



Underrepresented Minority Students and Graduate School

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

Mary Anderson-Rowland, Arizona State University MARY R.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 three 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 over 185 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 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.

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Abstract.

The technology demands on the U.S. workforce are increasing. Not only does the United States need more engineers and computer scientists, but now more than ever, more of these professionals are needed with a Master's or a PhD degree. Some companies want at least half of their hires to have a graduate degree. The reasons for this demand are obvious: companies may outsource work which requires low skills, but they will not outsource their research which is needed to keep them competitive and at the leading edge in their products. Most engineering graduates are looking to start their career with a good salary upon graduation with the Baccalaureate degree, not go to graduate school.

In an Academic Success and Professional Development Program at Arizona State University with many transfer students, we encourage all of the students, minority and Caucasian, to go right on to graduate school. In this paper, we will particularly look at the program underrepresented minority students to learn what their main pros and cons were for going to graduate school. We also note the influence of the program on the decision to go to graduate school for the two groups and observe that the larger effect was with minority students. Suggestions on how to increase graduate school interest for both groups are discussed.

I. Introduction

Since 2002 the Ira A. Fulton Schools of Engineering at Arizona State University, we have had an Academic Success program for both native and transfer upper division students in engineering and computer science. The program features an Academic Success and Professional Development (ASAP) class, mentoring, scholarships, and support through a Motivated Engineering Transfer Students (METS) Center. Each day 30-40 students use the Center and each semester 300-400 students use its services. Seventy percent of the Center usage is by transfer students who find the Center especially helpful their first year of transfer. The primary purposes of the Academic Success program are to graduate the student, to provide professional development by teaching skills which are not gained through the classroom, to support the student financially through a scholarship, to encourage the student, and to have the student go directly to graduate school after graduating with a Bachelor's degree in engineering or computer science. Computer science is contained within the Schools of Engineering at ASU and therefore, henceforth in this paper, the term "engineering" shall include computer science. The Ira A. Fulton Schools of Engineering receives over 400 new transfer students each fall, with additional students transferring in the spring.

The Academic Success program began in 2002 as the result of receiving a National Science Foundation (NSF) CSEMS grant (#0123146) for \$400,000 over four years to support upper division engineering classmen with scholarships of \$3,125 per academic year. At that time the amount essentially covered a year's tuition. The first class was half transfer students, showing that such a program was attractive and especially needed by transfer students. ASU applied and

received a second CSEMS grant of \$400,000 (#0324212) focused just on upper division transfer students, again with a \$3,125 scholarship. The first program focused on native upper division engineering students and graduate students who had graduated through the Academic Success Program.

II. The Academic Success and Professional Development Program

At first the scholarship students attended an Academic Success seminar. After a few years, the seminar was changed to a one credit class which was open to both scholarship and non-scholarship students. The advantage of having the class for credit for the students is to be able to get credit for good work by having a grade that counted in their GPA (although the credit does not count on their Program of Study). From a program director view, this was a way to make sure that the students did what they needed to do to be successful. More recently, at the request of the students, the class was changed to two semester credit hours. Since the first two CSEMS NSF grants, each grant program has been continued with an S-STEM NSF grant #0728695 for transfer students and #1060226 for native and graduate students. Due to word of mouth about the good information that the students receive and the suggestion of Academic Advisors, the attendance in the Academic Success Class grew to 179 in Fall 2013 with a majority of the students being non-scholarship holders.

This large class was difficult to work with and still keep the class a small supportive, networking type of environment. Each of the six meetings of the class was held six times to keep the attendance under 30 students and to accommodate the numerous different schedules of the students. The Ira A. Fulton Schools of Engineering Dean's Office noted the successful outcomes of the program and began to expand and to sustain the program by offering two sections of a one credit Academic Success Class for new transfer students in the Fall 2013 semester. These classes were attended by some 60 students. One section of this class was offered in Spring 2014.

The one credit transfer success class is welcomed by the directors of the ASAP two credit class. While all transfer students can benefit from an Academic Success class, some transfer students do not fit well into the two credit class with an emphasis on research and graduate school. Although the one credit class is patterned after the two credit class, there is less of an emphasis on graduate school and research. The students in the one semester, one credit class are encouraged to enroll in the two-credit class their next semester, especially if they are curious about or interested in graduate school and research. Research will be done to compare the differential effects of the one and the two credit Academic Success classes.

