

AC 2007-2989: THE ST@R PROJECT: AN INITIATIVE TO INCREASE THE RETENTION RATES OF 1ST AND 2ND YEAR UNDERREPRESENTED STUDENTS ENROLLED IN ELECTRICAL ENGINEERING

Edward Brown,

Edward E. Brown, Jr. is an assistant professor in the Department of Electrical Engineering at the Rochester Institute of Technology. He received his B.S. in electrical engineering from the University of Pennsylvania (1992). He received his M.S. (2000) and Ph.D. (2004) in electrical engineering from Vanderbilt University. He is a 2005-2006 recipient of the Semiconductor Industry Association Stay Tech Award which focuses on improving the retention rates of undergraduate engineering students.

The ST@R Project: An Initiative to Increase the Retention Rates of 1st and 2nd Year Underrepresented Students Enrolled in Electrical Engineering

Abstract

According to a 2002 NSF report, only 20.5% of engineering bachelor degrees in the U.S. was awarded to women and 11.6% to African American, Latin American, and Native American (AALANA) students¹. To address the growing concerns of the underrepresented populations within the field of electrical engineering as well as other STEM (science, technology, engineering, and math) related disciplines at the Rochester Institute of Technology, the **ST@R Project** was created. The ST@R Project (which stands for *Stay Tech @ RIT*) is an initiative sponsored by the **Semiconductor Industry Association** (SIA) seeking to study new and innovative methods to increase the recruitment and retention rates of these underrepresented populations. The ST@R Project achieves these goals by focusing its efforts on three major areas: (1) *Student Support Services and Outreach Efforts*, (2) *Mentoring and Coaching*, and (3) *Career Exploration and Professional Development*. To improve the pipeline of electrical engineers as well as increase the number of underrepresented individuals, the ST@R project also focuses on researching and developing a pedagogical system that addresses diverse teaching and learning styles within the engineering classroom. The main objective is to appropriately accommodate the needs of an increasingly diverse student population to insure overall student success within the various fields of engineering. This means that understanding issues related to *multicontextuality*, *multiple intelligences*, and *learning organizations* are significant in achieving this effort.

This report will discuss the current results of the ST@R project and will emphasize the positive impact of the *Career Exploration and Professional Development* component of the program. While the integration of teaching and research is an important topic in the field of engineering education, via the ST@R Project, it was also discovered how powerful integrating *teaching and industry* can be for students' overall understanding of engineering course material. It is hoped that through the ST@R Project, a framework for integrating *teaching, research, and industry* can be properly developed.

Introduction

The objective of the **ST@R Project** is to address the issue of increasing the retention rate of first and second year students enrolled in electrical engineering and electrical engineering-related majors at RIT with an emphasis on increasing career opportunities for individuals traditionally underrepresented in STEM (Science, Technology, Engineering, and Mathematics) disciplines. This document will report on the results and findings of the **ST@R Project** for the 2005-2006 academic school year.

Objectives

During the 2005-06 academic school year, the ST@R Project focused its efforts and objectives on the following 3 areas:

- 1) ***Student Support Services and Outreach Efforts*** - The ST@R Project utilized RIT's *Engineering Student Support Services* to provide academic advising and career counseling to all participating students. The ST@R Project meetings were actually held in the RIT *Engineering Learning Center* where math and science tutoring services were made available for students to assist them where necessary with their engineering coursework. In addition, the ST@R Project also worked in conjunction with RIT's *North Star Center* whose objective is to enhance the academic experience for the African American, Latino/a American, and Native American (AALANA) students pursuing their education at RIT. Lastly, each participating freshman and student mentor was awarded with the following:
 - An RIT bookstore gift certificate to assist them in purchasing textbooks and supplies for their courses
 - Student membership to IEEE (Institute of Electrical and Electronics Engineers)
 - Souvenir polo shirts with the ST@R Project/SIA logo to promote community and awareness of the program on campus
- 2) ***Mentoring and Coaching*** - Each ST@R Project 1st year student was paired with an upper-class student with a similar academic and personal background as the freshman student. The goal was to have upper-class students act as mentors and role models for freshmen students and assist them in their understanding of the electrical engineering discipline as well as how to navigate through the electrical engineering program. In addition, the program coordinator acted as a mentor to the upper classmen. In the end, a professional (as well as a social) network was formed among the student participants as a direct consequence of this novel style of *peer/tier-mentoring*. This proved to be essential since most 1st year engineering students (particularly from underrepresented populations) struggle in identifying a network of students *within their major* that they can associate with professionally *and* socially.
- 3) ***Career Exploration and Professional Development*** – The success and impact of the ST@R Project was not only reflected in its intent to retain 1st and 2nd year students in the electrical engineering program, but ultimately in its ability to assist students in obtaining co-ops and permanent positions within their electrical engineering major. Thus, the ST@R Project benefited greatly from partnerships with SIA affiliated corporations such as ***IBM, Intel*** and other similar companies and institutions in helping students identify possible career choices in engineering. The ST@R Project also arranged professional development seminars and talks to prepare students for future careers in engineering. The goal was to keep students excited, engaged, and enthused about completing their baccalaureate degree. This component of the program proved to be extremely valuable because the ST@R Project not only had industry representatives give presentations about their organizations, but they also connected what they did in practice with the actual science and engineering topics students were currently learning in the classroom. In

