

## Summary of a 14-Year NSF-Sponsored S-STEM Academic Scholarship and Professional Program

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Prior to joining the ASU Electrical Engineering faculty in 1990, Dr. 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 over 200 technical papers in refereed journals and conference proceedings – over 60 with students. He has authored three engineering texts on classical controls, linear systems, and multivariable control. Dr. Rodriguez has given over 70 invited presentations - 13 plenary - at international and national forums, conferences and corporations. Since 1994, he has directed an extensive engineering mentoring-research academic success and professional development (ASAP) program that has served over 500 students. These efforts have been supported by NSF STEP, S-STEM, and CSEM grants as well as industry. Dr. Rodriguez' 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); design and control of micro-air vehicles (MAVs), control of bio-economic systems, renewable resources, and sustainable development; control of semiconductor, (hypersonic) aerospace, robotic, and low power electronic systems. Recently, he has worked closely with NASA researchers on the design of scramjet-powered hypersonic vehicles. Dr. Rodriguez' honors include: 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; Ralf Yorke Memorial Best Paper Prize. Dr. 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, Army Research Laboratory (ARL) Autonomous Systems. Dr. Rodriguez received his Ph.D. in Electrical Engineering from the Massachusetts Institute of Technology in 1990. Personal Web site: <http://aar.faculty.asu.edu/>

# **Summary of a 14 Year NSF Sponsored S-STEM Academic Scholarship and Professional Development Program, Collaborative Interdisciplinary Research Community (CIRC)**

## **Abstract**

An NSF S-STEM Program, the Collaborative Interdisciplinary Research Community (CIRC), established in 2002 (#0123146) is coming to a close. The purpose of the program is to enrich the lives of upper division engineering and computer science students so that they fared well as students, graduated, and went on to graduate school right after receiving their Bachelor's degree. The program has grown from a workshop to a two credit class which serves both scholarship and non-scholarship students. The scholarships were funded through the NSF S-STEM grant. The program has a focus on females and underrepresented minority students and approximately 60% of the scholarships have gone to these groups. Many of these students are first generation and the scholarship students all have unmet financial need. A scholarship supplement with an emphasis on students from Hispanic Serving Institutions was added last fall.

The program features an Academic Success and Professional Development class which includes information on resumes, portfolios, elevator speeches, how to work a career fair, interest/research papers, reducing stress, graduate school, and career planning for 10 years past the baccalaureate degree. The underlying academic support is the Guaranteed 4.0 Plan. The program has proven successful with a graduation rate of 95% and 50% of the students going right on to graduate school for the scholarship students. These rates are much higher than national averages.

The lessons learned through developing the program and working with the students are best practices that could benefit any engineering student program.

## **Introduction**

In 2002, the Arizona State University (ASU) College of Engineering and Applied Sciences received an NSF CSEM grant (#0123146) for an upper division engineering and computer science student scholarship program. The program was called CIRC (Collaborative Interdisciplinary Research Community). The focus for CIRC students was females and underrepresented minority students with unmet financial need. This program complemented a lower division program for native students with an emphasis on minority students. The lower division students were recruited primarily from a High School Mathematics Summer Program for Minority Students held at ASU. Of the 22 students in the first CIRC class, several were transfer students implying that more attention needed to be paid to transfer students. A second NSF CSEM grant (#0324212) was secured the next year targeting upper division transfer students and their program was called CIRC/METS (Motivated Engineering Transfer Students). After the first year, the CIRC was composed then of native upper division students and graduate students. The minimum requirements for a student to receive one of these scholarships were:

- U.S. citizen, permanent citizen, or refugee
- Full-time, upper division student in engineering or computer science
- At least a 3.0 GPA
- Unmet financial need, as shown by FAFSA

Since one of the goals was to encourage students to go to graduate school, for the first few years, to prime the pump, scholarships were awarded to graduate students who met the above minimum requirements, except for being an upper division undergraduate student. The graduate students were good role models for the students in the CIRC and CIRC/METS programs. After the first few years, the only graduate students awarded scholarships were those who had graduated through the CIRC or CIRC/METS program as undergraduates. These graduate students in good standing can receive CIRC scholarships for up to four semesters.

