

AC 2010-1170: EVALUATING A UNIVERSITY/COMMUNITY COLLEGE COLLABORATION FOR ENCOURAGEMENT OF ENGINEERING AND COMPUTER SCIENCE TRANSFER STUDENTS

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Evaluating a University/Community College Collaboration for Encouragement of Engineering and Computer Science Transfer Students

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Abstract

Community colleges (CCs) are a strategic source for more engineering and computer science students in the United States. An exploratory program for a university collaboration with three non-metropolitan CCs was funded last year by the National Science Foundation (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 brief history of the collaboration is given and the various phases of the collaboration described. These phases include communication (each CC is some distance from the university), a joint high school outreach effort, encouraging CC students, assisting with the transfer process, and supporting transfer students at the university.

The retention of upper-division transfer women students in engineering and computer science at Arizona State University will be examined. A focal point of this paper will be the evaluation of an innovative retention program for upper-division transfer students. These students enroll in a one-hour credit Academic Success class which is also attended by scholarship students, both transfer and non-transfer students. Transfer students who were not eligible for the scholarship can receive a \$300 scholarship by attending the six meetings of the class and doing the assignments. The assignments are designed to help the students succeed academically and to encourage them to go on to graduate school after they graduate with a Bachelor's degree in engineering or computer science.

The \$300 scholarship program has been offered for three semesters to 20 students. This paper will focus on the experiences of the women students in the program through a survey. In general, all of the students rate the program as excellent or very good and helpful to their academic life. The scholarship amount was judged to be "about right".

I. Introduction

Arizona State University (ASU) is creating a new model: the New American University. "This university is a single, unified institution comprising four differentiated campuses positively impacting the economic, social, cultural and environmental health of the communities it serves. Its research is inspired by real world application, blurring the boundaries that traditionally separate academic disciplines. ASU serves more than 67,000

students in metropolitan Phoenix, Arizona, the nation's fifth largest city. ASU champions intellectual and cultural diversity, and welcomes students from all fifty states and more than one hundred nations across the globe.”¹

As the nation’s largest public university, ASU’s Tempe campus is also the nation’s largest single campus. On this campus the Ira A. Fulton Schools of Engineering serve 4,000 undergraduate and 2,200 graduate students in engineering and computer science. The Ira A. Fulton Schools of Engineering at ASU includes engineering, computer science, and construction. In this paper the term “engineering” shall generally 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 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.² 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, 43 Full-Time, Lower Division transfers, and 140 Full-Time Upper 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. A smaller number of new students, both first-time and transfer students, join the Fulton Schools of Engineering each spring. As can be seen from this table, the largest underrepresented minority group in the Fulton Schools outside of women is Hispanics.

The percentage of women among the new first-time, full-time, freshmen (20.4%) is a little larger than the current 19.9% women among all Fall 2009 enrolled Schools of Engineering students (excluding construction). However, the percentage of women among the new Fall 2009 transfer students (9.3% of lower division and 17.9% of upper division) is smaller than the current percentage of women enrolled in the Schools of Engineering. Likewise, the percentage of underrepresented minority students among the new first-time, full-time, freshmen (22.1%) is a little larger than the current 20.6% underrepresented minorities among all Fall 2009 enrolled in the Schools of Engineering (excluding construction). However, 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.

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. Source: Office of Institutional Analysis, Arizona State University.³

Each year some 300 students transfer into the Fulton Schools of Engineering. In recent years, the number of transfer students has been decreasing. This decrease is likely due to the recent increased standards that transfer students need 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 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.

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 transfer students face a big adjustment when transferring from a community college with small classes and close, free parking to the largest student enrollment campus in the nation. Traditionally, little has been done to assist transfer students with the transfer process or to help them be retained after they have matriculated to the university. In addition to adjusting to a new academic system,

most transfer students work, some close to full-time.⁴ Female and underrepresented minority transfers may face additional barriers when transferring to a larger institution.

