AC 2012-5344: DETERMINING THE COMMUNITY COLLEGE AUDIENCE

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

Mary Anderson-Rowland is the PI of an NSF STEP grant to work with five non-metropolitan community colleges to produce more engineers, especially female and underrepresented minority engineers. She also directs two academic scholarship programs, including one for transfer students. An Associate Professor in computing, informatics, and systems design engineering, she was the Associate Dean of Student Affairs in the Ira A. Fulton Schools of Engineering at ASU from 1993-2004. Anderson-Rowland was named a top 5% teacher in the Fulton Schools of Engineering for 2009-2010. She received the WEPAN Engineering Educator Award 2009, ASEE Minorities Award 2006, the SHPE Educator of the Year 2005, and the National Engineering Award in 2003, the highest honor given by AAES. In 2002, she was named the Distinguished Engineering Educator by the Society of Women Engineers. She has more than 175 publications primarily in the areas of recruitment and retention of women and underrepresented minority engineering and computer science students. Her awards are based on her mentoring of students, especially transfer, women, and underrepresented minority students, and her research in the areas of recruitment and retention. A SWE and ASEE Fellow, she is a frequent speaker on career opportunities and diversity in engineering.

Dr. Armando A. Rodriguez, Arizona State University

Prior to joining the ASU faculty in 1990, Armando A. Rodriguez worked at MIT, IBM, AT&T Bell Laboratories, and Raytheon Missile Systems. He has also consulted for Eglin Air Force Base, Boeing Defense and Space Systems, Honeywell, and NASA. He has published more than 200 technical papers in refereed journals and conference proceedings. He has authored three engineering texts. Rodriguez has given more than 70 invited presentations, 13 plenary, at international and national forums, conferences, and corporations. Since 1994, he has directed an extensive engineering mentoring-research program that has served more than 300 students. Rodriguez's research interests include control of nonlinear distributed parameter and sampled-data systems; modeling, simulation, animation, and real-time control (MoSART) of Flexible Autonomous Machines operating in an uncertain Environment (FAME); control of bio-economic systems, renewable resources, and sustainable development; and control of semiconductor, (hypersonic) aerospace, robotic, and low power electronic systems. Rodriguez has received the following honors AT&T Bell Laboratories Fellowship; Boeing A.D. Welliver Fellowship; ASU Engineering Teaching Excellence Award; IEEE International Outstanding Advisor Award; White House Presidential Excellence Award for Science, Mathematics, and Engineering Mentoring; and the Ralf Yorque Memorial Best Paper Prize. Rodriguez has also served on various national technical committees and panels. He is currently serving on the following National Academies panels: Survivability and Lethality Analysis and Army Research Laboratory (ARL) Autonomous Systems. Personal website: http://aar.faculty.asu.edu/.

Ms. Anita Grierson, Arizona State University

Anita Grierson has been the Director of the METS Center in the Ira A. Fulton School of Engineering at ASU since 2008. Grierson has more than 10 years corporate experience in program management, business development, and biomechanical engineering, with products as diverse as air bag systems for helicopters, body armor, and orthopedic implants. She received her bachelor's degree in mechanical engineering from the University of Michigan in 1990, her master's degree in mechanical engineering from Northwestern University in 1994, and a master's in business administration from Arizona State University in 2000.

Determining the Community College Audience

Abstract

With the continued need for more engineers and computer scientists in the United States, efforts to educate and to encourage more students to consider engineering are increasing at the community college (CC) level. Students at non-metropolitan CCs may especially need to have someone reach out to them with encouragement about attending a four year school and to consider engineering as a career. Therefore a question that needs to be answered is this: "How can a university best do outreach to a non-metropolitan CC?" In our experience, having a captive audience in the classroom is the best way to reach CC students with information about engineering. In this way, their attention is focused on engineering for at least a few minutes. The next question that begs itself is: "What is the most effective engineering message for rural CC students?" That question suggests the next one: "Who is the audience at the rural CC?"

This paper describes the results of a short questionnaire given to 116 students at a non-metropolitan CC. This work is sponsored by a National Science Foundation STEP grant. The questionnaire was given at the end of a 20-60 minutes presentation in a classroom by an engineering university professor. It was not surprising to learn that the students wanted more information on financing a Bachelor's degree and on the transfer process; a number of students also wanted more information on engineering. We note the information by gender, ethnicity, and age. Suggestions are given for using these results to advantage when designing the engineering outreach message according to the audience.

