increases from the five non-metropolitan community colleges will then be discussed.

This paper will describe the challenges, lessons learned, and results of the program for its first year and a half of existence. The primary challenge was known before the project began: only one school is within an hour's drive of the four-year institution. The other four schools are three to four hours distant. In spite of this, strong collaborations and interactions are occurring between the schools. The paper will describe participation in high school recruitment, presentations in classrooms, student feedback from class room visits, and the advantages of being available at a table in the student union so that students can come by and ask questions. The paper will also discuss the changes that have taken place in the community colleges to better support their programs in engineering and computer science.

I. Introduction

Motivated by the growing shortage of engineers in the United States and in Arizona, the Ira A. Fulton Schools of Engineering at Arizona State University (ASU) wrote a successful proposal for an academic scholarship program funded by the NSF CSEMS program (grant # 0123146) in 2002 for upper division engineering and computer science students, with an emphasis on women and underrepresented minority students. This program was called CIRC (Collaborative Interdisciplinary Research Community). Eleven students of this first cohort of 22 happened to be transfer students and these transfer students spoke of all of the challenges and barriers they

faced as new transfer students. Based on this, a second successful NSF CSEMS proposal was written for upper division engineering and computer science students, but this time for transfer students, again with an emphasis on women and underrepresented minority students (grant # 032412). The CIRC/METS (Motivated Engineering Transfer Students) program was established in fall 2003. Please note that the term “engineering” will be used for “engineering and computer science” forthwith in this paper.

Since 2003, ASU has been building its engineering transfer program. The first two CSEMS academic scholarship programs were followed with two S-STEM grants, one for non-transfer students (grant #0631189) and one for transfer students (grant # 0728695). The Fulton Schools of Engineering provide an excellent facility for a transfer center, called the METS (Motivated Engineering Transfer Students) Center. This Center, home also to the Academic Scholarship Programs, was established by an NSF METS grant (# 0315817) jointly written by the Maricopa County Community College District and ASU. Through this grant, a coalition was developed with five local community colleges, which received half of the grant money. The program under this grant supported “Be An Engineer” events at the community colleges (CCs) which included a panel of Fulton Engineering Students and a panel of engineers from industry to help encourage community students to consider engineering as a career. At the same time, the METS Center started hosting Transfer Orientation Days with a program and tour for visiting potential transfer students. The CCs also advertised the transfer scholarships and the METS Center to their students.¹⁻⁵

A time came when the local CCs wanted to go their own direction with more emphasis on recruitment, so ASU was able to obtain an Exploratory METS grant (#0836050) to explore the feasibility of a four-year research institution partnering with three non-metropolitan community colleges (Arizona Western College, Central Arizona College, and Cochise College) to encourage more students to engineering and to assist them with their transfer to earn a Bachelor of Science in Engineering degree or a Bachelor of Science in Computer Science degree. The obvious primary challenge of this collaboration was the distance separating the CCs from ASU. Although Central Arizona is only about an hour from ASU, Arizona Western and Cochise are each a good three hours distant. While planning and administrative work can easily be done by Internet and phone, with this distance, it is difficult to take students out of school for a full day to serve on a panel or to have the students from these rural areas visit ASU. These challenges and how we are working together in spite of them have been documented in other papers.⁶⁻⁷

In the fall of 2009, the METSTEP Program (Motivated Engineering Transfer Students Talent Expansion Program) was funded by the NSF STEP program (grant # 0856834). Conditional on passing a three-year check, this grant is for five years. The grant allowed the METS Center to continue as a resource for Fulton transfer students and continued the leveraging with two NSF S-STEM Academic Scholarship Programs. These scholarship students meet in the METS Center

conference room six times per semester (each meeting is held five times to accommodate all students). The METSTEP grant supports collaboration with five non-metropolitan CCs, the three already mentioned, and two additional rural CCs, Eastern Arizona College and Mohave College. The drive to Eastern is a straight shot of three hours. The drive to Mohave is a winding four hours at minimum.

