AC 2011-2296: EXPLORING COLLABORATIONS WITH NON-METROPOLITAN COMMUNITY COLLEGES TO GRADUATE MORE ENGINEERING AND COMPUTER SCIENCE STUDENTS WITH BACHELOR'S AND GRADUATE DEGREES

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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 METSTEP. 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.

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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.

Exploring Collaborations with Non-Metropolitan Community Colleges to Graduate More Engineering and Computer Science Students with Bachelor's and Graduate Degrees: Two Years Later

Abstract

In Fall 2008, the National Science Foundation (NSF grant # 0836050) funded a one-year grant (with a no-cost extension) to explore the feasibility of a four-year research institution working with three non-metropolitan community colleges (Arizona Western College, Central Arizona College, and Cochise College) to encourage more students to study engineering and computer science and to assist them with their transfer to earn a Bachelor's degree in these fields. The program involved communication (each CC is some distance from the university), joint high school outreach efforts, encouraging CC students, assisting with the transfer process, and supporting transfer students at the university.

Transfer students at the Ira A. Fulton School of Engineering at Arizona State University are supported by a Motivated Engineering Transfer Student (METS) Center where students can network, study, socialize, and receive informal mentoring. In addition, transfer students can enroll in an Academic Success Class for one credit and attend additional workshops which are held in the Center. Scholarship for over 30 qualified transfer students are provided each year through an NSF S-STEM Scholarship Program.

An experimental scholarship program, for transfer students who do not qualify for NSF S-STEM scholarships, was also evaluated. An emphasis in this project was placed on involving women and underrepresented minority students and encouraging students to go right on to graduate school, as has been done with all NSF S-STEM Scholarship Programs in the ASU Schools of Engineering.

The grant research showed that although there are challenges, a very vital collaboration can be held between a four-year research university and rural community colleges even though they are located one to over three hours distant from each other. A key to the success of the project was the passion of the community college liaisons, along with the passion of the university leaders. The success of this project was rewarded with a five-year (three-year plus possible two-year extension) NSF STEP grant (NSF grant # 0856834) which began in the Fall 2009. The new project continued the collaboration with the three community colleges in this project and added two additional non-metropolitan community colleges.

I. Introduction

In 2002 the first author began working with local community colleges (CCs). Collaborations were established and representatives from six CCs and the Ira A. Fulton School of Engineering at Arizona State University (ASU) worked together to encourage

high school students to begin their engineering or computer science (hereafter in this paper, the term "engineering" shall include both engineering and computer science) degrees at a CC, to encourage CC engineering students to continue to a Bachelor's degree, to make a smooth transfer to a four-year institution, to have financial support and resources available after transfer, and to encourage the students to go for a Master's or PhD degree full-time after graduating with a Bachelor's degree.[1-8]

In Fall 2008, we began to investigate how the successful activities developed with local CCs could be adapted, expanded, and modified to work with non-metropolitan (rural) CCs. The CCs chosen were Arizona Western College, Central Arizona College, and Cochise College. These CCs were not located close to ASU or any university and were from one to four hours distance by car. Central Arizona College is only about an hour distance from ASU. The trips to Cochise or Arizona Western take three-four hours. In addition, the CCs had never had professors, staff, and students from any university ever visit them. A primary liaison at each CC led the CC efforts.

The early results of this grant have been reported[9-11] and this paper will give a final summary of the results. The math, science, and engineering classes at each of the three CCs have been given a "shot in the arm" due to this grant. The exploratory project was originally scheduled for one year, but a two-year extension without additional funding was granted because the project got off to a slow start due to paperwork. The success of this project led to the funding of an NSF STEP grant to continue the work with these three CCs plus two additional rural CCs.

Since 2003, transfer students at the Ira A. Fulton School of Engineering at Arizona State University have been supported by a Motivated Engineering Transfer Student (METS) Center where students can network, study, socialize, and receive informal mentoring. Since 2002 scholarships have been provided for qualified transfer students through an NSF S-STEM Scholarship Program (formerly CSEMS Program). Currently, over 30 upper division transfer students in engineering are supported with a $4,000 scholarship for the academic year. Students must be enrolled full-time in engineering, have at least a 3.0 GPA, have unmet financial need, and be a US citizen or permanent resident. In addition, transfer students enroll in an Academic Success Class for one credit and attend additional workshops which are held in the Center. A continual emphasis in working with transfer students is to encourage women and underrepresented minority students to consider and to choose engineering as a major. Throughout the scholarship programs, approximately 60% of the students have been women or underrepresented students.