I. Introduction

With the increasing need for engineers in the United States, more attention is turning to the community colleges (CCs) as a possible source. However, it is known that most CC students do not get an Associate Degree or go on to a four-year school.[1,2,3,4,5] Only 15% of students who start Texas Community Colleges "full-time go on to earn four-year degrees within six years".[1] In Illinois, "fewer than 1 in 5 first-time students who take full loads of classes graduate with associate degrees within three years".[2] A study of California Community Colleges found that "70 percent of students did not complete a degree, certificate, or transfer to a university".[3] National studies have also been conducted recently on this issue and try to answer the question: 'What helps students graduate?"[4] "A Matter of Degrees: Promising Practices for Community College Student Success" describes 13 promising practices in community colleges.[5] This study warns that there is not just one magic cure for student success but an accumulation of events and experiences that will affect the success of a student. The 13 promising practices (which are really not new) fall in the three areas of Planning Success, Initiating Success, and Sustaining Success.[5]

Many CC students are undecided in their career choice. Of 61 university transfer students in an engineering scholarship program in the Ira A. Fulton Schools of Engineering at Arizona State University (ASU), 19 (31%) did not know what they wanted to major in and this influenced their decision to go to a community college (CC).[6] The three primary reasons why they attended a CC was the low tuition, proximity to home, and the smaller classes. Over 50% of these 61 students did not decide on engineering or computer science as a major until they were in the CC.[6] Dependent on why they are at a CC, the student may need help with deciding on a career that interests them, gaining the confidence to go to a four-year school, or be shown a way that they can afford financially to attend a university. In many cases for CC students, not only has the choice of a career not been made, but engineering is not even on their radar screen. In order for CC students to be made aware of engineering and computer science as careers, someone needs to talk to them. For convenience, henceforth in the paper the word "engineering" will include computer science. Since many CCs were established because there is no easy access to a university for those who live in that community, these non-metropolitan (rural) CCs may have students who have had no contact with engineers and little or no knowledge of engineering, let alone any engineering role models. Our work with non-metropolitan CCs has been documented in several publications.[7-14]

The CC in this study is at least an hour and a half from any four-year school and over three hours from Arizona State University, the home of this outreach team. The CC is in a very rural area and the student body includes a strong Hispanic population. The students who have transferred from this CC tell us that, if they wish to stay in the area, the primary occupations to which local students aspire are to be a border patrolman, to work with the border control in some way, or to work at Wal-Mart. These students also tell us that it is also common "knowledge" that if you are not in the top 20% of your high school class, you will not be able to make it even at the CC level. It takes strong determination to break through these beliefs. Fortunately, in our work with these students we have seen examples of students who have done very well in their academic career even though they were not expected to. For example, one student, who was not in the top 20% of his high school class in the local high school and had no role model in his family with any postsecondary education, determined that he would make it in college in spite of having been told that he couldn't. With the help of our encouragement, the award of scholarships, and an academic success class which emphasized going on for a graduate degree, this student not only graduated well with a degree in electrical engineering from ASU, but he is now working on his PhD degree at a Big Ten school with a full fellowship supporting him! This minority student wants to be an engineering professor! We want to increase the numbers of students like this example. How can we do this? How can we get students to even consider engineering?

When we drive over three hours each way to visit a CC, we want to be sure to utilize our time well while we are on the campus. Just announcing a meeting to talk about engineering, even with food involved, is not effective in drawing an audience which knows very little about engineering in the first place. We have determined that speaking to captive audiences in a

classroom is our most effective and efficient way of reaching students and of, at least, planting a seed of interest concerning the many opportunities available to an engineer. At first, the instructors in math, science, and engineering classes were quite reluctant to give up any class time for visitors to "talk about engineering". We appreciate that these instructors have a lot of material to cover in a limited time. However, after having heard an effective 10 or 15 minutes minute presentation, which includes encouragement to take more mathematics classes, information on how the material in their current class has a place in engineering, and how engineering is a very exciting, challenging, stable, and well-paid career, these instructors often are now willing to give us an entire class period to talk to their students on our next visit. We also try to point out to the students how important their math and engineering instructors are. We mention that there is a big divide in the type of technical job for which you qualify based on your math knowledge. We try to visit the CCs once a semester and to address as many classes and students as we can. We have learned that we need to adjust the message depending on whether students are at the Algebra stage or the Differential Equations level, since most of the students taking Calculus or above are already thinking of a career in science or engineering. We try to incorporate many of the statements that students find encouraging from the "Changing the Conversation"[15] suggestions.