II. A Program for Transfer Students

The first upper division Academic Scholarship Program directed by the author was begun in the fall of 2002 with a four-year \$400,000 National Science Foundation (NSF) CSEMS grant (#0123146). This program provided an annual academic scholarship of \$3,125 which covered the ASU tuition at that time. The Collaborative Interdisciplinary Research Community (CIRC) program began with 22 students in the Fall of 2003, 11 of whom were transfer students. In the fall of 2003, a second \$400,000 CSEMS NSF grant (#0324212) enabled a second upper division academic scholarship program to begin with the same requirements and program as CIRC, except this program was only for transfer students. This second program was called the Collaborative Interdisciplinary Research Community/Maricopa Engineering Transfer Scholars (CIRC/METS). Our focus was working with the MCCC transfer students. As we have now begun to work with Arizona community colleges outside of Maricopa County, the METS stands for “Motivated Engineering Transfer Students”. The scholarships for the transfer students were also \$3,125 per academic year. This successful program ran from 2003-2008 with 76 students and over a 92% retention and graduation rate in engineering and computer science. Diversity was an emphasis and 65% of the students in the program were either female or an underrepresented minority.¹³ In particular, 29 (38.2%) of the transfer students were women. This percentage is much higher than the current 18.2% of women enrolled. For more information on these programs see references 4-13.

The CIRC/METS program continues with an NSF S-STEM grant (#0836050), so the continuing students, from the first CIRC/METS program, when it ended are now being supported in a second CIRC/METS program with \$4,000 scholarships per year. When a CIRC/METS student graduates and continues full-time in graduate school in engineering or computer science at ASU, the student is supported for a maximum of four semesters by a second CIRC program funded by an NSF S-STEM grant (#0728695).

Through the CIRC/METS program, transfer students in the Fulton Schools of Engineering can apply for and receive a \$4,000 scholarship per academic year. The requirements for the scholarship include: U.S. citizenship or permanent residency, full-time student in engineering or computer science, a cumulative GPA of at least 3.0, and unmet financial need according to FAFSA. Each semester six workshops are held with multiple meeting times for each. The topics include the “Guaranteed 4.0 Plan”¹⁴, resumes, interviews, how to use computer data bases for research papers, graduate school presented by a graduate student panel, and engineers with advanced degrees from industry. The purpose of the workshops is to help round out the student with engineering information that they do not receive in the classroom, to help them graduate, and to encourage them to go right on to graduate school full-time, if possible. Assignments to help the students are given through the semester including researching graduate schools and planning their life for 10 years after they graduate with their bachelor’s degree.¹⁵ For students to continue to receive the scholarship, they must attend the workshops,

complete the assignments, and keep their GPA above 3.0. The scholars are served refreshments at each meeting to help make them feel special (and to encourage attendance).

At the same time, with NSF support, industry support, and support from ASU, the Fulton Schools of Engineering established a place dedicated to supporting transfer students, the METS (Motivated Engineering Transfer Students) Center. This Center provides a place for transfer students and their friends to meet, study, relax, use one of the eight computers or two printers, or to attend a workshop. The Center also houses the office of the METS Center Director and space for the four part-time students who work in the Center and the part-time student who assists the author in running the Academic Scholarship Workshops. The METS Center sponsors workshops, open houses at the beginning of semesters, a transfer information day near the end of each semester, and formal and informal mentoring.

In 2007 the author began collaborating with three non-metropolitan Arizona Community Colleges: Arizona Western, Arizona Central, and Cochise. In 2008 we received funding from a NSF grant (#0836059) to continue to support the METS Center, but to now work with these rural CCs in increasing the numbers of students who major in engineering and computer science, with an emphasis on women and underrepresented minority students.¹⁶

A literature review on engineering and computer science community college students was conducted in a previous paper.⁴ We now turn to the research question of this paper.