A major research question in this grant was what it would take to entice new transfer students to enroll in an Academic Success class that would help them increase their GPA and retention after transfer. We learned that $300 is sufficient to interest students. Due to word-of-mouth and encouragement through the transfer center, over 30 students are voluntarily enrolled for the academic success class in Fall 2010, most of whom are working for the $300 scholarship.

II. Need: What needs did we address?

First, this project addressed the need for more engineers. In order to remain competitive world-wide, the United States needs to produce more engineers. The primary project goal is to graduate more engineering students.

Second, this project addressed the need for more diversity among engineers. "Efforts to strengthen U.S. science and engineering and the nation's competitive edge must include all Americans, especially minorities, who are the fastest growing groups of the U.S. population but the most underrepresented in science and engineering careers."[12] The need for more minorities, emphasizes the well recognized fact that diversity makes better engineering. Women are the most underrepresented group among engineers, with only about 10% representation. A goal of the project was to establish a program to graduate more women and underrepresented minority students in engineering.

Third, this project addressed the need for four-year institutions to work collaboratively with community colleges. "Although two-year colleges have long been seen as a stepping stone to a bachelor's degree in the United States, engineering is one of several academic fields in which four-year colleges have been reluctant to establish formal transfer agreements with community colleges….Engineering instructors at two-year colleges say the real reason that their students have few transfer options is because many four-year institutions believe community colleges offer an inferior product."[13] On the other hand, CC personnel tend to distrust a large university who wants to work with them. It seems to the CC that the university is really trying to dissuade high school students from going to a CC and therefore should not trust a university to work with them for their recruitment of students. A goal of the project was to establish a friendly, cooperative, supportive, "win-win" environment for both the CC and the university.

Fourth, this project addressed the need for four-year institutions to work with non-metropolitan community colleges. While it is relatively easy to have exchange visits with local community colleges, it is a real challenge to have university faculty and student role models travel three to four hours to a rural community college or to have those CC students come to visit the university campus. A goal of the project was to find alternative and creative modes of communication when a face-to-face meeting is not possible.

Fifth, this project addressed the need to keep a "Motivated Engineering Transfer Students" (METS) Center open and staffed. At the writing of the project proposal, there was no money available for the operation of the METS Center for the 2008-2009 academic year. The METS Center space was available, but there was no funding for the Center Director or four part-time students needed to run the Center and provide informal counseling to new transfer students, a key to the success of the Center.

Sixth, this project addressed the need to learn how a limited amount of money could be most efficiently spent and at the same give the most number of transfer students,

especially new transfers, help in order to thrive academically, professionally, socially, and emotionally.

Seventh, there is a need for more engineering students to have advanced engineering degrees in order for the United States to not lose its place in research and development world-wide.

III. Approach: What approach did we use to address this need?

The approach to each of these needs will now be described.

- (1) Need: Graduate more engineers

To increase the number of engineers, the project focused on rural community colleges where there is a high potential for success. The goal was to have reciprocal visits with each CC each semester. In our research at ASU, we have learned that about half of the engineering transfer students who come into ASU, only decided on an engineering career after they began their studies at the CC. This lack of a clear career goal may have been a factor why the student went to the CC. One of our approaches then was to work with the CCs to encourage local high school students to study engineering and computer science at their local CC. Since we are dealing with non-metropolitan CCs, the income of the families who live in the area is quite low and most of the families cannot afford to pay for a university education for four or five years. In addition, most of the local high school students have never had any interaction with or role modeling by an engineer or engineering student. Whenever possible, the Fulton representatives have included engineering transfer students from the particular CC we are visiting in the presentations to the CC students. For most of these students, engineering is not on their radar. Faculty and students from the Fulton Schools of Engineering went with CC liaisons to high schools to speak to students and also met with high school students who were taking dual-enrollment courses at the local CC.