some cases, these corporate representatives taught courses related to their particular industry. This aspect of the program will be detailed later in this paper.

Background of Participating Students

The STAR Project began with an initial cohort of 14 freshman students with the following ethnic and gender backgrounds:

<u>Ethnicity</u>		<u>Gender</u>	
White American	- 6	Male	- 12
African/African American	- 5	Female	- 2
Latino American	- 3		

In addition, 9 of the freshman students had Math SAT scores ≤ 600 . 12 of the students majored in electrical engineering and 2 of the students majored in computer engineering. At the beginning of the program, students were given questionnaires to gauge their understanding of electrical engineering as a discipline so that the program could be properly coordinated to attend to the needs of the students.

There were 5 student mentors composed of four 2nd year students and one 5th year student with the following ethnic and gender backgrounds:

<u>Ethnicity</u>		<u>Gender</u>	
White American	- 3	Male	- 3
African American	- 2	Female-	2

All of the student mentors were electrical engineering majors with GPA's above 3.0/4.0. Also, all of the student mentors were the first in their families to attend college and major in an engineering discipline.

It should be noted, however, that as the ST@R Project progressed throughout the year, it seemed reasonable and responsible to include the overall engineering student body in the various programs (highlighted in the next section) in order to achieve greater success in realizing the ST@R Project's outreach and diversity goals. Thus, even though the original student population included 19 students total (14 freshmen + 5 student mentors), the impact of the ST@R Project was actually felt by a much larger student population.

Program Highlights

Some of the highlights and synopses of the ST@R Project program agenda include:

- **Panel Discussion: “What is Electrical Engineering? Fact vs. Fiction, Myth vs. Reality”**

This panel discussion was given in front of 13 AALANA students participating in the university's North Star Academy Pre-College Summer Engineering Program. The panel was composed of 3 African/African-American upper class students (2 male and 1 female). The program coordinator acted as group moderator:

Many students enter into electrical engineering programs not really having a clear understanding about what the field is all about, or what an electrical engineer truly does, let alone what it means to be an electrical engineering student. This tends to be the case for students of color as well as female students, and particularly those who may be the first in their families to attend college and major in a STEM related discipline. During this informal panel discussion, current AALANA EE undergraduate students spoke about their experiences as 1st Year Electrical Engineering majors and what their expectations were about engineering at RIT versus the reality of their experiences. A Q/A session for the North Star students followed afterwards.

- **Presentation: “A Day in the Life at Intel”**

Ms. Aneita Gage, Technical Training Manager at Intel Corporation, Chandler, AZ, facilitated a talk on what it's like to work at Intel:

The purpose of this presentation was to get *ST@R* students excited about their chosen EE discipline and gain exposure to individuals currently working in industry. Over 20 students attended the program. Ms. Gage (see Figure 1) discussed her experiences as an employee at Intel and what a young, newly hired engineer should expect when entering into the corporate realm. She also reviewed resumes for students and gave a resume writing workshop later on that day to RIT's undergraduate chapter of the *National Society of Black Engineers* (NSBE). Over 20 students were in attendance for that workshop, as well.