The students for this program were originally recruited from the lower division scholarship program, other native students, and graduates of the CIRC and CIRC/METS programs. At first separate meetings for CIRC and CIRC/METS students were held, but since these programs include students from all engineering and computer science majors, it was very difficult find a time when everyone could meet. As the program grew, duplicate sessions were added. Currently, two 75 minute sessions on Thursday and two sessions on Friday on usually the same topic are held every other week in order to accommodate all schedules. A couple of years ago, the funding for the lower division S-STEM scholarship program concluded, so those students no longer transfer into CIRC. However transfer students from an NSF STEP program (#0856834) do join CIRC as graduate students.

In summer 2015, a supplement of \$119,999 was secured for this grant from NSF (#1060226). This grant, all in scholarship money, allowed scholarships to be directed to four Hispanic Serving Institutions. The institutions are community colleges with whom we have been working. Much has already been published on this program, including the evolution of CIRC.<sup>1-6</sup> Major highlights will be discussed.

### **Program Highlights**

The goals of this scholarship program have remained the same through its history. The first goal is to graduate the student. The second goal is that they will graduate in good stead with an excellent set of experiences in addition to the classroom, including internships and research positions. A third goal is that the student will go right on to graduate school full-time after graduation and earn an engineering or computer science Master's or Ph.D. degree. Everything done in this program is designed to help the student reach these three goals.

An Academic Success and Professional Development seminar or class has always been a part of the CIRC program. The class is currently a two-credit class and can be repeated for credit and a grade. Only one hour of credit (as a replacement for ASU 101) can be counted on a Program of Study. Students who hold a CIRC, CIRC/METS, or NSF STEP scholarship at ASU are required to take the course. The class is also open to non-scholarship students. A fundamental change to the Academic Success and Professional Development class and CIRC came in spring 2005 with the addition of the "Guaranteed 4.0 Plan" learning system by Donna O. Johnson Mackey.<sup>7</sup> In the

evaluation of the CIRC program each semester, the students would be asked, “Has this program helped you academically?” Each semester, most students would answer, “No.” After the introduction of the 4.0 Plan, students usually answer this question with a “Yes.” Although time management was discussed each semester before the 4.0 Plan, if a schedule does not include the right items, the schedule may not help academically. In the 4.0 Plan, the student is not only advised what to do, but when to do it, and to have it on the schedule so that it gets done. In a research study one semester, 17 new transfer students on scholarship, who took the Academic Success and Professional Development class and the 4.0 Plan, were compared with the over 170 new transfer students who did not take the course. The comparison was made to compare the amount of “transfer shock” in GPA experienced by each group.<sup>8</sup> The students who had the 4.0 Plan on average did not experience any statistically significant grade drop. The other students on average had a GPA at ASU their first semester that was .4 grade lower than their GPA at the community college when they transferred. Word about the Academic Success Course and the 4.0 Plan has gone out and although this class is not intended as a remedial course in anyway, academic advisors have referred students struggling with their grades to this class and the class has helped them. Obviously, the 4.0 Plan will not help a student unless they are serious about changing their learning habits and are willing to do the recommended procedures to ensure a good course grade. The 4.0 Plan even benefits students who were earning a 4.0 GPA before they were introduced to the 4.0 Plan. A 4.0 student was recently asked if the 4.0 Plan made any difference in his learning habits. The student replied that the 4.0 Plan had made him more efficient enough in his time earning a 4.0 that he had time to learn to play the guitar during Fall 2015.

Word of mouth is a good recruitment process for the Academic Success and Professional Development course. Recently, a new transfer student who had taken the Academic Success class his first semester met a friend he had known at his community college. The friends compared their lives and GPAs. The student in the Academic Success class earned a 3.4 GPA his first semester at ASU. The other student’s GPA last semester was around 2.5. The Academic Success student recommended the class to his friend and brought him in to the Transfer Center to find out how he could get a Late Add for the course. The 4.0 Plan is based on research. Research shows that if you often repeat items, you will retain them. The 4.0 Plan has the student read material before class and note, through bullet points in their own words, primary items in the material. The learning system includes repetition. The material is further repeated in the lecture, by note taking during the lecture, and by bullet point notes done right after the lecture. Controlled research experiments have shown that students retain material better through bullet point notes than by using highlighters or just reading the material.<sup>9</sup>

The scholarship students through the 4.0 Plan have an incentive to have good grades. They need to have at least a 3.0 GPA to retain their scholarship of \$4,000 per year. Also a 3.2 – 3.5 GPA is needed for students to be accepted as 4+1 students who can take two or three graduate classes that double count for the undergraduate degree and a Master’s degree, thereby enabling the student to complete a Master’s degree in one year after the Bachelor’s degree. Higher GPAs are also good, of course, to make the student more competitive for internships, research positions, scholarships, and fellowships. Also, the good grades assure graduation. Our scholarship students

are graduated at a rate of over 95%. The rate is actually higher than this since several students who had to move away from ASU for personal reasons have finished their engineering degree at another school.