University representative also visited mathematics and science classes at the rural CCs to encourage undecided CC students (who were already in the right path of classes) to consider and choose engineering as a major. At the same time, the ASU representatives encouraged the engineering CC students to continue their studies in engineering. The students are encouraged to keep their GPA at 3.0 or above for easy entry into the university and for competitiveness for scholarships and to apply early in order to be eligible for scholarships and to be able to register for classes earlier. While in the classrooms and in private chats with students, the ASU representatives convey the importance of a Bachelor's degree, no matter what the major. The students are given information not only on engineering, but also on the transfer process and the need to plan ahead to optimize their time in school by taking the correct courses for a particular major.

Each CC had $3,000 in scholarship money to use to encourage students to consider engineering or to remain in engineering. The money was usually given in amounts of $300 or $500 either as outright scholarships or for tuition to take an "Introduction to Engineering" class.

Each CC brings a van or car loads of students to a Transfer Orientation at the METS Center each semester. At ASU the potential transfer students are introduced to the METS Transfer Center, to the METS staff, to financial aid staff, and to academic advisors, as well as taken on a tour and lab demonstration to acquaint them with ASU. Since ASU is the largest university in the United States and the Tempe campus where the Ira A. Fulton Schools of Engineering reside is the largest single campus in the nation, this visit does a lot to show the potential transfer that in spite of the overall size of the campus, there can still be personal contact and support. About half of the fear of the large campus disappears once a student has been able to find a parking spot and be able to make it to the METS Center.

Once the students have transferred, the staff of the METS program all work to encourage and support these students to graduation and graduate school. Besides the information counseling available by staff, the METS Center provides a place for "studying", networking, study groups, computers and printing, socializing, and for eating with a refrigerator and microwave. Helpful workshops are held several times each semester. In addition to regular scholarships, transfer students are encouraged to apply for an S-STEM Scholarship sponsored by the National Science Foundation S-STEM program, which provides $4K per academic year. Other $300 scholarships were offered with funds for this project and now additional $4K scholarships are available from an NSF STEP grant now in place.

As a part of the Academic Scholarship Program, transfer scholarship students enroll in a one-credit Academic Success Class. All transfer students are encouraged to enroll in the Academic Success Class which meets five different times per session to accommodate all students for six sessions. The topics include the "Guaranteed 4.0 Plan" learning system developed by Donna O. Johnson, the resume, the interview, internships, research positions, portfolios, computer research, and speakers from academic and engineers from industry with advanced degrees. A favorite program is on graduate school featuring a panel of graduate students to "tell it like it is". The course also has assignments designed to help the students develop their academic, professional, social, and emotional skills. Assignments include a detailed time management schedule, an updated resume, a ten-year personal plan, a portfolio, and evidence of an application for a scholarship, internships, research position, or graduate school.

The transfer students from day one (whenever Fulton representatives talk with the students) are encouraged to think about going right on to engineering graduate school full-time right after receiving their Bachelor's degree. The students are shown the advantages of a graduate degree in industry, as well as the requirement for academia; and told about the low percentage of students who earn advanced degrees after they start working full-time in industry and become encumbered with a house, car, and a family.

- (2) Need: More diversity among engineers

Non-metropolitan community colleges in Arizona are very diverse and therefore lend themselves directly as a partial solution for the need for more diversity. Each of these

three community colleges has over 50% female student enrollment. Central is a Hispanic-serving institution and also includes a Native American presence. Cochise has over 30% minority STEM class students, primarily Hispanic and African American. In additional the families who live in the areas surrounding each of these colleges, in general, are low income families. The very fact that these students grew up in rural areas adds diversity to their backgrounds that can enrich engineering.

- (3)Need: Four-year institutions to work collaboratively with community colleges

The natural suspicion of "why would a university want to come to a CC" was addressed head-on due to the experience that the ASU team had experienced in working with CCs before. This mistrust was broken down by several fundamental factors.

Dr. Michael Crow, the President of Arizona State University, set increasing transfer student enrollment from 5,000 to 10,000 per year as a goal a few years ago. Arizona State University and the Ira A. Fulton School of Engineering want transfers and the majority (73%) of the engineering transfers come from community colleges.

An equivalency guide for all 20 community colleges in Arizona is already in place for the three Arizona universities. Representatives from each school sit down together each year to update and improve this guide. Therefore the matter of transferring credits from a CC to a university is quite straight forward and not a matter for individual course and institution debate.

