Exploring Strategies for a University/Non-Metropolitan Community College Collaboration

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Abstract

Community Colleges (CCs) are a strategic source for more engineering students in the United States. An exploratory program for university collaboration with three non-metropolitan CCs was funded last year by the National Science Foundation (NSF grant # 0836050) targeting engineering and computer science students. One of the CCs is a Hispanic-serving institution and since, in general, women and underrepresented minority students are over represented in the CCs compared with four-year institutions, collaborations with these CCs also have the potential of increasing engineering diversity.

A summary and evaluation of the results of this grant will be given. 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. An experimental scholarship program for transfer students who do not qualify for NSF S-STEM scholarships is also evaluated. The experiences of these students will be analyzed. Evaluations will focus on women's experiences as compared to men, as well as minority students' experiences as compared to non-minority students.

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I. Introduction

As the demand for engineers increases in the United States and general student interest in an engineering career decreases, community colleges (CCs) are a large untapped resource. Since CCs are overrepresented with women and underrepresented minority students, CCs are also a good source of diversity in engineering. Much has been written on the power of diversity for making better engineering. Each year several hundred students transfer into Arizona State University and, in particular, the Ira A. Fulton Schools of Engineering. Until 2002 little was done by the engineering schools to recruit, to assist with the transfer of, or to work on the retention of transfer students. In Fall 2002 a C-SEMS Academic Scholarship program funded by NSF (#0123146) supported 22 upper division students, half of them transfer students, mostly from community colleges. In Fall 2003 a second NSF C-SEMS Academic Scholarship Program was begun (#03242120) focused on upper division transfer students. At the same time, a collaborative program with local community colleges was begun with NSF support (#0315817). Arizona State University, a Research I university, is now the largest public research university in the nation with over 67,000 students. The Fulton Schools of Engineering are on the Tempe campus, the largest single U.S. campus with over 53,000 students. The Fulton Schools include nearly 4,000 undergraduates and 2,200 graduate students in engineering and computer science (Office of Institutional Analysis 2009). In this paper the term "engineering" shall include both engineering and computer science. The computer science programs include both Computer

Science with a Bachelor of Science degree and Computer Systems Engineering with a Bachelor of Science in Engineering degree. Construction students are also in the Fulton Schools of Engineering, but they are not included in this study.

In the same Phoenix area as the location of Arizona State University (ASU), there is also a district of independent community colleges. More than 250,000 students attend these ten colleges each year in the Maricopa County Community College District (MCCCD) taking credit and non-credit courses. In 2007, 56% of these students were women, 42% were non-Anglo, 41% were age 25 or older, 75% were part-time, 39% were evening students, 35% intended to transfer to a college or university, 30% intended to gain or improve workforce skills, and 12% attended only for personal interest (Maricopa County Community College District). Of the ten colleges, six have engineering or computer science programs or courses for a pre-engineering/computer science major.

In Fall 2009, 883 First-Time, Full-Time freshmen, 140 Full-Time Upper Division transfers, and 43 Lower Division transfers made up the 1,066 new full-time students in the Fulton Schools of Engineering. See Table I. In addition, 26 first-time, 7 lower division, and 38 upper division new part-time students transferred to the Fulton Schools. As can be seen from this table, the largest underrepresented minority group in the Fulton Schools of Engineering outside of women is Hispanics. A smaller number of new students, both first-time and transfer students, join the Fulton Schools of Engineering each spring.

Currently 19.9% of the current undergraduate enrollment are women and 20.6% are underrepresented minority students (American Indian, Black, and Hispanic). The percentage of women among the new Fall 2009 transfer students is smaller than the current percentage of women enrolled in the Schools of Engineering. In all categories of the new 2009 transfer students, except for upper division full-time, the percentage of underrepresented minority students is higher than the current percentage of Schools of Engineering underrepresented minority students. Therefore, we would like to increase the number and percent of women and underrepresented minority students among the full-time, upper division transfer students that come into Fulton Schools of Engineering each year.