With a survey, we hoped to learn more about our audience at this particular school.

II. The Survey

In Fall 2011, we administered a short questionnaire to over 116 students one day at a non-metropolitan CC. This work is sponsored by the National Science Foundation STEP grant 0856834. The questionnaire was given at the end of 20-60 minute presentations in classrooms and in one case to several classes at one time who met in a large room. Refreshments were offered to the students in the large meeting. Some of the instructors took attendance to ensure that their students would hear the message. Other instructors did not and some of their students took the opportunity to cut the rest of the class. We had three speakers for the classes that day: a male, Hispanic electrical engineering professor, a Caucasian female industrial engineering professor, and a briefly retired Caucasian woman engineer. These three different speakers were used in mathematics classes that ranged from trigonometry and pre-calculus to calculus III, a chemistry class, and an Intro to Engineering class.

The students were assured on the survey that individual information would not be made public. The students were asked their gender, age, ethnicity, year in school, and mathematics class enrollment. We then asked the students how strongly they agreed with the following four statements and to circle the number that best represented how they felt where:

1 = very unlikely, 2 = not likely, 3 = indifferent, 4 = likely, and 5 = very likely

The statements were:

- I plan to get an Associate's degree (2 year degree)

- I plan to get a Bachelor's degree (4-year degree)
- It is likely I will choose Engineering or computer Science as a major
- It is likely I will transfer to ASU's Fulton Schools of Engineering

The next questions were:

- If not ASU, which 4-year school do you plan to attend? What draws you to your first choice? (e.g. specific program, family connection, size of school, location, etc.)
- Intended major?
- How certain are you about your choice of major? (Circle One)
    - Very Confident, Confident, Neutral, Doubtful, Very Doubtful
- How supportive is your family in your plan to obtain a bachelor's degree? (Circle One)
    - Very Supportive, Supportive, Somewhat Supportive, Not Supportive, Not applicable
- What could prevent you from obtaining a bachelor's degree? (Circle all that apply)
    - Language problems, math problems, finances, family obligations, other (specify)
- Please check the topics that you would like to know more about. (Check all that apply)
    - What are the different engineering and computer science majors?
    - How do I finance a Bachelor's degree?
    - How do I transfer from a community college to a four-year school?
    - Why is an engineering or computer science degree good to have?
    - What do engineers really do?
    - Where are the engineering jobs?
- What else would you like to know about ASU, engineering education and careers?

Finally we asked them to leave their name and email address if they wanted follow up. The students were also invited to meet with the speakers after class for more information.

III. Survey Results

We collected survey results from 116 students. Not all of the students completed the information for each question on the survey, so the number totals varied from category to category or question to question. See Table I for a summary of the demographics of the students. Among the students 44 (34.9%) were female. The primary results of the survey are shown in Tables II and III.

First, we notice in Table II that students, in general, were more certain of earning a Bachelor's degree than an Associate degree. Both more females ($p=.163$) and more males ($p=.018$) plan to get a Bachelor's degree than an Associate Degree. It is interesting to note that the females were somewhat more certain ($p=.153$) than males that they will earn an Associate Degree. More Caucasians ($p=.013$) and more Hispanics ($p=.039$) plan to get a Bachelor's degree than an Associate Degree. There was not much difference between ethnicities in earning an Associate Degree. Caucasians and Hispanics planned to get a Bachelor's degree at about the same rate; however, the percentage of Other students who planned to get a Bachelor's degree was

somewhat less than that for Hispanics (p=.151). Very few of the students were indifferent on whether they would earn an Associate or a Bachelor's degree. Those who were less than or equal to 21 years of age were more certain (p=.028) of earning an Associate degree than those over 21 years of age, although the two age groups had about the same percentage who planned to earn a Bachelor's degree.