The ASU and CC teams realize that most of the high school students local to the non-metropolitan community colleges will be attending their local community college if they attend college at all. Therefore, it is not a matter of the university folks trying to recruit these local high school students from the CCs, but rather helping the CCs to recruit these students so there will be more transfer students in the future. The only exception to this case might be the student who qualifies for an Honors College and has the financial support to go to a university. ASU has one of the leading Honors Colleges in the nation and this experience cannot be duplicated at a CC. The ASU team recognizes the advantages that a CC student has: much lower tuition, little driving time, free parking, can live at home (saving room and food costs), smaller classes, professors who tend to spend more time with their students, knows many of the students who will be there.

The CC students are encouraged by the CC and ASU team to stay at the community college until they can no longer make progress on their engineering degree. At the same time, when they can no longer make progress on their engineering. ASU is in the process of signing agreements with each Arizona CC so that students, who can no longer progress in their program of study at the CC, can transfer to ASU and double count courses there for their Associates Degree at the CC and for their Bachelor's Degree at ASU. This is a "Win-win-win" situation for the student, the CC, and ASU.

A much needed "METS Pathway" is being developed that will show a student at each CC what courses they can and should take at the CC for a particular ASU engineering major. With this guide the student is empowered to manage their own progress and make

sure that they take courses to optimize their program and also to avoid classes that have no added value to their program.

One additional area of collaboration that has been built is with the teachers of the mathematics, science, and engineering classes at the CCs. When they first were asked if an ASU team could come into their classroom once a semester, they were reluctant to give up more than 10-15 minutes due to all of the material that they needed to cover in that class. After a couple of visits, most of the CC instructors have become very welcoming and are willing to give up an entire class period. The university team is making sure that the instructors know how important their work is for these students. The students are complimented on taking mathematics and science classes and given a glimpse of some of the awesome things that they can do with mathematics and science as an engineer. The instructors have realized for most students this is the first time that they are actually getting a vision of what can be done with math and science. This makes the students more eager to do their math and science classes and increases the number of students taking the math and science classes – a good thing for instructors since sometimes classes are too small to make.

A key factor in this university/community college collaboration has been the passion and caliber of all involved. Without the leadership of the CC liaisons, this cooperative work would not take place.

- (4) Need: Four-year institutions to work with *non-metropolitan* community colleges.

Although universities have been slow to work with and encourage community colleges, the work has been even slower with *non-metropolitan* community colleges. The reason is obvious: these CCs are located in rural areas and thus at some distance from the university. Central Arizona is only about one hour from the ASU campus, so it is not too difficult to have a student give up three or four hours to drive to and visit a classroom. In one case, an ASU engineering student who had transferred from CAC spent about 30 minutes talking with a CAC physics class and then left to drive to ASU to take a class. The ASU student was taking his senior design class that semester and the students had many questions as they compared what they had been learning in an engineering design class. The student model was the favorite part of the two hour visit from the ASU team.

The other two colleges are a good three hours from the ASU campus. Since the ASU team would rather not spend nights away from home, this means a very early morning start three to four hours before the first class visit or appointment. The schedule is set up by the CC team. The ASU team typically visits with four to six classes and then returns to ASU late that night. The visit is a full day commitment. This day commitment is particularly difficult for the ASU transfer student to make. Usually ASU engineering students have light schedules on Friday. However, most CCs have none or very few classes on Friday. Since ASU engineering classes are heavily Monday-Wednesday or Tuesday-Thursday classes, any one of those four days is difficult for a student to miss.

The Academic Success Classes are a big help to newly transferred students and much of this information would be of interest and help to potential transfer students. Due to the rural location of these CCs, it is difficult to bring engineering speakers in as speakers. Therefore we have tried to do live interactive video conferences of the Success Class and the CCs. This attempt has met with limited success. A large barrier is that the class times at the university conflicts with the class times at the CCs and CC times conflict with each other. We have made each of the video tapings into a webcast which can be used later with an Engineering Club, which we hope to develop at the CCs. One of the local CCs that send many transfer students each year to Fulton has a very strong STEM Club where engineering majors form a support group for each other which carries over to ASU.