The Academic Success Program is similar to an Honors College or Academy on a university campus. An Honors College is not for all students, but for those who fit this structure and philosophy, it is a tremendous experience. Similarly, the Academic Success Program is not for all students, but those who have been in the program have benefitted greatly. The graduation rate of these scholarship students has been about 95% and in recent years about 50% of these students, both transfer and native, are going directly to graduate school after the Bachelor's degree. These rates are exceptional when one realizes that nationally less than 20-25% of engineering graduates go directly to graduate school. The upper division transfer rate of

graduation at ASU for engineering students is about 70% (less than 65% for females). Typically only about 11% of transfer students go directly to graduate school after graduation. It should also be noted that these high graduation and graduate school rates are for students who all have unmet financial need, a requirement of the program scholarship.

The difference between an Honors College and the Academic Success Program is that we do not primarily seek only the top academic students. Although we welcome top students, the minimum criteria for receiving a scholarship is as follows:

- Minimum 3.0 GPA
- Full-time engineering or computer science major
- U.S. Citizenship, Permanent Resident, or refugee
- Unmet financial need as defined by FAFSA

In addition, we focus on females and underrepresented minority students. We have maintained a program representation of about 60% female and/or underrepresented minority students.¹

The ASAP class is based on the “Guaranteed 4.0 Plan” by Donna O. Johnson.² Basic to this plan is a detailed time management system. Time management is a major issue for most students. By having a plan to spend adequate time to learn material, the student’s angst goes down and performance goes up. The 4.0 Plan is a system for learning how to learn. Students who take the Plan seriously increase their grades and students who have already been earning straight A’s find that they can do so in less time. New transfer students who follow the Plan find that they can avoid “transfer shock” and do as well or better at the university than they did at the community college.³ This is particularly important for transfer students since their GPA starts again at 0.0 when they transfer.

The ASAP class includes the following topics in addition to the 4.0 Plan: resumes, the elevator speech, interviewing, working a career fair, academic success tips, portfolios, how to access on-line data bases, how to write a research paper, the 4+1 program, how to apply to graduate school, and graduate school. A favorite program is to have a panel of graduate students who have gone through the program address and answer the questions of the students in the ASAP class to “tell it as it really is”. In addition, engineers with advanced degrees are brought to the class to talk to the students about engineers in industry, what the company is looking for in a hire, and how engineers with advanced degrees are used in their company. An additional topic that usually stretches the mind of the students is to have them write a minimum 5 page paper on their career and life plans for the first 10 years past their Bachelor’s degree. There are some 20 topics that need to be covered in the paper. An advantage of the students taking the class several times is that the research papers get deeper and more thorough through time and the career plans become more detailed and well thoughtout.⁴ Additional program information is found in the references.⁵

III. Graduate School

Many students who attend engineering schools never consider going to graduate school. Three common myths are:

1. Only students who aspire to go into academia need to go to graduate school

2. An engineer only needs a Bachelor's degree to get a great job and excellent salary
3. Earning a Master's degree will price them out of a job in a tight employment market

Since students are not generally aware of what difference graduate school can make in their life, they do not seriously consider or plan for graduate school.

In addition, with high rising tuition fees, school, let alone graduate school is difficult to support for many Arizona families. The state of Arizona, for example, is one of the leading states in the nation with a high percentage of families not able to support a college education for their children. Therefore, additional reasons that prevent students from aspiring to graduate school include:

1. I need to go get a good paying job as fast as I can because my family needs financial help, I don't want to go into debt, or I do not want to go into deeper debt
2. I am not sure what I want to do, so I want to work for a couple of years and figure that out first
3. The company where I want to work does not require a Master' degree
4. I am the first in my family to even earn a Bachelor's degree
5. I am not smart enough to go to graduate school

First generation students with unmet financial need, who started their postsecondary education at a community college because it was the only way they could afford to go to college, are not usually thinking about pursuing a graduate degree before going to work as an engineer or computer scientist. In general, their main concerns include finding adequate financial support to get them through a Bachelor's degree so they can find a good, well-paying job and be able to pay off their debts and support themselves and often their family.