- **Guest Lecture: Mr. David Shields from the Rochester Gas and Electric Company**

Mr. David Shields, Power Quality and Electrical Distribution Engineer gave a guest lecture on AC power systems to RIT students taking a Circuits II course:

The purpose of this lecture is to incorporate the theory learned in the engineering classroom with what happens in actual practice in industry. Mr. David Shields, who has 30 years of experience working in Power Distribution Systems at the Rochester Gas and Electric Company in Rochester, NY, guest lectured a Circuits II course during the week the class discussed AC Power (see Figure 2 and 3). Over 100 students have been in attendance for this lecture. Mr. Shields discussed how power is delivered from the local power company to the university while at the same time linking his lecture to the theoretical concepts the students were learning in their textbook (e.g., average power, complex power, power factor, etc.). He also demonstrated some of the tools and equipment he uses out in the field. This talk was beneficial to students understanding of AC Power theory since sometimes these ideas can be abstract for the first time learner

and also because the course currently does not offer a laboratory component that would illustrate these concepts in further detail.

- **Resume Writing Workshop**

Ms. Maureen Arquette, RIT Co-op Office facilitated a two day resume writing workshop:

In anticipation of the university's annual Spring Career Fair, Maureen Arquette from the RIT Co-Op Office held a two day workshop specifically for ST@R Project students on resume writing and interviewing tips.

- **End of Year Program: “Robotically Roving the Red Planet for Two (Earth) Years...and Counting!”**

Dr. Edward Tunstel, Senior Robotics Engineer at the NASA Jet Propulsion Laboratory, Pasadena, CA, and Group Leader of JPL's Advanced Robotic Controls Group, gave a presentation discussing his research on mobile robotics and the MARS Rover Project at JPL:

In January 2004, NASA landed two robotic vehicles on Mars to rove the surface as surrogate explorers in search of evidence for past existence of surface water. Each rover is designed to perform field geology using a robotic arm to position science instruments on surface samples. They are also designed to navigate the surface of Mars using computer vision to see the environment and six wheels to travel over rough terrain so that field geology can be performed at multiple locations. Dr. Tunstel's talk provided an overview and status of the ongoing NASA Mars Exploration Rover (MER) Mission and a description of how such exciting exploration is conducted from Earth. He also discussed his experiences as an electrical engineer at JPL and the relevant coursework students need to take in order to prepare for a career at JPL. Again, the purpose of the presentation was to get ST@R students excited about their chosen EE discipline and gain exposure to individuals currently working in the corporate realm. It was estimated that *approximately 200* RIT students, faculty, staff, and administrators were in attendance. Several faculty members and students found his talk relevant as well as pertinent to the school of engineering's desire to get students more involved in multidisciplinary design projects (see Figure 4 and 5).

In addition, during his visit, Dr. Tunstel also took part in guest-lecturing an electrical engineering class on *Control Systems Design* to connect the theory taught in that class with actual practice in the field of space robotics. Several students found this to be extremely beneficial to their understanding of Control Theory.

Student Accomplishments and Statements

As stated earlier, the success and impact of the ST@R Project is ultimately in its ability to retain students in the electrical engineering major and assist them in obtaining co-ops and permanent positions within the engineering field. All of the 1st year student participants are still in the

electrical engineering major as well as the student mentors. In addition, several RIT students obtained opportunities through the ST@R Project. Some of the student highlights include:

- *1 female* electrical engineering student was offered a *permanent position* with **Intel Corporation**
- *1 male* electrical engineering student received a *\$1500 scholarship* from the **Rochester Engineering Society**
- *2 male* AALANA electrical engineering students received co-op positions with **Intel Corporation** for the 2006 Summer Quarter
- *1 male* AALANA electrical engineering student received a co-op position with the **United States Naval Research Office** in Washington, D.C. to study radar systems and stealth technology during the 2006 Summer Quarter
- *1 male* AALANA electrical engineering student obtained an undergraduate summer research position at the **Georgia Institute of Technology** in Atlanta, GA. to study mobile robotic systems during the 2006 Summer Quarter
- *1 female* AALANA electrical engineering student was awarded an undergraduate summer research position at **Purdue University** in West Lafayette, IN to study the cytotoxicity levels of nanoparticles in living cells during the 2006 Summer Quarter
- *1 male* AALANA electrical engineering freshman student switched from computer engineering to electrical engineering and is currently serving as an officer in the RIT undergraduate **IEEE** chapter
- *1 female* AALANA electrical engineering freshman student completed her first year with a perfect **4.0/4.0 GPA**

Here are statements about the impact of the ST@R Project from 2 student participants:

“Through the mentoring program and other efforts, the ST@R project has motivated me to continue studying engineering at RIT. The program has introduced me to valuable resources, like the Engineering Learning Center, that have helped me a great deal. By encouraging me to attend the Fall Career Fair, even though I was a first year student, the project helped me to not just be academically aware but also corporately aware. The "Day in the Life of Intel" talk provided me with insight about the corporate world, and the speech from Dr. Tunstel increased my interest in robotics...I think the ST@R project has accomplished its purpose.”