Each meeting an evaluation sheet is collected from the attendees. The questions on the form ask the student to identify the most interesting thing they learned at the meeting, the most important thing they learned at the meeting, what they need to know more about, and any comments. These sheets serve several purposes. A summary of the comments is given to the special speaker of the meeting. Most speakers appreciate this feedback as they continually work on their presentations to make them relevant and more interesting to students. At times the summary answers have been handed out at the next meeting with all of the major questions answered. At the least, the course instructor can use the feedback to answer questions, clarify items, or to act on suggestions to improve the class. Usually the instructor will receive honest comments from the students and therefore will be able to keep in good touch with the class.

Early on in the program, the instructor realized that often students, even excellent academic students, do not always consider graduate school. There is still a myth that it is best to get out and start earning money as soon as possible and only students who wish to become an academic in a research university need a graduate degree. There is also a general assumption that a student needs to be close to a genius to make it through graduate school. Many times, quite a bit of convincing is needed to get students to consider how graduate school can help them. Graduate students in the program can be excellent models to prove that graduate school is doable, is even fun, and that you do not have to be a genius to qualify for graduate school. Once students learn about the advantages of an advanced degree (more challenging and interesting work, higher salary, more chance to design), students are often interested, although it may take several semesters for them to commit to graduate school. Graduate students in the program explain the “Nuts and Bolts of Graduate School” including explaining the 4+1 Program, as well as put on a graduate student panel each semester. Due to these efforts, 50% of the scholarship students go on to graduate school. Seventy per cent of the transfer students in the class report that the class influenced them to go to graduate school and without the class they would not have gone.

A difficult task which needs continual is to get students interested in some area of engineering or computer science. A goal is to get them interested enough that they want to do research in the area. Many students lack an understanding of what research really is. They may have had a bad experience with a research team, but never actually got in on the research. An assignment to get the students involved in research has been modified several times since the assignment of a “research paper” seems quite daunting to many students. At one time students were asked to write a short research paper. The title of the assignment frightened students and some students in the class, who were not on a scholarship, withdrew from the class rather than tackle the assignment. The assignment is now in two parts and does not require that the paper actually come to a new conclusion. The student first is asked to consult with an engineering librarian and learn how to use engineering data bases in order to find at least 10 resources on a topic of their choosing. Then they are to write a 3-5 page paper using the 10 references. This exercise, although not a class favorite, has produced some good results. Some students have found a new

area in which they are genuinely interested. Some students have used the opportunity to dig further in an area with which they were already familiar. A few students found an area in which they really weren't interested (which is also good information). Some students have used their interest paper to write a research proposal and have been funded. Students are encouraged to get involved in undergraduate research. The research can be very interesting and doing research with a funded professor is an excellent way to get graduate work funded. Students are also encouraged to apply for research grants available in engineering and computer science. In general, our Ira A. Fulton Schools of Engineering research positions pay \$1,500 a semester for about five hours of research a week. The co-PI of our CIRC grant gives a presentation on research each semester and works with students to write a research proposal. He has been successful in helping many students secure a research grant and then often, also serves as their mentor.

Our program is very closely related with the Fulton Engineering Student Career Services. Students are given the best advice on how to secure an internship. Working a Career Fair well takes a lot of preparation. The Student Career Services Director personally comes to the Academic Success and Professional meeting to speak to the students. The Motivated Engineering Transfer Student (METS) Center hosts companies for information sessions, which the students are encouraged to attend. Starting this academic year, a student staff member of the Student Career Services spends four hours a week in the Center (two hours, two days a week) to help students with resumes, personal statements, cover letters, etc. In addition, the students are encouraged to put their updated resume on line with Career Services each semester. There are many videos and PowerPoint presentations available on-line by Career Services on interviews, resumes, negotiating a salary, portfolios, and other employment advice for the students.