- (5) Need: Keep a "Motivated Engineering Transfer Students" (METS) Center open and staffed

The project fulfilled this need perfectly. The METS Center was able to continue to serve transfer students and we were able to hire a new METS Center Director who has done an outstanding job in developing the skills of the transfer students who work in the Center to better serve the students. The Center is now so well used that a new problem has emerged: students may see that there are no computers available and leave. The Center also holds its own workshops to help students with professional and academic skills. The Center averaged 44 students per day during Fall 2010. A few years ago, the Center averaged about 44 students per week.

- (6) Need: Learn how a limited amount of money could be spent most efficiently

Since the number of $4,000 scholarships for transfer students is limited and transfer students without unmet financial need can also benefit from the Academic Success Class, an objective of this project was to learn if small scholarships, such as $300, were sufficient to entice transfer students to take the class. Originally, it was thought that at least $500 would be necessary to get the students' attention. However, due to the limited project budget, we tried $300. A transfer student could earn a $300 scholarship if they registered for the Success Class, attended the classes, and did all of the assignments on time. We have now given our 43 $300 scholarships to 38 students (students can earn the $300 twice). With word of mouth and advertisement and encouragement from METS Center staff, the numbers of transfer students taking this class for the scholarship has increased. Emails are also sent out to new transfer students informing them of this opportunity.

- (7) Need: More engineering students to have advanced engineering degrees

In order to earn the $300 scholarship, the students have to attend the Academic Success Class. At least once a year one of the meetings is devoted to graduate school with a graduate student panel to answer questions and to tell why they chose graduate school, what it is like, and what they want to do with their advanced degree. The students also talk about their own fears in attempting graduate school and assure the undergraduate students that graduate school is different, not harder, and that it is fun because you are studying topics in which you are interested.

IV. Benefit: What are the potential benefits of our work? Who are the target audiences?

The target audience for this project included high school students local to the three targeted CCs and the undecided and engineering students at the three targeted CCs. The potential benefits are that more engineering degrees are earned. More engineers help both Arizona industries and the nation to meet their needs for more qualified and skilled STEM workers. The project was part of the entire effort to have more engineering graduate students go right on to graduate school full-time. The beneficiaries of the graduate degrees are both the student and national research efforts. Another beneficiary of this project was the targeted CCs. The mathematics and science teachers have appreciated the students gaining more perspective on the importance of taking mathematics and science classes and more students wanting to take such classes. The administrators of the CCs who have worked on this project are pleased with the assistance to help grow their engineering programs and to have more Associate Degrees earned through transfer to ASU.

V. Outcomes: What have we learned?

We have learned that although the distance between these non-metropolitan CCs and ASU is a challenge, it is still possible to work together and to accomplish our goal of producing more engineering graduates. The most effective spokesperson for a rural CC is a student who recently transferred from that school and is now a successful engineering student at ASU. This role model can speak to the doubts and fears of the students in the audience because the student has been there. However, it is difficult for an ASU student to miss a day of classes to travel over three hours each way to speak to CC students. We are still learning how to use video conferencing and webcasts in effective ways.

Setting up engineering information meetings (even with food) for invited guests are not effective for either students on campus or high school students and parents. The captive audience of the mathematics or science classroom is the most effective and efficient way to reach CC students. However, having a table with ASU personnel available for a time after the class visits is effective. Students from the classroom visits come by the table and ask follow-up and personnel questions. One very effective interaction with CC students was made possible when a CC instructor had the Fulton team visit with a physics class for two hours. We have learned that we need to know our audience. Classes of dual enrolled high school students are at a quite different level than students taking College Physics.

We have learned that a visit to a CC campus is very helpful in getting students interested enough to be willing to travel to ASU to check out the campus and more about engineering. In several instances, only three or four students had signed up for a Transfer Orientation trip to ASU. After a visit to that campus by two or three representatives from the ASU team, eight or more additional students had signed up to make the visit.

We have learned that through our meetings with the CC students that they are very excited to meet and talk with faculty, staff, and students from a university. In the ASU presentations to the students, we ask them about their career plans, what they want from a career, and point out that if they are interested in medicine, then bioengineering may be a good major. We have learned that CC students may be very interested in being a pharmacist or physical therapist (probably due to TV ads) and suggest that they also investigate Chemical Engineering (designing drugs may be more interesting than dispensing drugs) and Biomedical Engineering, as well as pointing out that while physical therapists can earn quite good money, it is hard work and women usually do not last in the industry past their 30's.