III. Retention of Upper-Division Transfer Women in Engineering and Computer Science

Since the retention of qualified upper-division transfer students with unmet financial need were retained and graduated at 92% in engineering and computer science (and nearly 95% at ASU) by being enrolled in an academic scholarship program and receiving \$4,000 scholars for each academic year, it would be good to know what the retention rate was in general for upper-division transfer students. We are particularly interested in the retention and graduation in engineering of women upper-division transfer students. Although Fulton has a number of part-time students, the status of almost all upper-division transfer students is determined in five years after matriculation. Table II shows the status of upper-division transfer students by gender after five years. Although there is considerable variation by the year, in general, women are retained and graduated at a lower rate than men and since their numbers are small to begin with, we see that there is reason for concern. In addition, the overall persistence rates of women and men upper-division transfer students are much lower than the general persistence rates of the transfer students in the CIRC/METS Academic Scholarship Program.

Five Year Persistence and Graduate Rates								
Category	Fall 01		Fall 02		Fall 03		Fall 04	
Gender	W	M	W	M	W	M	W	M
Number Entering	17	115	26	91	29	114	22	105
In College	35%	60%	62%	49%	62%	68%	45%	70%
Other College	35%	11%	4%	14%	10%	7%	27%	7%
Total	70%	71%	66%	63%	72%	75%	72%	77%

TABLE II. Five-year Persistence and Graduation Rates for Upper-Division Transfer Students in Engineering and Computer Science

To read this table, consider Fall 01. Seventeen upper division women and 115 upper division men transferred into Engineering and Computer Science. After five years, 6 (35%) had graduated or were still enrolled in the Fulton Schools, while another 6 (35%) had graduated or were still enrolled at ASU in a college other than Fulton Schools. Since 70% total were graduated or still enrolled at ASU, 5 (30%) had left ASU without a degree. For Fall 01, we see that about the same percentage (29%) of the men left ASU without a degree. In Falls 03 and 04, the percentage of women graduated or still enrolled at ASU is lower than for men.

If we consider the upper-division engineering students who entered Fulton in Fall 05, at this point we only have four years of data and so these numbers are not included in Table II. However, only 47% of the 19 women graduated in the college, 5% graduated from an Other college, and the rest are no longer enrolled. On the other hand, 62% of the 108 upper-division men who entered that fall have graduated from the college and 13% are enrolled or graduated from an Other college. So with this group, 47% of the women left without a degree and only 25% of the men left without a degree.

IV. The Research Question

Since Fall 2002 Fulton transfer students, primarily from local community colleges, have been accepted into an Academic Scholarship Program to broaden their view of engineering, to increase their academic skills ensuring retention and graduation, and to encourage them to go right on to a technical graduate degree after receiving their Bachelor's degree. This program has proved successful with over 92% of the participants being retained and graduated. During the first six years, three transfer students graduated from the program the first year and then 76 students participated from 2003-2008. More students are now participating in a second NSF grant for transfer students.

Since the program has been so successful, a natural question to ask is how we can work with more community college transfer students, especially new transfer students who have so many adjustments to make.⁵ A major limiting factor is funding since the students in this program are now receiving a \$4,000 scholarship for the academic year. Another limitation is that the Scholarship Program is for students who have at least a 3.0 GPA and have unmet financial need. Clearly, students who do not have a 3.0 GPA could benefit from this program with its stress on time management and the Guaranteed 4.0 Plan. Additionally, students without unmet financial need can benefit from the speakers and topics presented in the Scholarship Program workshops. Lastly, the author believes that

the assignments that go with the workshops are very helpful for a student to complete in order to gain the most benefit from their degree.

The author assumes that in general students would not attend a series of six meetings per semester and do the assignments without some type of compensation. A few students who have experienced the program, but are no longer eligible with unmet financial need, have continued to attend the meetings because they have experienced the value of the meetings and may or may not do the assignments. The scholarship students are served refreshments at each meeting to help make them feel special, but food alone is not enough incentive to get students to commit to such a program. What type of incentive would need to be offered for a new transfer student to be willing to take the Academic Success Seminar class? For a starting point in Fall 2008, the author determined that a \$300 scholarship might be enough to get a transfer student to enroll in FSE 294 for one hour credit for the workshops, with the credit hour an additional incentive to complete the assignments. The research question then is, “Is \$300 enough to entice a community college transfer student to take an Academic Success Workshop series designed for retention and graduation?”