In recent years, the number of transfer students has been decreasing. This decrease is due to several factors. First, ASU began a campaign to build its freshman class. Since ASU was an 80% commuter school with many transfer students, loyalty and school traditions seemed weak. The campaign was quite successful in building a present freshmen class of over 11,000. Undoubtedly, without the campaign some of these freshmen would have been transfer students a couple of years later. A few years after the campaign, there was an increase in the standards that transfer students needed to meet in order to transfer into the Fulton Schools of Engineering programs. A major change in the requirement for automatic admission for both first-time freshmen and transfer students is that a student must graduate in the upper 25% (rather than 50%) of their high school class. Also raised were several other criteria under which a student can be admitted, including SAT or ACT scores and the cumulative GPA from high school, community college or college. For example students with more than 24 transfer hours must have a minimum transfer GPA of 3.00 for 24 or more transfer hours, and no high school math or

Fall 2009 New Enrollment						
Students	**ALL**	**Women**	**American Indian**	**Black**	**Hispanic**	**Underrep Minority**
First-time Full-time Freshmen	883	180 (20.4%)	19 (2.2%)	21 (2.4%)	155 (17.6%)	195 (22.1%)
Lower Division Full-time	43	4 (9.3%)	3 (7.0%)	2 (4.7%)	5 (11.6%)	10 (23.3%)
Upper Division Full-time	140	25 (17.9%)	3 (2.1%)	5 (3.6%)	18 (12.9%)	26 (18.6%)
Subtotal	1066					
First-time Part-time Freshmen	26	6 (23.1%)	4 (15.4%)	2 (3.8)	5 (19.2%)	11 (42.3%)
Lower Division Part-time	7	1 (14.3%)	0 (0%)	1 (14.3%)	1 (14.3%)	2 (28.6%)
Upper Division Part-time	38	5 (13.2%)	1 (2.6%)	2 (5.3%)	6 (15.8%)	9 (23.7%)
Subtotal	71					

Table I. Full-time and Part-time New Enrollment for Fall 2009 in the Ira A. Fulton Schools of Engineering by freshmen, transfer, gender, and ethnicity (Enrollment Fall 2009).

science competency deficiencies. Students who do not meet the Fulton Schools of Engineering program standards may be admitted to the University College at ASU and later transfer to Fulton after satisfying the Schools of Engineering criteria.

II. Transfer Student Programs

Although the community college students were welcome for years and new transfers were invited to an ASU university orientation, there was no special program for them in the Fulton Schools of Engineering. The community college students enjoyed driving to a school close to their home, ample free parking, small classes, friendly professors who enjoyed teaching for the most part, and receiving individualized assistance with their classes. In some cases there was little or no homework. The students were able to carry full class loads while working half to full-time. ASU is large, parking is expensive and difficult, and some classes are very large. Students may believe that they can continue to be full-time students even if they are working 20 hours or more per week. Our records show that while some students with very good GPAs who transfer from a community college can earn the same GPA their first semester at the university, others will have a GPA a whole point lower. First semester transfer students may be lonely (don't know anyone in their classes), feel isolated (most of the other students have taken classes together for two years), feel like freshmen again (having to start all over with a 0.0 GPA), don't know where the resources are (no one told me that there is class material on Blackboard), and find that the pace of the classes is much faster. All of this can be overwhelming. Added to this is the fact that most of the easier classes have already been taken and now the schedule may

include a math class, a computer class, a science class, and an engineering class, with no "easy" class to break the pattern. Furthermore, since everyone else (including other transfer students) seems so cheerful, they must be adjusting well and the problem must just be the student himself or herself (Anderson-Rowland 2008).

The articulation of credits from Arizona CCs to the three state universities is not a problem. For years there have been complete published articulation agreements with each Arizona CC and the Arizona universities.

These were some of the underlying factors that led us to create a center for transfer students so they could connect with others from their community college, network, form study groups, have a place to eat lunch, have a place to study with computers and printers, and have informal mentoring from the Center staff. A challenge for the CC transfer students is the increased cost for tuition when attending the university. Many of them chose to go to a community college because it was close to their home and because they felt they would get a good education, but a large factor was that the CC tuition is much lower than that for a university. Having the C-SEMS Academic Scholarship program helped transfer students with unmet financial need with a $3,125 academic year scholarship during 2003-2008 and then with a follow-on S-STEM NSF grant (#0836050) starting in Fall 2008, we have been able to provide $4,000 academic year scholarships for about 25 transfer students each semester (Anderson-Rowland 2004a,b,c). Central to the assistance we provide for transfer students is making sure that they have good time management and study skills through the *Guaranteed 4.0 Plan* (Johnson 2004).