In our Academic Success and Professional Development Program at ASU with many transfer students, we encourage all of the students in the class (assuming that their GPA is at least a 3.0), minority and Caucasian, to go right on to graduate school. Our primary reasons include that a Master's degree engineer, in general:

1. Is more likely to find an area of interest and passion
2. Feels much more confident about an area of engineering
3. Is usually placed in a position of leadership with more interesting challenges
4. Has more choices of projects in which they will be involved
5. Receives a considerably higher salary which further increases

We strongly feel that the time to do graduate school is right after the Bachelor's degree. We are aware of students who try to work full-time with their company paying their tuition, but who find it extremely difficult to do graduate school this way and drop out. We discourage working full-time while doing graduate school for the following reasons:

1. It is extremely difficult to start a new job, work over 40 hours a week, and attend graduate school
2. It is very difficult to quit a full-time job and a good salary to go back to school full-time

3. Life happens. Most engineers who leave the university do not come back to do a Master's degree.
4. Although there are on-line graduate courses, we believe that graduate school is best and can really be fun if you earn your advanced degree(s) in person with other like-minded students.

IV. The Study

In Fall 2012, a survey was given to the students in the ASAP course. The 21-day enrollment was 179 students⁵ and 161 students completed the course. One hundred nineteen transfer students of the 133 total transfer students (89.5%) completed the survey. In this paper, we will particularly look at the underrepresented minority students in the study to pull out what their main pros and cons were for going to graduate school. Since most of the underrepresented minority students at ASU are Hispanic/Latino students, we will compare the 37 Hispanic/Latino students with 60 Caucasian students for their opinions on graduate school. It is interesting to note that before taking the Academic Success and Professional Development class, only 32.43% of the Hispanic/Latino students thought that they might be interested in graduate school and after taking the class, 89.19% thought that they wanted to go right on to graduate school. See Figure 1. Since the number of minority students receiving graduate degrees in engineering is very low, these percentages are quite large. By contrast, 35% of the Caucasian students were thinking graduate school before the class, and after the class, 83.33% decided that they wanted to go right on to graduate school. See Figure 2. The estimated national average of the percentage of engineering students who go right on to graduate school is less than 25%. It should be noted that although a few of these students are already in graduate school, this percentage is measuring if the student plans to go to graduate school, not how many actually will. However, the large difference in intent to go to graduate school implies that the ASAP class had a significant effect on this decision.

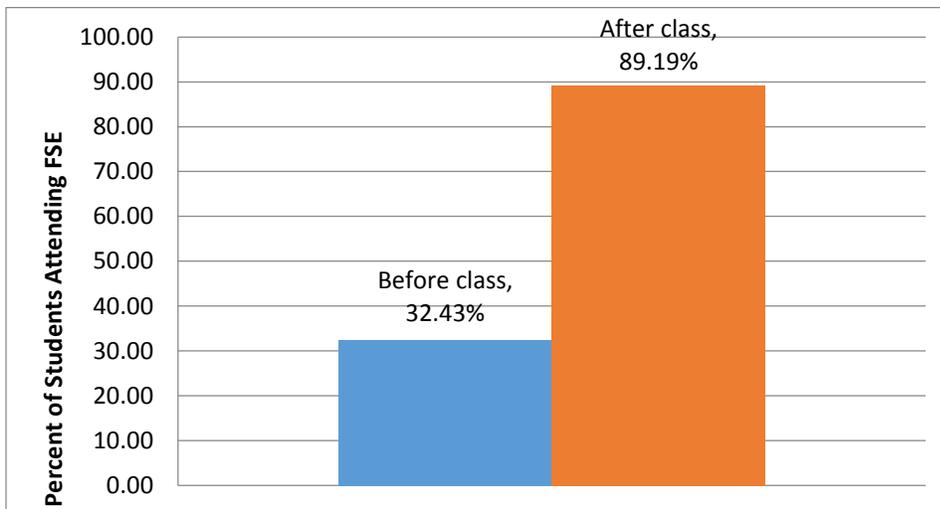


Figure 1. Percentage of Hispanic/Latino Students in an Academic Success Class Who Plan to Go to Graduate School, n=37.