Gender	**Number of Students**
Females	44 (34.9%)
Males	72 (65.1%)
Total	116
Ethnicity	
Caucasian	64 (55.2%)
Hispanic	33 (28.4%)
Other	19 (16.4%)
Total	116
Age	
<21 years	74 (63.8%)
21+ years	42 (36.2%)
	116

Table I. Gender, Ethnicity, and Age of Survey Students

Non-Metropolitan CC Survey									
Classification	**Plan to Get an Associate Degree**			**Plan to Get a Bachelor's Degree**			**Family Support**		
	% Likely, Very likely	**% Indifferent**	**% Not likely, Very Unlikely**	**% Likely, Very likely**	**% Indifferent**	**% Not likely, Very Unlikely**	**% Supportive, Very Supportive**	**% Somewhat Supportive**	**% Not Supportive**
Overall	85.34	0.86	13.79	95.69	1.72	2.59	90.52	2.59	6.90
Female	90.91	0.00	9.09	97.73	2.27	0.00	88.64	4.55	6.82
Male	81.94	1.39	16.67	94.44	1.39	4.17	91.67	1.39	6.94
Caucasian	87.50	0.00	12.50	98.44	0.00	1.56	92.19	1.56	6.25
Hispanic/Latino	81.82	3.03	15.15	96.97	0.00	3.03	90.91	3.03	6.06
Other	84.21	0.00	15.79	84.21	10.53	5.26	84.21	5.26	10.53
≤21Years	91.89	0.00	8.11	97.30	1.35	1.35	91.89	2.70	5.41
>21Years	75.61	2.44	21.95	95.12	2.44	2.44	90.24	2.44	7.32

Table II. Results of Non-Metropolitan CC Survey by Gender, Ethnicity, and Age: Plans to Get An Associate or Bachelor's Degree, Family Support

Both males and females felt that their families were supportive and there did not seem to be any difference in family support due to the age of the student or ethnicity.

Non-Metropolitan CC Survey									
Classification	**Will Choose Engineering or Computer Science**			**Plan to Transfer to ASU**			**Certain of Major**		
	% Likely, Very likely	**% Indifferent**	**% Not likely, Very Unlikely**	**% Likely, Very likely**	**% Indifferent**	**% Not likely, Very Unlikely**	**% Confident, Very Confident**	**% Neutral**	**% Doubtful**
Overall	55.17	12.07	32.76	14.66	32.76	52.59	81.03	14.66	4.31
Female	36.36	11.36	52.27	9.09	25.00	65.91	81.82	13.64	4.55
Male	66.67	12.50	20.83	18.06	37.50	44.44	80.56	15.28	4.17
Caucasian	53.13	17.19	29.69	7.81	31.25	60.94	79.69	17.19	3.12
Hispanic /Latino	69.70	3.03	27.27	24.24	48.48	27.27	78.79	15.15	6.06
Other	36.84	10.53	52.63	21.05	10.53	68.42	84.21	0.05	15.74
≤21Years	51.35	13.51	35.14	14.86	32.43	52.70	78.38	16.22	5.40
>21Years	63.41	9.76	26.83	14.63	34.15	51.22	85.71	9.52	4.79

Table III. Results of Non-Metropolitan CC Survey by Gender, Ethnicity, and Age: Choice of Engineering or CS, Plan to Transfer to ASU, Certainty of Major

In Table III we see that males are more likely (p=.001) to choose engineering or computer science as females, which would be expected. Males were also more likely (p=.153) to transfer to ASU than females. Males and females appeared to be equally certain of their major. Hispanics were more certain (p=.102) that they would choose engineering than Caucasians and also more certain (p=.016) than the Other group. Caucasians appeared to be less likely than Hispanics (p=.045) or Others (p=.183) to transfer to ASU. The ethnic groups were about the same in their certainty of their major. The two age groups were about the same in their intent to transfer to ASU, but the older group was somewhat more certain (p=.204) of choosing engineering or computer science (p=.204),

Topic	**Number Students**
How do I finance a Bachelor's degree	52
How do I transfer from a community college to a four year school?	41
Where are the engineering jobs?	33
What are the different engineering and computer science majors?	22
What do engineers really do?	20
Why is an engineering or computer science degree good to have?	16
Total number of students responding	77

Table IV. Results of Non-Metropolitan CC Survey of What Topic Students Want to Know More About

Table IV shows the ranking of the topics that the CC students wanted to know more about. Not surprising, financing an education at a four-year college ranked number one and is of concern to 67.5% of the students who responded to this question. The students were also very interested in information on the mechanics of transferring to a four-year college. The third ranked question concerns where the engineering jobs are located. The next ranked question was on the many different types of engineers and computer science majors.