We will take a look at the overall picture. First, is the number of transfer students increasing?

II. Transfer Enrollments

A few years ago, ASU's President, Dr. Michael Crow stated a goal of increasing the number of transfer students from 5,000 to 10,000. This emphasis fits one of the pillars of ASU: to reach out to the community. Along with this decision, a Vice Provost with an Office of Transfer Partnerships was hired in July 2009 to "help... create and sustain productive relationships with community colleges and other transfer institutions, on behalf of students who wish to complete their baccalaureate degrees". This university-level support has been very helpful to the engineering transfer programs. The Transfer Partnership Vice Provost is meeting with community colleges around the state. A course equivalency guide already exists linking each of the 21 Arizona community colleges with each of the three state universities. Therefore a student in any CC can learn from the equivalency guide which courses transfer with what equivalency at each of the state universities. Representatives from the universities and community colleges meet each year to update this guide.

The Transfer Partnership Vice Provost is in the process of making the transfer process more seamless and a "win-win" situation between CC and university. In some CCs there are not enough courses for a student to earn an Associates Degree in a particular area such as engineering. Rather than having the CC student stay at the CC taking courses that will not transfer in their major, agreements are being made that the CC student can transfer to ASU when there are no more relevant major courses and complete the Associates Degree at ASU (with the CC getting the credit for the degree) with these classes also counting toward a Bachelor's Degree at ASU. This is a win-win-win situation. The student is able to complete their Bachelor's degree in a shorter time, the CC gets credit for the Associate Degree, and ASU gets credit for the Bachelor's degree. This transfer of credits back for an Associate Degree already occurs now, but a clear guide and agreement is needed to make the process simpler and better known.

A second effort by the Office of Transfer Partnerships is creating Pathways for CC students. These Pathways are road maps for each major at a CC detailing the courses offered at a particular CC and showing the student exactly which courses are required for the Associates and Bachelor's degrees at ASU. In working with CC students, we have had a need for these curriculum road maps for several years and are delighted that we have begun working with the

Transfer Partnerships Office in Spring 2011 to develop these. These road maps will also make the counselors' jobs at both the CC and at ASU much simpler and empower the student to plan his academic career.

A third effort by the Transfer Partnerships Office is that a plan is now offered to graduating high school students that if they choose to go to a CC first, the student can contract with ASU that when she transfers to ASU as a junior, she will pay the same tuition as that of a native junior who started college at the same time. This tuition relief would be beneficial to all transfer students.

The enrollments at the community colleges continue to increase. Increases of 9% in enrollment were just reported for the Spring 2011 semester for the 10 Maricopa County Community College District schools. Table I shows the enrollment increases in just the past two years in the three CCs who have been in the collaboration since Fall 2008. As the CC enrollments increase, there are more potential transfer students for ASU. About 2/3 of the Ira A. Fulton Schools of Engineering (excluding construction) transfer students come from community colleges and about 80% of the transfer students are upper division students, our target students for this project. See Table II.

	AWC		CAC		Cochise	
	2008	2010	2008	2010	2008	2010
Number of students	6,701	8,545	3812	5036	4,573	5,252
Ave. number of students enrolled in STEM classes	1,193	1,818	306	886	1,577	1,786
Ave percent of women enrolled in STEM classes	57%	59%	18.4%	30.1%	56%	46%
Ave percent of Native American students enrolled in STEM classes	0.4%	2%	11.4%	21.9%	0.97%	1%
Ave percent of Hispanic students enrolled in STEM classes	10.5%	57%	14.6%	27.5%	26.5%	30%
Ave percent of African American students enrolled in STEM classes	0.4%	3%	20.7%	24.5%	6.5%	4%

TABLE 1. Enrollment figures for three participating Community Colleges since 2008.