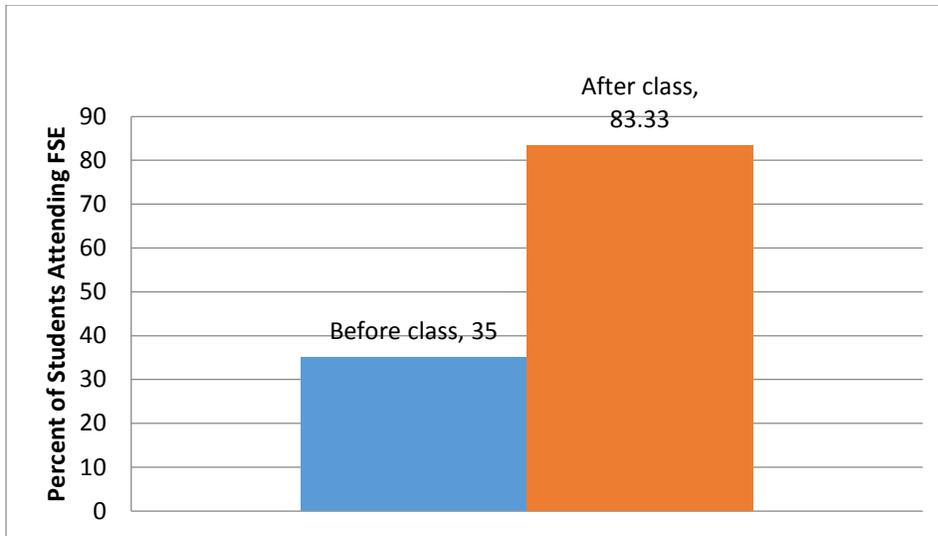


Figure 2. Percentage of Caucasian Students in an Academic Success Class : Who Plan to Go to Graduate School, n=60.

Next we asked the students why they plan or don't plan to go to graduate school. A summary of the responses from the Hispanic/Latino students is as follows:

Pro for going to graduate school:

- More job opportunities, flexibility, advancement
 - get a better job, career advancement
 - be involved in the highest level technology
 - Master's degree valued by employers
 - I know it is better to enter a company with a Master's degree
- Money
 - higher education, more money.
- The 4+1 program
 - can earn a Master's degree in one year after the Bachelor's degree
- More knowledge and education is good
 - want to be well-educated
 - it is my dream
 - I do not see rejecting education as an option, and I'm grateful for it.
 - to get a PhD
- Research
 - want to go into research to be a valuable engineer for 40+ years
- Want to progress the field
 - want to further knowledge and understanding of engineering
- Role models
 - Graduate School panel and industry professionals were convincing
- Separate myself from other engineers
- Received a large amount of information about graduate school

- Academic Success and Professional Development class
- research experience
- benefits of grad school outweigh the benefits of going straight to work
- now see benefits of Master's degree in industry
- learned what graduate school has to offer
- Right time
 - I know that if I don't do it now, then it will be harder to do in the future

Con for going to graduate school

- Finances
 - I would like to go, but need to begin work as soon as possible
 - I cannot afford graduate school.
- Not qualified
 - my GPA is not high enough; I need to concentrate on getting a Bachelor's degree

The primary reasons for going to graduate school include: understanding what graduate school is all about; understanding the importance of a graduate degree in industry; career flexibility and opportunity; understanding the field better; and preparing for research to work on the most technical areas of engineering.

Students often reject graduate school because they cannot see a way to finance themselves. We try to impress upon them that there are many sources of support for graduate school and a good way to begin is to get involved with research as undergraduates. We also encourage students to think about taking out a loan for graduate school, if necessary, as an investment in their future. We recently added a presentation to the class that shows the students how taking out a loan for their education outweighs working part-time or full-time at low wages for a long time in order to complete their education.