We have also learned that since some of the rural CCs do not have a complete two-year pre-engineering program, students have transferred to another community college local to ASU to earn an Associate Degree and have then transferred to ASU. We have sought out these ASU students to have them work with ASU teams to reach high school students in their home towns.

Since two of the three non-metropolitan CCs in this project are border towns, the average high school student may have a very limited vision of possible careers for themselves: boarder guard, border law enforcement, or working at WalMart. Therefore it is very important that their vision be enlarged while they are in high school or earlier so they can begin to take the right math and science classes that will allow them to have the option of going into the many technical careers that are available. An excellent way to accomplish this is to have students make a trip to their high school during the Christmas break when high schools are in session and ASU has not yet started. The students contact their former math and science teachers to gain access to the classroom. Some of these visits have been made through the SHPE de ASU student organization and some have been made by students on their own with materials supplied by the METS Center. These visits have been most satisfying and fulfilling for the students going back to their former high school and high school students report that it has been interesting.

Finally, we have learned that some students from rural CCs transfer into engineering at ASU as sophomores because there are no more engineering courses for them to take at the CC. Since the ASU transfer program is primarily for upper division transfer students (because lower division CC students are not encouraged to transfer), there needs to be some support for these particular lower division engineering transfer students in order to help the student and the CC program from which they transferred. The engineering students from that CC need to know that there is a path to a Bachelor's degree with support for them.

VI. Deliverables: What are the products of our research? How are we ensuring they will have an impact?

Due to this grant and the initial collaborative events, we were able to get a larger grant from the NSF STEP program (grant #0917867). This is a five-year $2.5M project (METSTEP) with the award having been made for the first three years, with the last two

years to be awarded after a successful presentation at the end of three years. Each of the CCs in this new grant has their own grant as a part of the project. Assuming a successful presentation, this new grant has assured that this project will continue for the next five years at these three targeted non-metropolitan CCs, as well as for two additional non-metropolitan CCs, Eastern Arizona College and Mohave College (three and four hours distance from ASU, respectively). The METSTEP project assured that the METS Center and Transfer Program in the Fulton School of Engineering will continue through the 2013-2014 academic year. Included in this METSTEP program are scholarships for engineering students at the CCs and for transfer students from these schools at ASU. There is also additional money to continue the $300 scholarships to help more transfer students.

The community college leaders in this collaborative meet each semester and are helping each other. This project has helped the three CCs hire additional faculty to help with engineering students, in one school to help reestablish their engineering program. As more students transfer from these colleges, they will in turn be able to encourage others from their home towns to go to a community college and to consider engineering. In one of these three rural CCs, the liaison has been promoted to Dean of Mathematics and Engineering. He is now in a position to assure that the efforts begun by this project will continue.

A website for Transfer Students has been created and is still being developed under the METSTEP project. This website will help to assure that our connections to non-metropolitan community colleges continue.

The number of ASU engineering transfer students from these three targeted community colleges is slowly rising: Fall 2007, 5; Fall 2008, 7; Fall 2009, 10; Fall 2010, 12. Some of the students that we reach choose engineering, but go to a four-year school other than ASU.

During the past two years, 50% of the transfer students with NSF S-STEM scholarships have gone right on to graduate school full-time in engineering after earning a Bachelor's degree.

Additional quantitative measures of what has happened with transfer enrollment and success will be covered in another paper.

VII. Conclusions

Through this project, we have developed a strong team of passionate faculty and staff at both the community college and the university. We have also helped to develop passionate transfer students who want to help others from their CC to transfer. The work done through this project has helped to break down barriers of the community college vs. the university and eliminated mistrust. The project has strengthened the cause for building a stronger engineering program at the CCs. The project has also helped the math

and science CC faculty see how this collaboration is helpful to them by getting more students excited about taking math and science classes.

We were able to make a good start on meeting all of the needs desigated for this project. Most important, of all, this project allowed us to keep the ASU METS Center open for a year in which it might have been closed and brought together the personnel and schools needed to prepare a successful proposal to the NSF STEP program which is allowing this project to continue and to expand for the next five years.