	ASU	New Transfers Arizona State University					ASU UG Students
Fall	New Freshmen	Freshman	Sophomores	Juniors	Seniors	Total	Total
10	9,544	267	1,918	3,457	516	6,158	

ASU, Colleges of Engineering (Excluding Construction) New Undergraduate Transfers from 2 Year Institutions Fall 2010			
Division	Full-time	Part-time	Total
Lower	55	11	66
Upper	213	55	268
Total	268	66	334

TABLE II. Distribution by Upper and Lower Division Engineering Transfer Students by Full-Time and Part-Time for Fall 2010.

The transfer enrollment in engineering has been steadily increasing since 2009. See Table III. The transfer enrollment for Fall 2010 increased nearly 50% from Fall 09. The new freshmen numbers have increased similarly. The major increase has occurred in the junior class level as it should. The major increases in transfer students have come from three local community colleges that we have worked with since 2002. These three colleges had the following increases from Fall 09 to Fall 10: Mesa Community College, 30 to 53; Glendale Community College, 25 to 40; and Chandler Gilbert Community College, 21 to 28. Some students who begin in Central and Cochise transfer first to Mesa or Chandler Gilbert before transferring to ASU. Students from Mesa, Glendale, and Chandler Gilbert do visit the METS Center on Transfer Day held each semester especially for potential transfer students, as well as the five target schools.

		New Engineering Transfers (Excluding Construction)					Engineering UG Students (excluding Construction)
Fall	New Freshmen	Freshman	Sophomores	Juniors	Seniors	Total	Total
10	1,157	12	56	242	34	334	4,414
09	939	6	50	172	21	224	3,925
08	881	23	62	99	17	201	3,759
07	774	15	52	110	19	196	3,698
06	721	8	62	119	18	207	3,855
05	848	20	129	179	35	363	4,124
04	812	16	128	188	38	370	4,122

TABLE III. New Engineering Freshmen and Transfer Students by Class Level – 2004-2010

When we compare the engineering transfer student increases over the last few years with the university transfer student increase, we see that engineering's increases have been larger (Tables III and IV). Although both had lower transfer enrollments in 07 and 08, engineering rebounded better in Fall 10.

	ASU	New Transfers Arizona State University					ASU UG Students
Fall	New Freshmen	Freshman	Sophomores	Juniors	Seniors	Total	Total
10	9,544	267	1,918	3,457	516	6,158	56,562
09	9,344	279	1,702	2,977	430	5,388	54,277
08	9,707	360	1,887	2,820	379	5,446	53,298
07	9,274	302	1,593	2,640	375	4,910	51,311
06	9,052	287	1,647	2,754	375	5,063	50,755
05	8,467	311	1,793	2,899	392	5,395	48,955
04	7,719	277	1,712	2,978	407	5,374	46,670

Table IV. New University Freshmen and Transfer Students by Class Level – 2004-20

The increase in enrollment in our target community colleges has been slow, but is increasing. Table V shows the transfer enrollments from Arizona Western, Central, Cochise and other CCs, which are primarily CCs which are local to ASU. Many of the students who have received scholarships at the CC through the NSF grants are still at the community college and plan to transfer to ASU in Fall 2011.

ASU, Colleges of Engineering (Excluding Construction) New Undergraduate Transfers from 2 Year Institutions Last Transfer Institution Attended									
Institution	Spring 2007	Fall 2007	Spring 2008	Fall 2008	Spring 2009	Fall 2009	Spring 2010	Fall 2010	Total
Arizona Western College		1	1	5		7		4	18
Central Arizona College				2		2		5	9
Cochise College		4				1		3	8
Subtotal	0	5	1	7	0	10	0	12	35
Other CCs	57	139	66	125	54	142	83	213	879
Total	57	144	67	132	54	152	83	225	914

TABLE V. New Undergraduate Transfers from Targeted Community College from Spr. 07 – Fall 10.