In 2003 we received NSF funding to work with potential and actual community college transfers (#0315817). The objective of the *Motivated Engineering Transfer Student* (METS) *Program* was to support, encourage and motivate (especially women and underrepresented students) at three levels: 1) in engineering or math/science classes at the community college level, particularly in the metropolitan Phoenix area, 2) as engineering transfers to the Fulton School and 3) as successful graduating engineers. We worked with six MCCCD colleges from 2003-2008 and continue to collaborate with them. However, there are 10 additional CCs in Arizona; most of them are non-metropolitan colleges. In Fall 2008 we received support from NSF (# 0836059) for an exploratory project to work with three non-metropolitan CCs. The purpose of the project is to determine if a university could work successfully with three community colleges that are one hour to four hours away. We are trying to determine the effectiveness of expanding the program to community colleges in non-metropolitan areas across the state of Arizona by leveraging high school and community outreach activities with these colleges (Anderson-Rowland 2009a). The purpose of both projects was to get more students to graduate with engineering and computer science degrees.

None of the three CCs that we worked with in the Exploratory Project, Western Arizona, Central Arizona, and Cochise College had worked before with personnel from a university. At first there were a few questions as to why we would want to work with a CC unless it was for something that we wanted and that the CC would lose. We made it absolutely clear to the CCs that we were not trying to recruit potential CC students from them to ASU. We wanted to work with the CC and their local high school students to interest and to encourage more high school students to consider engineering for a career. In the process, we would then have more CC transfer students

coming to ASU, but we encourage the CC students to stay at the CC as long as they can progress in an engineering or computer science program. This philosophy is in line with the ASU administration which is currently working to enable CCs whose transfer students complete an Associate Degree at ASU to get the credit for the degree. This provides a win-win situation for the CCs and the University. We want to assist the CCs with students who are uncertain of a major and to help the CC student in the transfer process. Once the student has transferred, we have our METS Center to continue to support the student, as well as an Academic Scholarship Program.

III. CC Programming

The activities at each CC vary. We now describe some of the activities at the colleges.

During the first semester, Fall 2008, of the Exploratory Project, we made two visits to one college and one visit to a second college. In Spring 2009, we made a visit to the third college. We learned that the audiences can be quite different: from traditional CC students to high school students taking courses at a CC to older students attending a CC without the ability to relocate their family to continue at a four-year school (Anderson-Rowland 2009a). We quickly learned that CC and ASU engineering students both have heavy class loads from Monday to Thursday. While we know that it is good to have role models close in age and from the area of the CC, ASU students cannot easily take a day off (since the one-way drive can be close to four hours) of school to visit their former CC. We need to find other ways to bring the engineering student role model to the CCs – either by teleconference, webcast, or video. We learned quickly that in order to make the most effective use of our time visiting a CC, we needed to visit the students in the CC math, physics, and science classes. Similarly, in visiting a high school with the CC, visits to the students who are taking college track mathematics and science are the most productive. An unsolved problem is how to get more on-line engineering courses available for older CC students who are unable to move their families to be close to a four-year college or university.

At the same time, as part of this project, the CCs have been starting and strengthening programs for pre-engineering students. For example, in Fall 08, Cochise College had a first cohort of eight high school students in their Running Start program take an Introduction to Engineering Careers and Engineering Design course. The Running Start program is designed for junior high school students to start taking courses at Cochise concurrently with their high school classes. The program is planned so that within one year of high school graduation, the students will have earned an Associate Degree. Also in Fall 08, a second cohort of twenty-four high school junior students enrolled in a math and college success course.

In Spring 09 recruitment was done at two local high schools for a third cohort of Running Start to begin in Fall 09. The first cohort (now high school seniors) took a Freshman Design course, and the second cohort took the Introduction to Engineering class. In Fall 09 a third cohort of 22 high school juniors began the Running Start Program. Cochise College also held day long STEM outreach sessions at both their Douglas and Sierra Vista campuses.

As part of the NSF grant, each of the CCs received scholarship money that can be given to pre-engineering students. The money can also be used as an incentive to encourage students to

register for engineering classes. We also offer an ASU engineering or computer science student mentor to the potential engineering students we meet at the CCs.

Two very successful activities with pre-engineering students occurred in Fall 09 with Central Arizona students. The Central Arizona liaison provided a captured audience of 13 students to an ASU team for two hours from his Intro to Engineering Design class. The favorite part of the program for the Central students was hearing from an ASU engineering student who had transferred there from Central AZ. The ASU student gave tips on transferring, told what engineering life was like, and answered many questions from the Central students. The ASU student still lives near AZ Central and commutes the 45 minutes to ASU. The METS Center Director gave a presentation on the different types of engineers and what they do and common questions and answers about engineering. The Project PI talked with the students about the greatest inventions of the past century and the grand challenges that engineers face today. Both the Director and the PI also answered many questions.