--- 1st year Freshman Student

“The STAR mentoring program has allowed me to connect with incoming freshman in electrical engineering and ease their adjustment from high school to college. Working with (the program coordinator) for the past year on the STAR project has been very influential in my growth as a person and as an electrical engineering student. Being a mentor has allowed me to help two young men adjust to the daily routine that a student studying engineering will encounter. Through the STAR project I have grown to know my mentees very well and I have watched their progress throughout the course of the year very closely. I am very proud of their accomplishments and I hope one day they will

become a mentor to incoming freshmen. I wish a program like the STAR project existed when I was a freshman I could have benefited tremendously from the academic support and programs that are offered.

The programs that were offered this year have definitely been successful in reaching out to students and developing engineers. The resume workshop that was facilitated by Ms. Aneita Gage from the Intel Corporation was very helpful for me with editing and revising my resume. Through the workshop I was able to network with hiring managers from Intel, which led to me receiving an offer for a 3-6 month co-op for the spring of 2007 in Albuquerque New Mexico. During the spring quarter of 2006 I took a course in Control Systems with (the program coordinator) and he arranged for Dr. Edward Tunstel from Jet Propulsion Laboratory to come in and present his work in the Mars Rover Project. The presentation was very engaging and interesting. After speaking with (the program coordinator) and Dr. Tunstel, my level of excitement and interest in control systems has increased. Not only did I benefit from the programs that were in place, (the program coordinator) also provided everyone with a book voucher at the book store which paid for two of my book throughout the course of the year. The STAR Project is definitely developing well rounded engineers who will succeed in and after academia. I am proud to be a STAR mentor and hope I can assist with the project next academic year as well.”

--- 2nd year Student Mentor

Future Work

Future work for the ST@R Project will center on investigating diverse teaching and learning styles for the engineering classroom in order to address the needs of an increasingly diverse student population^{2,7,9}. These populations include (but are not limited to) students from underrepresented and underserved communities as well as those students from diverse socioeconomic backgrounds. This research is important due to the fact that this particular population is a key source for future talent and will ultimately be responsible for helping the United States maintain a competitive advantage in the global technological community⁵.

To accomplish this task, ST@R Project research will focus on reframing the *context*³ in which engineering classroom topics are presented by cultivating a *student centered* approach to teaching, learning, and research versus the traditional *content centered* approach. Understanding issues relating to *multicontextuality*, *learning organizations*, and *multiple intelligences* will be significant in achieving this effort^{3,6,8}.

ST@R Project research will also include math and science outreach initiatives in K-12 education. This includes providing workshops and programs for students in the local community which discuss careers in science and engineering as well as conducting engineering experiments using educational tools like the *LEGO Mindstorms* kits⁴.

Conclusion

The ST@R Project achieved its goals and was considered successful by all involved. All students who actively participated in the program were encouraged to continue on to the next phase of their individual undergraduate engineering majors. In addition, several students obtained industry and research opportunities through the ST@R Project.

Figures



Figure 1: *Aneita Gage*, from *Intel Corporation*, discusses resume writing and “*A Day in the Life at Intel.*”



Figure 2: *Mr. David Shields*, from the *Rochester Gas and Electric Company* discusses AC Power with students from a Circuits II course.



Figure 3: *Mr. David Shields*, demonstrates the tools and equipment he uses to analyze AC Power.



Figure 4: *Dr. Edward Tunstel*, a senior robotics engineer with *NASA's Jet Propulsion Laboratory*, was the keynote speaker for the ST@R Project end of year program; He presented a talk on "*Robotically Roving the Red Planet for Two (Earth) Years...and Counting!*"



Figure 5: Students attending the ST@R Project end of year program featuring *Dr. Edward Tunstel* from *NASA's Jet Propulsion Laboratory*; Approximately 200 students, faculty, staff and administrators were in attendance.

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