When we first started to visit the rural CCs, the students had not had anyone from a university come to their school and talk about engineering as a major and a career. Many of the freshmen and sophomores had already decided where they would go for a transfer, such as a young woman from Arizona Western who had selected an engineering school in Texas which had nearby facilities for her to take her horses with her to college. Some students have learned about engineering from our presentations and have gone to an engineering school other than ASU. As we continue to visit the schools and talk to more freshman, sophomores, and juniors, and more of

these students visit ASU, the engineering transfer enrollment at ASU should increase from these schools.

III. Initial Expectations with Exploratory Grant and Accomplishments

Initially, the goal of the ASU team was to work in a collaborative with non-metropolitan community colleges to help strengthen or begin an engineering program, to visit community college classrooms to excite undecided students and to encourage students already pursuing engineering, to help the CCs recruit high school students to their school in engineering, and to have the potential CC transfer students visit ASU before they transferred to ease the transfer process. We also expected to continue to support and to encourage the students through the Academic Scholarship Program and the METS Center after they transferred. In addition, we wanted as many as possible of these transfer students to go right on to graduate school full-time after they graduated with a Bachelor's degree. We believe that we are continuing to accomplish these expectations.

The initiation expectations were a bit different for each community college. Arizona Western College wanted to explore opportunities to strengthen the AWC Engineering Program by improving its outreach activities to local high schools and to strengthen ties with ASU; thereby ensuring a seamless transfer of AWC engineering students to ASU. Scholarships were awarded to six students in the summer of 2009 and to two students in spring 2010. In order to attract more students for scholarship awards, the scholarship amount was increased from \$300 to \$600. Field trips to ASU or colleges of engineering at other universities were identified as a requirement for the award of the scholarship; eight students travelled to Tempe. To ensure better student success in Fundamentals of Engineering Design, the co-requisite of Pre-calculus has been changed into a pre-requisite and Calculus I has been made a co-requisite. Local high school students and advisors at these schools are invited to participate in "engineering celebrations" where AWC engineering students demonstrate a performance of their semester projects. ASU professors, the METS Center Director, and some ASU students have participated in such events.

Central Arizona wanted to figure out how best to conduct outreach programs and to revive a dormant engineering program. There were definitely successes and failures in that regard; mostly successes as they quickly learned how to tune the presentation to students and optimize campus resources and scheduling. The exploratory grant made it possible to leverage new engineering course creations from another grant with scholarship monies from the exploratory grant.

Cochise College started the efforts to build an engineering pipeline from the high school to the university level in Fall 2007. This pipeline from the high school to Cochise initially centered

around the foundation of the Running Start Academy on the Sierra Vista Campus. This academy has engineering as its focus. It was also along this time that ASU METS contacted Cochise College expressing interest in a collaboration effort to help students get into community college engineering programs and then on to ASU.

Cochise College had two expectations when it entered into the partnership with ASU's METS program in 2008. The institution was looking to establish a relationship with a state university to assist Cochise students in the acquisition of bachelor's degrees in a STEM field. Cochise College was also looking for a university partner who would actively recruit students into our engineering program.

The first NSF grant allowed Cochise College representatives to attend two advisory meetings during the 2008-2009 academic year. These meetings created an opportunity to form a network necessary to make the partnership between Cochise College and Arizona State University sustainable. In the Fall 2008 semester, Cochise College hired a person to lead the effort in building its Engineering program. This director also serves an important role in teaching and mentoring Running Start students who are enrolled in Physics and Engineering classes. Eight scholarships were awarded between \$300 and \$500, half of them to minority students. ASU representatives visited both the Sierra Vista and Douglas campuses and a joint visit to Douglas High School was made by Cochise and METS representatives. Cochise College also created its Associate of Science Degree in Engineering during the spring semester of 2009. This degree included the newly created introductory level Engineering courses, EGR 101 and EGR 102.

We now discuss the expectations for the five year STEP grant that began in Fall 2009.

IV. METSTEP Expectations and Results

Arizona Western expected to increase the number of students enrolled in core engineering courses and to increase the numbers of students interested in visiting the College of Engineering at the three state universities.