IV. Analysis of the Survey Data

Since the purpose of this survey was to look for trends, we considered any p-value up to at least .25 as worthy of notice. We wanted to use the data to generally inform our presentations. At first glance the number of women (35%) hearing a message about engineering was very encouraging, but many of the females were in low level mathematics classes with no intent to continue even into Calculus.

The number one area in which the students wanted more information was financing a Bachelor's degree. The ASU presentations at this CC include information about the grant scholarships available both at the CC and at ASU. The students also learn that there is a good opportunity for paid internships full-time during the summers and half-time during the academic year for ASU engineering students due to the many high tech companies which are situated very near to the campus. The number two area was a need for information about the transfer process which is included in our presentations. The students need to be made aware of the time line that should be followed for transfer. Critical transfer dates include the primary scholarship deadline and the FAFSA deadline. In order to be eligible for university scholarships, transfer students need to have applied before the scholarship deadline. FAFSA deadlines are important to note since FAFSA scores are needed in order to prove that the student has unmet financial need. Many scholarships at ASU require a FAFSA score even if the scholarship is not based on financial need. Early application and acceptance are also important for early registration.

It is encouraging that 33 students were interested in learning more about engineering. In the third ranked area, the students were interested in knowing more about where the engineering jobs are located. Fortunately, Arizona is a state in which more engineers are needed by the high tech companies. Some Arizona companies hire a larger percentage of students with graduate degrees than undergraduate degrees. These facts should comfort the students who would like to stay in Arizona and who are concerned with the location of engineering jobs. In reply to the fourth ranked question "What are the different engineering and computer science majors?" the primary majors are discussed in the ASU presentation to the CC students during the classroom visits. The students are given the address of several websites, including that of ASEE, where they can learn more about engineering. Interested students are also given a copy of the ASEE "Go For It" magazine which includes very excellent information about engineers and helps to explain what engineers really do. Students are assured that the selection of an engineering major does not necessarily limit the person to that area of engineering. Much cutting edge research is

interdisciplinary. Students are informed that they can switch to a different area for a Master's degree. One of the ASU speakers with an electrical engineering degree explains how he has worked in many engineering areas including aerospace and mechanical. The ASU presentation to the CC students also includes reasons why engineering is a good degree to have. These reasons include salary (comparative salaries with other careers are shown), choice in type of engineering job (travel or no travelling, small or large company, number of hours of work expected in a week, and low unemployment, as well as the possibility of flex time or working from home. At the end of the presentation, the students are reminded that money is not the only rationale that should be used to select a career. The students are encouraged to follow their heart: if they are passionate about a career, they will surely do well in it.

It is not surprising that the students were more certain of earning a Bachelor's degree than an Associate's degree. Students who plan to go on to a four year school may not see the value of obtaining an Associate Degree. Those who are older may be more aware that the Associate degree is not critical to their career path leading to their lower percentage of planning to get an Associate Degree. In Arizona, because of the education elective units which are required for an Associate Degree, students at a CC needs to take several education classes that do not count toward an engineering degree at a college. Caucasians and females are the groups the least likely to transfer to ASU. This would be a good area for further exploration. Many of the females have selected a university which is somewhat closer to their homes than ASU. Since ASU has had a presence on this campus for only a few years, some of these students may not have ever investigated if ASU would be a good school for them to attend. A current joint effort between ASU and this CC is determining a "METS Pathways" in engineering for students transferring from a CC. The METS Pathway will detail all of the courses that a student at any particular CC can take that will count toward their BSE degree in a particular major. At the same time, the Pathway will show all of the courses needed at ASU for the transfer student to complete the BSE and which courses can be reverse transferred to the CC to complete an Associate's Degree in Science or Engineering. Since the state of Arizona has complete articulation agreements with its three universities and all 21 of its CCs, this task may be difficult, but is not impossible.

The certainty of family support in academic endeavors seemed higher than might be expected since many of the students are assumed to be first generation students. Perhaps families are supporting their children to get an education so that they can leave the area that they live in because there are not a lot of opportunities for local career development.