References

1. Anderson-Rowland, M.R., "Community College Transfer Students: Does Gender Make a Difference?" Proceedings of the American Engineering Education Annual Conference, Pittsburgh, PA, June, 2008, 14 pages. http://soa.asee.org/paper/conference/paper-view.cfm?id=9331
2. Anderson-Rowland, M.R. and VanIngen-Dunn, C., "Encouraging Transfer Students to Pursue a Bachelor's Degree in Engineering and Computer Science," American Society for Engineering Education Annual Conference, Honolulu, HI, June 2007, 7 pages. http://soa.asee.org/paper/conference/paper-view.cfm?id=2527
3. Anderson-Rowland, M.R., VanIngen-Dunn, C., and Banks, D.L., "Improving a University/Community College Partnership Program Having a Reduced Budget," Proceedings of the American Society for Engineering Education Annual Conference, Chicago, IL, June 2006, CD-ROM, 7 pages. http://soa.asee.org/paper/conference/paper-view.cfm?id=2527
4. Anderson-Rowland, M.R., "Evaluating an Academic Scholarship Program for Engineering and Computer Science Transfer Students," 36th ASEE/IEEE Frontiers in Education Conference, San Diego, October 2006, 6 pages. http://fie-conference.org/fie2006/index.html
5. Anderson-Rowland, M.R., Banks, D.L., Zerby, D.L., and Chain, E.L., "The METS Center: A Place Where Community College Transition Students Encourage Each Other in Obtaining an Engineering Degree," Proceedings of the 2005 WEPAN/NAMEPA Joint Conference, Las Vegas, Nevada, April 2005, 11 pages. http://dpubs.libraries.psu.edu/DPubS?service=UI&version=1.0&verb=Display&page=toc&handle=psu.wepan/1181066962
6. Anderson-Rowland, M.R., Vanis, M.I., Guerriero, W., Matar, B.H., Zerby, D.M., Chain, E.L., and Banks, D.L., "Improving the Transition Success of Engineering Community College Students to a University," Proceedings of the American Society for Engineering Education Annual Conference, Portland, Oregon, June 2005, CD-ROM, 16 pages. http://soa.asee.org/paper/conference/paper-view.cfm?id=21561
7. Anderson-Rowland, M.R., Vanis, M., Zerby, D., Banks, D., and Matar, B., "METS Pilot Program: A Community College/University Collaboration to Recruit Underrepresented Minority Students into Engineering," Proceedings of the American Society for Engineering Education Annual Conference, Salt Lake City, Utah, June 2004, CD-ROM, 9 pages. http://soa.asee.org/paper/conference/paper-view.cfm?id=20172
8. Anderson-Rowland, M.R., Banks, D.L., Vanis, M.I., Matar, B., Chain, E., and Zerby, D.M., "METS: A Collaboration to Assist Student Transitioning into Engineering from the Community Colleges to University," 34th ASEE/IEEE Frontiers in Education Conference, Savannah, GA, October, 2004, CD-ROM, 6 pages. http://fie-conference.org/fie2004/index.htm

9. Anderson-Rowland, M.R. and Grierson, A.E., "Collaborations with Non-Metropolitan Community Colleges," Proceedings of the *2009 American Society for Engineering Education annual Conference & Exposition*, Austin, TX, June 2009, 12 pages, CD-ROM and http://soa.asee.org/paper/conference/paper-view.cfm?id=12214
10. Anderson-Rowland, M.R. and Grierson, A.E., "Evaluating a University/Community College Collaboration for Encouragement of Engineering and Computer Science Transfer Students", Proceedings of the 2010 American Society for Engineering Education Annual Conference & Exposition, Louisville, Kentucky, June 2010, 13 pages, http://soa.asee.org/paper/conference/paper-view.cfm?id=23719
11. Anderson-Rowland, Mary R., "Exploring Strategies for a University/Non-Metropolitan Community College Collaboration", Proceedings of the 2010 WEPAN/NAMEPA Conference, Baltimore, Maryland, April 2010, 10 pages, soon to be on www.wepan.org
12. National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, http://www.nationalacademies.org/newsroom/nalerts/20100930.html
13. Selingo, Jeffrey, "Role Reversal," ASEE PRISM, March 2007, pp. 26-31.