Having successfully tuned our approach to outreach programming at the community college in the first phase, Central Arizona shifted their attention (in part) to high school outreach. This is a difficult problem on several levels: logistics, funding and outreach. Funding and logistics are obvious problems as funds spread thin in making initial contact with the high schools. Central had expected that this would be much easier than it proved to be. Recent developments with administration staff at Vista Grande and Poston Butte high schools in Pinal County are promising. There are tentative plans for two outreach events in early Spring 2011 to attract prospective students to the STEM areas.

For Cochise, the goal of the project was to get students into the engineering pipeline at the community college so they can continue on to universities to pursue bachelor's degrees. Progress for Cochise College is measured in students who enroll in the STEM classes that support engineering along with those who transfer to four year schools. Other goals of the project include a) maintaining the relationship that has been established with ASU; b) creating a network with other rural community colleges who are building programs in the STEM fields; and c) to offer scholarship incentives for qualified and capable students to pursue engineering degrees.

Seeing an increase in the number of students who enroll in Calculus I, II and III, Differential equations, Engineering 102, Physics 230 and 231 is very important. It is also important to Cochise College to be able to document how many student contacts are made by ASU through visits to our campuses by METS reps and having students visit ASU for orientations. Having more qualified students apply for METS/STEP scholarships is also important to Cochise College.

V. Successes: What has gone well so far?

Arizona Western's activities over the past year and a half have included: collaboration with ASU in terms of having ASU professors and students participate in AWC Engineering Celebrations at the end of the semester, a visit by ASU METS to AWC to encourage AWC STEM students to consider an engineering career, and a visit by AWC STEM students to ASU (also to the University of Arizona (UA) and Northern Arizona University (NAU)) for exploring engineering disciplines and transfer logistics. AWC experienced improved participation by their AEC Engineering Advisory Committee. Additional related activities include: bringing a 4-year Bachelor program in engineering to Yuma (AWC-UA BSSE), initiating engineering education at middle and high schools, and increasing the number of engineering internship assignments/projects in/around Yuma.

For Central College, by far, the campus visits to and from ASU have been excellent and continuously improving. The collaboration between community colleges has also been useful as we share our best practices.

Cochise College reports that the biggest change is the increased student interest in pursuing degrees in engineering. Student demand for STEM classes has increased as a result. Cochise College is eager to see how far this ride is going to go. This growing interest is also leading to other grant opportunities and partnerships with local high schools. The more we continue to invest in this collaboration the more our students are going to benefit.

The single most important aspect is the personal contacts made by ASU professors, students, and METS/STEP personnel. These relationships with our students are first developed when ASU reps visit our campuses and continue when our students are invited to visit ASU. It really shows that the university cares. Knowing that people from a university are interested in them, is very important for students, especially those from rural areas. This builds a level of comfort and

confidence. They can immediately see that there is another place where they can go, fit in, and find support.

It is gratifying to see the excitement in the eyes of our students when the ASU folks give of their time. These personal contacts give our students a feeling like they have "an in" at ASU. They know they have people who are there to help them and more importantly GUIDE them in their journey towards engineering.

It has also been beneficial for community colleges to share successes and challenges among themselves. This helps to build a stronger STEM program statewide. A collective effort to improve means the state, its students, and institutions of higher education all profit.

The ASU representatives have discovered that it is sometimes very difficult to get CC students to ask questions of them during a class visit. If a time later in the day when the ASU reps will be available for questions is announced during the class visit, several students will usually show up with questions and a request for more contact information.

V. Challenges: What has been more difficult than you originally thought?

Arizona Western has found that it has been more difficult than originally thought in encouraging students to submit the necessary paperwork for scholarships and other activities at AWC, as well as paperwork for admission, transfer, and scholarships at ASU or other universities in a timely manner.