An unusual assignment that began a few years ago is to have the students work on eliminating stress in their lives. This is accomplished through the use of Richard Carlson's "Don't Sweat the Small Stuff at Work."<sup>10</sup> The students are asked to read the 100 suggestions made by Carlson and asked to select four that they know they need to work on eliminating from their lives in order to reduce stress. All engineering students have stress.<sup>7</sup> Topics that are often chosen by the students include Don't Procrastinate, Don't be Late, and Get Rid of Fear of Public Speaking. The students are asked to keep a log of how many times they break these lessons each week and take a self-chosen penalty. They then write a short paper about their experience at the end of the semester. If the student takes this assignment seriously, she/he can definitely remove stress from their life and improve themselves to be a good team worker in industry or academia in the future.

Another unique opportunity for the CIRC students is that each spring each student is asked to write a ten-year plan of their activities after they earn their Bachelor's degree. The 20 topics include advanced studies, where they will work, when they will have children, travel, savings plans, insurance, where they will live, and other topics.

This class is recommended by several academic advisors to students who need academic help. This is not the purpose of the course, but it has helped most students. Since the students are not on scholarships, there is a greater tendency for them to just quit the course when it gets a little tough, "since they don't need it anyway."

The students have enjoyed several rather novel programs during the last few years. Some of the scholarship students in the program who are doing research, have had an internship, or had an interesting summer experience, share their experiences with the class. The presentations have been good experiences for the presenting students, as well as the students at the meeting. One student developed a “Health, Fitness, and Money” presentation.<sup>11</sup> The money part of the presentation compared working part-time for a low salary to not working, going to school full-time, and doing well with a loan.

Having both graduate and undergraduate students in the same class has had many benefits, especially for the undergraduate student. A challenge has been to have some different activities for the graduate students since most of them have been in the Academic Success class numerous times. They do a presentation on graduate school and a panel discussion on graduate school, but they also need different assignments. It has seemed to work well to have the graduate students read a book and then write a short summary of it and tell what they learned. Two of the books used for this purpose have been “Who Moved My Cheese”<sup>12</sup> and “Women Don’t Ask.”<sup>13</sup> Often men don’t ask either so the book has been good for female and male students.

As an additional support to the students in this program is the METS Center to which native students are also welcome to use for networking, working on assignments, seeking information. About 30% of the 300-400 student who frequent this center each semester are native students. The METS Center website includes a detailed list of questions and answers that answer most students’ questions about academics, a career, and graduate school.<sup>14, 15</sup>

The course instructor for the Academic Success and Professional Development class also meets with each student in the class one-on-one for about 30 minutes during the semester. Often the meeting is just a way for the instructor to better get to know the student. Sometimes the students have concerns and decisions to make for which they appreciate counsel. Sometime the visit uncovers some important information of which the student was unaware. In general, the visit also lets the student know that if they have questions, the instructor is someone who can listen and help to answer the question.

The METS Center is staffed by four or five successful transfer students. Students, native or transfer, often will not make an appointment with an academic advisor or career counselor and walk across campus for the meeting, but will avail themselves of the transfer staff that are always available at the METS Center. These students’ job is to be ready to help students with answers or to help the student find the answer.

Additional information on this program can be found in references 16-29.

## **Results**

The program continues to graduate the scholarship students at over a 95% rate. The rate of graduates going right on to graduate school is about 50%. The basic programming of CIRC which has evolved from a seminar to a one-credit class to a two-credit class has now been duplicated by the Dean’s office in the form of a one-credit Academic Success and Professional Development class for new transfer students. The goal is to require this class of them as the ASU

101 Introductory course is required of new freshmen and lower division students. The one credit class is offered in an 8-week session and students only take the class once, while scholarship students take the two credit Academic Success and Professional Development class each semester that they have a scholarship.

Due to a new supplement awarded last August, additional scholarships for transfer students are available for this and next academic year. This is welcome news since some students, who were on an S-STEM grant for transfer students, lost their scholarship because the funding ended. The focus of the new funding are four Hispanic Serving Institutions (CCs) who have been working with the CIRC/METS programs for several years.

The challenge is that at the end of May 2016, the grant for this program and the supplement end. Scholarships are available for next year, but plans for the Academic Success and Professional Development class are uncertain. There is no funding for an instructor. The NSF STEP funding is also ending this coming summer. No-cost extensions are expected to allow administration of the scholarships next year in case changes need to be made.

The Dean's Office has assured that the METS Center will continue, which provides the space for the CIRC meetings. Although the Center will continue with Dean's Office funding for student staffing, there is no funding for a director, who is essential for a good center. Grant proposals have been written and there is hope that additional funding will allow this excellent program to continue.

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