It is perhaps surprising, but certainly hopeful, to see that Hispanics as an ethnic group are the most certain of choosing engineering or computer science as a major. Their certainty of a major is also quite high. Because they are interested in engineering or computer science, they may realize that an Associate Degree is not that important, but a Bachelor's degree certainly is. The Hispanic students also are the most certain as a group to transfer to ASU, although nearly half of them are still indifferent on this choice. These ratings make sense if we consider that the engineering school at ASU is ranked number one in the state and has an excellent reputation

among industry. ASU also has a reputation as being a good school for Hispanics. ASU also has a very strong student section of Society of Hispanic Professional Engineers, which should be mentioned for potential Hispanic engineering students.

There is other information that a four-year school can learn about their potential transfer students. Many of the students were not rejecting ASU as a school to transfer to, but had been programmed to consider other schools. For example, one school selected by many students is closer to their home than ASU is, but the students had never thought to compare the engineering programs nor to check to see what scholarships and other support were available for transfer students. Another school was known because for its low tuition if you were a member of the church supporting the school. The students had not thought about the fact that if they could obtain a scholarship to go to ASU, the cost of ASU might be as low as or lower than another school they were considering. Several students have chosen a university because they can have free housing living with relatives who live close to that university, which is a very understandable factor. A factor that was new to most of the students was that because ASU is so close to many industries, it is possible for students to work 20 hours a week (at a good salary) while going to school. Also, we have learned that some students did not realize that engineering internships are paid internships.

When we begin a classroom presentation, we often first discuss careers in general. As would be expected, few in the lower level mathematics courses were interested in engineering, while almost all of the students in Calculus III intended to be engineers, while a few of these students were pursuing physics or mathematics. An effective message for many of the students in the low level mathematics classes is to discuss careers. The students are asked about their career choice and why they chose it. To open their minds to other possibilities, suggestions are made that perhaps instead of a physical therapist, they might want to be an engineer involved in biomedical engineering or environmental issues. Instead of being a pharmacist, perhaps the student should consider Chemical Engineering and be able to develop new drugs. The 21st Century Challenges are presented with the many opportunities that are available to engineers. Engineers can choose jobs with travel and without travel, in a large city or a small city, in a large company or a small company, and so on. The salaries earned by engineers and other majors are compared in the class presentations. An emphasis is made that you should not choose a career for the money you will make, but if you choose something that you truly love, you will do well in it, and if you make good money at the career, then that is a bonus. Students who intend to be doctors are surprised to learn that Biomedical Engineering is an excellent undergraduate degree for them in preparation for medical school and which gives them options in addition to medical school. The students are warned that pre-med degrees are not a very marketable degree and that a biomedical degree has much more potential. Students interested in law (although we have seen very few of these at the CC) are encouraged to look at engineering as their undergraduate degree. The students are also told that the engineering degree is required for patent law. Additional

information that may be of interest to the students is the lower unemployment rate of engineers than other careers.

The time spent at a table between classes and at the end of the day proved to be useful for some students who had not heard the class presentations and for some students who had questions after the class presentation. One surprising result was that at least two students who had been accepted into a Technology school thought that they had been accepted into engineering because the major was listed as Mechanical Engineering Technology. Since some of the lower level mathematics classes are populated by high school students, it is best to not assume anything about the audience, even to the point of explaining the difference between an Associate degree and a Bachelor's degree. We were once asked if it was better to get an Associate Degree or a Bachelor's degree.

V. Summary and Conclusions

Surveys will be given at the other partner non-metropolitan schools to learn about the characteristics of the students at these schools in order to better present a message about engineering that will pique their interest. The closer the engineering message can be tied to the students' concerns and interests, the better they will listen to information about engineering and the chances are increased that they will be interested to the point of exploring the opportunities of engineering on their own.

It is important to experiment with different approaches. There is the need to remember that each school is different and that the students in the various class levels are usually at a different point in their career choice. Presentations at schools where the audience is a pretty tough group will probably have a better chance of being heard if the speaker knows about gangs and street life and is able to really talk to where these students live. Such a faculty member can immediately get their attention. The students are then willing to listen to some information about engineering because they are interested in and respect the individual delivering the message.

Each four-year school working with community colleges should learn about the students in their CC to be better able to talk to the students about their concerns and to draw their attention to engineering and computer science. The best advertisement for engineering and any particular four-year college is to have engineering role model students who are alumni from the CC being visited come and speak to the CC students. The students will believe "one of their own" and determine that if he or she could make it in engineering at a four-year college, then so can they.

Future research will include learning more about the attitudes and myths that the students may have about engineering, the engineering curriculum, what engineers do, and how they relate to an engineering career.

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