V. The Workshop Experiment

The first semester that the \$300 Scholarship was offered was Fall 2008. Three \$300 scholarship students (two of whom enrolled in FSE 294) completed the semester and did all of the assignments. In Spring 2009, eleven \$300 scholarship students (with one repeat) completed the workshops, and in Fall 2009, the \$300 scholarship program was completed by seven students. See Table II for the distribution by gender and ethnicity of the twenty students.

Ethnicity	Gender		Total
	F	M	
Hispanic	2	9	11 (55%)
Caucasian	3	3	6 (30%)
African American		2	2 (10%)
Asian		1	1 (5%)
Total	5 (25%)	15 (75%)	20 (100.0%)

TABLE II. Demographics of \$300 Scholarship Students

The students in the \$300 Scholarship Program over represent both women and ethnic minority students. Of the 3,995 undergraduate students in the Schools of Engineering (excluding Construction) for Fall 2009, 796 (19.9%) are women.³ In this group of transfer students, 25% were women. In Fall 2009, the Schools of Engineering (excluding Construction) had 822 (20.6%) minority undergraduate students³, while our transfer student group had 65% minority students. These statistics show that the program is being successful in encouraging women and minority transfer students. The average age of the women is 24.8, ranging from 19 to 32. The average age of the men is 23.9, ranging from 20 to 35.

A survey on their experience with the \$300 Scholarship program was sent to the 20 individual students who participated. Returns were received from 19 of the students. Seven of the students were in their first semester in Fulton, one in their second semester, and eight in their third semester. The students transferred from nine different CCs in Arizona. Glendale CC had the most transfer students in this program with six students. Although we have sent emails to new transfer students telling them about the METS Center and the scholarship programs, most of the students heard about the program from someone at the METS Center or from a friend who was in the Scholarship Program.

We were interested to know what their motivation was for doing the program. The students were given a list of possible reasons and asked to check all that applied. In addition, they were asked to add another other reasons that they may have had. The results are shown in Table III. By a small margin, money and wanting help with their academics were the top #1 reasons for students attending.

Motivation for Completing \$300 Program*	#1 Reason			All Reasons		
	W	M	Total	W	M	Total
Needed the money	2	2	4	6	8	14
Wanted help with my academics		4	4	5	8	13
Heard good things about the program	1	1	2	6	9	15
Wanted to learn more about jobs and internships		2	2	5	9	14
Thought that participating would help get the larger scholarship the next semester		2	2		3	3
Thought that the program sounded like fun		1	1	3	8	11
Wanted to learn more about engineering	1		1	2	6	8
Didn't qualify for CIRC/METS Scholarship	1		1	2	2	4
Other**	1		1	3		3

Table III. Motivation for Completing Academic Scholarship Program by Gender

*Students were asked to check all that apply.

**Wanted to know more about industry, opportunity to stay focused, to become acquainted with more engineering students since new on campus

The primary motivations for the students to complete the program were that they: heard good things about the program, needed the money, wanted to learn more about jobs and internships, wanted help with academics, and thought that the program sounded like fun.

When asked to give an overall rating of the Academic Success Scholarship Program, 94.7% of the students rated the program as excellent or very good. See Table IV.

Program Rating	W	M	Total
Excellent	6	9	15
Very Good		3	3
Good		1	1
Fair			
Poor			
Total	6	13	19

Table IV. Program Rating by Gender

A major question was if the \$300 was a large enough incentive for students to do the Academic Success Program. Table V shows that most of the students thought that the scholarship amount was about right or they would have done the program for free knowing how much they learned. However, the value of the course is not known before the student enrolls. One student commented that the \$300 was an incentive for him to complete the program. A related question was if the student would recommend this program to other transfer students who did not have a CIRC/METS scholarship. All 19 students said they would recommend the program.

\$300 Scholarship was:*	W	M	Total
About right	4	6	10
I wouldn't have done the program for less		2	2
I would have done the program for free knowing how much I learned	2	8	10
Other Comments		1	

Table V. Opinions on Amount of Scholarship for Program Completion by Gender

*Students were asked to check all that apply.