As mentioned above, Central finds outreach to high schools is very difficult. In retrospect, it is easy to see that outreach to high schools is a more than full time job for a staff of people devoted strictly to that enterprise and funded for all of the necessary travel and incentives that high school administrations and students need. Specifically, high schools need funding to be certified for AP Mathematics – a feature that advances student success for STEM at the community college. Starting with Physics in the first term because the math requirement was already met during high school gives the student an opportunity to take more engineering courses at the community college prior to transfer. More high school students accessing community college services gives rise to the need for more scholarship incentive money. In short, a separate grant initiative is probably in order if progress in this area is to be made.

The biggest challenge for Cochise College has been overcoming logistical issues with setting up METS visits to our campuses and student orientations to ASU. The distance between the two institutions often causes time constraints and challenges for everyone involved. Other challenges include ways to create and maintain mentoring, support, and advising connections for Cochise College students with university students, professors, and advisors.

Other items to consider for improving include a) focusing efforts to recruit students who are enrolled in lower level math and science classes into engineering fields; b) providing different presentations to help attract students into engineering area; and c) creating non-traditional pathways for students who are place bound. During individual community college visits, the university should bring a range of people who are prepared to deliver, *short, but potent, testimonials, inspiration and reasons* for students to "rethink" the choices they may have made towards declaring a major or Associates degree. This means bring students, METS personnel and professors (and maybe even successful engineers).

The University needs to remind students that they can transfer back credit...to the community college for an associates. When they (University personnel) say it, somehow it means more than when we (at the community college level) say it. The University should also consider programs along the lines of 3 + 1 for students at the community college level that already have families and employment in the area. It should also consider distance learning opportunities for students who are locked to the area and cannot physically transfer to ASU.

VI. Results: What changes have taken place?

Arizona Western has more students showing interest in and inquiring about engineering and the curriculum time line. The Engineering Orientation (Field trip to colleges of engineering at universities) has been re-introduced and these are attracting more students. Joint sessions with representatives from ASU have helped in attracting students to engineering disciplines.

Central has two grants, one concurrent to the exploratory grant and a new one received last month which serves to support the pre-engineering program. Both grants have or will provide significant equipment resources for the engineering pathway. Enrollments are up significantly from previous years with a corresponding increase in STEM graduates.

Cochise has more students enrolled in pre-engineering classes (math and physics) so we are offering more sections more often. More students say they wish to be engineers or something in the math and sciences because they know that that is where the demand is for future workers.

The math department is also making major changes to its developmental math curriculum. The department is participating in the *Changing the Equation* program promoted by the National Center for Academic Transformation (NCAT). This module, software driven approach will allow students to progress quickly through the developmental math requirements while better preparing them for college level mathematics.

The networking with other community colleges is a benefit of the program. The best part has to be collaboration with the ASU METS program. Cochise College and its students are reaping the

benefits of ASU taking the time to come to our campuses to actively recruit students into engineering programs.

VII. Conclusions

By all reports, the partnership is doing well and students at the community college are getting excited about engineering. The cooperation among the CC and ASU representatives, CC staff, and CC instructors has been outstanding. It has also been gratifying to see the CCs help each other. Mohave College is in the process of establishing an engineering program. Central and Cochise have recently gone through setting up new courses and are helping them with content, texts, and ideas. The Academic Associate Dean of the Ira A. Fulton Schools of Engineering has also assisted Mohave with their materials for setting up an engineering program. This Dean sits on the Equivalency Guide Committee, the committee that needs to approve these materials.

As Dr. Richard Hall of Cochise stated: “This partnership will always be challenged with the time and distance between Cochise County (and the other community colleges) and Metro Phoenix. This is a challenge that we continue to work on because students benefit from our continued efforts to build the program.”

This project is leveraged by three S-STEM grant programs. In the past two years, the retention and graduation rates of the upper division transfer students in the S-STEM program have been 95%. This rate is in contrast with the overall 70% graduation rate for upper division transfer males and 60% rate for upper division transfer females in engineering. The engineering and computer science enrollment in Arizona community colleges is up for Fall 2010 (9% in Maricopa County) and the number of Fall 2010 engineering transfer students at the university has increased over 50% from Fall 2009. The program is doing well.

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