A few weeks later the AZ Central liaison drove to ASU with 14 students to visit ASU and the METS Center. Students had the opportunity to meet with their ASU academic advisor either before or after the program. During the visit the students received information on admission, financial aid, scheduling classes, the METS Center, the Academic Scholarship Programs for transfer students, the Guaranteed 4.0 Plan, and had the option of taking a short tour of the engineering buildings. Most of the students accepted an invitation to join a meeting of the Academic Scholarship Program students (about half are transfer students) and heard a speaker from industry. The visit was judged very successful by all who participated.

In December, 2009, a team of ASU personnel visited AZ Western for a "Be An Engineer" event. A total of 40-50 students, speakers, counselors, and instructors attended, including some students who did not stay for the entire event. Feedback forms were provided by 23 students. A few of the general comments were:

- "I learned how and what it takes to be successful"
- "Guest speakers had a lot of relevant information"
- "..it gave me motivation to keep on going…"
- I learned "not to fear math"
- Favorite activity was "asking questions to people who have done it"
- "everything was perfect"
- My favorite activity was "learning what path engineers take"

IV. The $300 Scholarship Experiment

Since the retention of transfer students who have attended the Academic Scholarship Program has been notably higher than the retention in general for transfer students, we wondered what we could do to provide more transfer students with the information and experience that students get by being in the scholarship program. Since the scholarship money itself ($4,000 per academic year) is the limiting factor and also since students without unmet financial need are not eligible for these scholarships, money was provided in the NSF grant for an experiment. The research question was: Would $300 be enough to entice transfer students to attend six workshops in a semester and to do the same assignments as the scholarship students?

Over the last three semesters 20 students have participated in this program. These students enrolled in FSE 294, a one-hour credit Academic Success Program, which is attended by the CIRC and CIRC/METS scholarship students. One of the 20 was a non-transfer student who took part even though he knew that he would not receive the $300.

Fourteen men and six women enrolled in FSE 294, a one credit class for the academic success program, participated in the program, and were sent evaluation surveys. Nineteen of the students responded, 13 men and 6 women. See Table II. All of the students found the program valuable and 94.7% of them gave an overall rating of the Academic Success Scholarship Program either an excellent or a very good. Ten of the students judged the $300 scholarship reward for taking the one hour credit class "about right". Ten of the students said that they would have taken the course for free if they had known how much benefit they would gain from the course. However, since hindsight is always more informative, the students, in general, agreed that the $300 was a nice incentive and two of the students said that they would not have taken the course if the $300 incentive had not been present.

Ethnicity	Women	Men	Totals
Hispanic	3	7	10
AA/Black		2	2
Caucasian/Asian	3	4	7
Totals	6	13	19

TABLE II. Demographics of Students Who Took FSE 294 Class and Completed The Survey

We are interested in two basic results: How did transfer students do academically when they took the FSE 294 course their first semester after transferring? and How did continuing transfer students do academically the semester that they were enrolled in FSE 294 compared to their last semester and their cumulative GPA when they entered the course? Of course, how the transfer student does their first semester will vary somewhat according to their academic ability coming in. However, this author has seen transfer students with excellent transfer grades do very well their first semester of transfer and at the same time has seen transfer students drop their GPA a whole letter their first semester in a university. Also the academic course load carried by the first semester transfer will certainly vary from student to student. Seven of the students, who participated in this study, took the FSE 294 academic success class their first semester of transfer Although the sample is small, the results are shown in Tables III and IV by gender and ethnicity. One of the two low GPA students had medical problems during the semester. It is difficult to say that an increase in a student's GPA for a semester was due entirely to enrollment in FSE 294 and participation in the Academic Scholarship Success Program. However, we deemed it useful to at least look at the difference between the GPA the semester the student took FSE 294 and the

Gender	GPA			Totals
	<3.0	**3.0- <3.5**	**3.5 – 4.0+**	
Women	1		1	2
Men	1	2	2	5
Totals	2	2	3	7

TABLE III. GPA at Semester End by Gender When Student First Took FSE 294 Academic Success Class.