The major reasons that the Caucasian students gave for going to graduate school and earning at least a Master's degree are as follows:

- More job opportunities, flexibility, advancement
 - including higher starting employment level
 - would be more successful with a graduate degree
 - the work I want to do requires at least a Master's degree
- Money
 - better starting pay
 - make more money
- The 4+1 Program
 - makes Master's degree easier and cheaper
- More knowledge and education is good
 - helps me attain my long term goals
 - have always wanted to go as far as I could with my education
 - love to learn

- extremely useful for learning more about a special area of interest
- Research is a good field and requires more than a Bachelor's degree
- Want to help progress the field
 - better able to make a difference in engineering
- Want to teach
 - may want to teach at a university after completing some work in industry
 - want to be able to teach at a Junior College
- Have the finances to go
 - have paid tuition with stipend
- Received a large amount of information about graduate school
 - it does not seem like such an impossibility anymore
 - course instructor was very convincing
 - became convinced that graduate school was beneficial
- Right time
 - do not have family responsibilities so now is the right time to go to graduate school
 - don't want to come back to school after beginning work

Con for going to graduate school:

- Finances
 - still unsure, but have family to take care of and need a job
 - age and family commitments
- Situation won't allow
- Not worth it
 - as a business owner, personal returns are much higher than going for another degree
 - not convinced graduate school is worth it since nearly all of the companies asked said they don't mind either way
 - companies where I want to work say they are looking for undergraduates
 - if I manage to land a good job before I graduate, I will not go to graduate school

Primary reasons for going to graduate school by Caucasians were better job opportunities and flexibility, more money, and the 4+1 program making it easy to go on to graduate school. Caucasians, more often than the Hispanic/Latino students, cited making more money as a primary reason. More of the Caucasian students cited family responsibilities as a primary reason for needing to get a job right away and not going to graduate school.

We note that the Hispanic/Latino students mentioned role models specifically and that they wanted to separate themselves from the rest of the engineers. The importance of role models for underrepresented minority students is well-documented in the research literature. The Caucasians did not mention these items. None of the Hispanic/Latino students mentioned that they already had the finances to go to graduate school as did two of the Caucasians. In addition, not being qualified to go to graduate school was mentioned by a Hispanic/Latino student, but not by a

Caucasian. No underrepresented minority students mentioned that graduate school was not worth it, as did several Caucasians. Although teaching in the future was listed as a reason to go to graduate school by some Caucasians, it was not listed by the Hispanic/Latino students.

V. Conclusions and Recommendations

The reasons given by the students for going to graduate school include all of the reasons given by the ASAP course and role models in that course. Many of the students admitted that when they came to ASU as a transfer student, they did not know what graduate school really was or why they would need to go to graduate school. Most of the students credited the Academic Success Program with either convincing or reassuring them that graduate school was the right thing to do. Several students with Master's degrees have told the ASAP students that after a Bachelor's degree they did not feel very confident about their field, but after a Master's degree they were much more self- confident about their field.

The students who have given reasons for not attending graduate school have been warned that the companies who do not require a Master's degree may not have work that will be interesting to them after a time and advancement may be limited. The students are also shown that the average salary for beginning engineers with Master's degrees command a salary approximately \$15,000 higher than that for a Bachelor's degree engineering. In addition, this higher salary increases the gap from a Bachelor's degree salary as time goes on. At the same time, it must be recognized that perhaps not everyone that is enrolled in the ASAP class should be going to graduate school. It is our belief that for anyone who can go to graduate school should go in order give themselves the most opportunity for an exciting career in engineering.

A conclusion to be drawn from this study is that it appears that we are doing a good job in presenting graduate school as an option to the students. The ASAP class was a major factor in changing the mind of a large percentage of students. Although this study measures intent (over 80% intending to attend graduate school, our actual numbers are that at least 50% of our ASAP students are going right on to graduate school and these numbers are more than double the national average. In addition this group of students is 60% female and minority and all have unmet financial need, which would ordinarily mean that the percentage going on to graduate school would be lower. In addition, the reasons, pro and con, given by the students in this study can be used in instructing future students since we know that these are the types of thinking done by students in making a graduate school decision. Further studies will be made to attempt to define more precisely what the primary reasons are for students to either go or not go to graduate school.

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