The students were asked to list the parts of the program that they thought were the most beneficial. Topics listed by the women as the most beneficial to them included: learning a more effective way to study, the 4.0 Plan, speakers from industry, workshops from Career Services and the library, networking with other transfer students and learning about their struggles and how they handle them, information about graduate school and research on campus, meeting people from industry and graduate students helped me to get focused, learning about Research Experiences for Undergraduates (REUs), getting prepared for a career fair, learning how to write a good resume, meeting with professors, learning that it is important to do research to find out whether research is an area they would like to pursue.

Additional topics listed by the men included: the suggestions of note taking and studying; the meetings; hearing professional recruiters come and talk about opportunities, what they are looking for, and how to get a job; meeting with the panel of graduate students; emphasis on course work; encouragement on graduate school; engineering job descriptions and academic encouragement through persuasive guest speakers; the help that staff are willing to give; made me more aware of the opportunities available to me; the facilities offered by the center; 4.0 Plan was very effective with time management and getting good grades; we could ask questions of working engineers about their work and what it is like to be a real engineer in industry; exposure to other careers through professionals; motivation to continue studies by peer-story-sharing; and broadening one's knowledge.

Several pertinent remarks were made by the students about the most beneficial part of the program:

- The 4.0 program is a great tool for anybody beginning the university education process. It is very easy to get lost at the beginning.

- The 4.0 plan definitely helped me. My first semester at ASU was rough. I saw a big improvement in my GPA once I tailored the 4.0 plan to fit my needs. I now have a 3.0 two semesters later (if only I could erase that first semester).
- The program made me more professional when it comes to applying for internships and scholarships.
- I believe that the program itself is very beneficial in enlightening us students to become aware of opportunities at ASU as well as teach us how to become successful students.

The students were then asked to list the most enjoyable parts of the program. The responses included the following:

- Meeting students whose goals were to attend graduate school and are now my role models
- Loved the interaction with my engineering classmates
- Loved the fact that I learned more about the engineering field
- Loved that I learned about REU's and internships
- Graduate student panel
- Director's trip abroad slideshow
- The ambience in the meetings: very casual, non-threatening
- The food, of course
- Meetings were always fun, flexible, and enjoyable. What I enjoyed most were all the connections I made. I met other engineers who helped me get the grades that I wanted, so I am very grateful for the program.
- Since I am new to ASU, I made some friends through this program.
- I had fun talking at my former CC about my transfer experience.
- Peer support
- The camaraderie among students and personnel
- The food was very good. (When I heard that lunch would be provided I did not expect much, but it was very good.)
- I enjoyed the presentations from guest speakers from industry the most. It gave me a very good idea of what real world engineering is all about. It also helped me get connected with recruiters of respectful companies...
- The speaker from the library on using data bases for research.
- The fact that everyone is studying engineering so that one can relate to them.
- Learning that studying should be approached as a science, not at random
- Understanding that resources existed on campus for most endeavors: enthusiasm and dedication are the only prerequisites.

VI. Conclusions

The feedback from the students who took the Academic Success program shows that the students thought that the promise of a \$300 scholarship was about right and if they had known how much they would learn from the program they would have done it for free. Several students pointed out that since it is difficult to understand how much can be learned from the program before you take it, having a \$300 incentive is a good thing to

have as an incentive. Two students said they wouldn't have done the program for less than the \$300 incentive.

The women in the program all thought that the program was excellent and gave lists similar to the men as to the benefits that they received through the program. Since there may not be many other women in some of the women's classes, the Academic Scholarship program provides another venue to meet other engineering women. The information gathered by this study supports that such a program is important to the well-being, if not directly the retention of the students. One woman student remarked that she was surprised to learn through the program that time management can really make life easier. The program helped her balance being a wife, a full-time student, and a student leader, as well as working and doing research.

Perhaps one student sums up the program best:

- The whole program is a success in my eyes. It helped me greatly in balancing my school-work-personal life to a point where I felt confident I would succeed in my academic studies. I met great people that helped me in my classes and the program was a great stress reliever. The topics discussed were fun, informative, and well worth my time. I hope that in the future more students are able to join in this wonderful program.

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