Ethnicity	GPA			Totals
	<3.0	3.0- <3.5	3.5 – 4.0+	
Minority	1	2	2	5
Non-Minority	1		1	2
Totals	2	2	3	7

TABLE IV. GPA at Semester End by Ethnicity When Student First Took FSE 294 Academic Success Class.

cumulative GPA going into that semester and the difference between the GPA the semester the student took FSE 294 and the GPA of the previous semester. Differences were then further analyzed by gender and ethnicity. See Tables V and VI.

Gender	n	Average Δ From Previous Semester Cum GPA	Average Δ From Previous Semester GPA
Women	3	+.077	+.387
Men	8	+.209	+.278

TABLE V. Average Change from Semester GPA When Student First Took FSE 294 and Previous Semester Cumulative GPA and Previous Semester GPA by Gender.

Ethnicity	n	Average Δ From Previous Semester Cum GPA	Average Δ From Previous Semester GPA
Minority	6	+.163	+.323
Non-Minority	5	+.204	+.288

TABLE VI. Average Change from Semester GPA When Student First Took FSE 294 and Previous Semester Cumulative GPA and Previous Semester GPA by Ethnicity.

Women had less of an increase in their GPA during the semester that they took FSE 294 compared with their cumulative GPA from the previous semester than men did. However, women had a higher increase in their GPA during the semester that they enrolled in FSE 294 than did men compared to their GPA on the previous semester. Women raised their GPA close to .4 of a point during the semester they first enrolled in FSE 294 compared to their GPA the previous semester. The same pattern held true with minority students as with women students. The minority students showed less of an increase in their semester GPA from their previous semester cumulative GPA while they took the FSE 294 class the first time than did non-minority students. However, the minority students showed a higher (over .3 of a grade) increase in their semester GPA during the first semester that they took the FSE 294 class over the previous semester GPA than did non-minority students. Another factor to note in this analysis is that in some cases students with high GPAs did not necessarily raise their GPA with the help of FSE 294, but the students were able to achieve their high GPA with less effort using ideas they received from the FSE 294 class.

The students were asked on the survey what the most surprising part of the program was for them. Following is a sample of the answers:

- I was surprised that I learned something and the food was good. I had expected just a boring class that I would just have to suffer through to get the scholarship, not really

learning anything. Not only did I learn a lot about engineering and grad school, I also learned about studying techniques. I am very happy with the program and look forward to it next semester.

- The amount of new information I acquired. I would not have received it elsewhere …
- …the 4.0 Plan. I've never seen another scholarship that has been so concerned in helping students succeed in finishing their engineering degree. I believe most of the motivation came from the (director) and from the presenters who gave their story.
- The facilities offered by the center that I did not know about. The valuable amount of knowledge that the staff members offer.
- Having to write the five page 10-year plan paper.
- I guess it is surprising that besides getting a free lunch,..we get a stipend.
- For me the most surprising part was all the things you didn't know other people were going through. Things I thought I was the only one experiencing.
- How much fun I would have. It did not feel like a boring class like I thought it was going to be. It was a great experience.
- The fact that professional engineers actually take the time and present themselves and their career experiences with the students.
- Some of the stories I heard were simply amazing. I can't remember anyone specific but some people talk about how they got to ASU and other people talked about how they came from other countries and what their goals are.
- That the study tactics really did work. For me studying had always been the extra effort necessary when material was not immediately understood. The studying methods listed in the 4.0 guidelines are incredibly helpful.
- That you are giving me $300.
- How relatively easy it actually was. Initially I had some concerns, but I see now that the program merely requires a change of habits.

V. Conclusions

The $300 Scholarship Program is considered a success. Perhaps this success can best be summed up by the students themselves who were also asked to give comments that could be used to advertise the $300 Scholarship Program. Here are a few of their answers:

- Get paid to improve your grades!
- It is the easiest $300 you will ever make and you get to meet a lot of nice people going through the exact thing as you are.
- Free food!
- It is a great program because you not only benefit from all the information acquired, but still get paid to do it. It's a no-brainer.
- This is a great place for engineering transfer students wanting to maintain the community college atmosphere of having a common place where other students are not just faces, but peers working towards the same goal.

And finally,

- Want to succeed at ASU being an engineering student? Need somebody to motivate you when things are tough? Need to learn more about internship and REU opportunities? Come and enjoy a biweekly fun meeting with lots of good refreshments and engineering

classmates that share your goals. Your participation will be rewarded with a $300 check at the end of the semester.

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