EVOLUTION OF THE ENGINEERS OF THE FUTURE SUMMER INSTITUTE

Evelyn Hanna[1], Ilene Rosen, Ed.D.[2] and Ronald Collado[3]

Abstract— *EOFSI creates somewhat of a "funnel", used to attract students to pursue a career in engineering, science or mathematics. In this paper, we will discuss the evolution of four summer programs that constitute EOFSI. TARGET, which is a four-week summer commuter program, introduces 7^{th} - 10^{th} grade girls to the fields of engineering and technology through various workshops and hands-on activities. As TARGET embarks into its sixth year, it will transform into a true academy with academic year activities. Working in research groups split up by engineering discipline, TEEM is a two-week residential summer program, which serves as an introduction to engineering for minority high school sophomores. The summer of 2001 was the inaugural year of the Governor's School of Engineering and Technology at Rutgers University, which will continue to host high school seniors for a one-month research and development project concluding with a formal presentation of students' group projects. EOF serves as preparatory a five-week introduction to the engineering curriculum for incoming first year students. EOF and TEEM have been in place for over fifteen years and have continued to grow and evolve.*

OFFICE OF STUDENT DEVELOPMENT

Since its inception, the office has evolved into a multifunctional, service-oriented program. The office was established in 1978 with the sole priority of providing access and support for students admitted to the School of Engineering via the New Jersey Educational Opportunity Fund (by definition, students who are coming from educationally and financially disadvantaged backgrounds). The first EOF population in the summer of 1978 totaled a class of twenty. Today the program supports approximately 275 funded and non-funded EOF students and the entering class has grown from twenty to fifty-five this past summer. With all of the growth and development of our programs we recently changed our name from The Office of Special Programs to The Office of Student Development (OSD), a name that more accurately reflects what we do.

Over the years the Office of Student Development has grown to include responsibility for all minority and women student programs and activities, as well as college wide retention programs and support systems. The office coordinates all pre-college programs under the Engineers of the Future Scholars Institute that include, but are not limited to, TARGET (The Academy at Rutgers for Girls in Engineering and Technology); TEEM (The Engineering Experience for Minorities); and the Engineers of the Future Summer EOF program.

In addition to the pre-college activities, the OSD administers an academic year course for all engineering students that utilizes the Learning To Learn (LTL) model in an attempt to develop and enhance student learning strategies, the course is listed as "Methods of Inquiry for Engineers". The office also promotes and coordinates student study groups, as well as sponsoring a supervised tutoring program offered four nights a week.

Retention and student activity programs are an important component of the Office mission. The Engineering Governing Council (the student government association), Minority Engineering Educational Task - the Rutgers chapter of the National Society of Black Engineers, the Society of Hispanic Engineers, the Society of Women Engineers and 25 other student organizations are administered by the office, as are several other university wide student groups.

The OSD administers disabled student concerns, academic integrity issues, financial aid information, scholarship programs and most student life activities. To this end, the Office works directly with both the Associate Dean for Academic Affairs and the Assistant Dean for first year students.

EOFSI

In an effort to construct a pipeline of students into the School of Engineering at Rutgers, the State University of New Jersey, the OSD has created the Engineers Of the Future Summer Institute (EOFSI). The pipeline consists of pre-college age students ranging from 7^{th} grade to incoming first-year students. Through the structure of the pipeline, students are encouraged to participate in one or more of the pre-college activities.

Middle school and high school girls are welcome to participate in The Academy at Rutgers for Girls in Engineering and Technology (TARGET). Sophomore minority students are encouraged to attend The Engineering Experience for Minorities (TEEM). As students complete the Junior year of high school, they apply for the Governor's

[1] Evelyn Hanna, School of Engineering, Rutgers, the State University of NJ, Office of Student Development, 98 Brett Rd, Piscataway, NJ 08854, evelynh@rci.rutgers.edu
[2] Ilene Rosen, Ed.D., School of Engineering, Rutgers, the State University of NJ, Office of Student Development, 98 Brett Rd, Piscataway, NJ 08854, ilrosen@rci.rutgers.edu
[3] Ronald Collado, School of Engineering, Rutgers, the State University of NJ, Office of Student Development, 98 Brett Rd, Piscataway, NJ 08854, rcollado@rci.rutgers.edu

School of Engineering and Technology. New Jersey funded Educational Opportunity Fund students attend the summer bridge program for incoming first-year School of Engineering students.

Since each separate entity of EOFSI is designed to compliment the other programs, students are encouraged to continue in the pipeline. As students participate in a respective program, they are informed of the other opportunities available for future summers. In an effort to track success of the pipeline, students are continuously tracked from the time of initial participation in EOFSI until the time of college entrance.

TARGET

With the age of technology upon us, as well as the increasing desire to diversify corporate America with young, talented individuals, women continue to be one of the underrepresented groups in the fields of engineering, science, and mathematics. At the School of Engineering at Rutgers University, women represent approximately twenty seven percent of applicants, thirty percent of admitted students, and twenty-two percent of the school population. If the initial interest to pursue technical careers is not present, young women entering institutions of higher learning will not choose to major in engineering, science, or mathematics. As a result there are then fewer women eligible to enter the technical workforce.

In 1997, The Academy at Rutgers for Girls in Engineering and Technology (TARGET) was designed by the Office of Student Development (OSD) at the School of Engineering at Rutgers University to address the issue concerning the lack of women in the engineering discipline. A theory was developed that early exposure to engineering and technology would spark an interest in middle school girls to continue in advanced math and science curricula in high school and even further continuation of such curricula on the university level. Hence, TARGET was founded to intrigue and urge young women to explore the fields of engineering, technology, science and mathematics.

In its inaugural summer, TARGET was a two-week session that hosted twenty 7^{th} and 8^{th} grade girls. Since the program was successful, the summers of 1998 and 1999 welcomed an additional session. Thus, TARGET was able to reach a total of forty girls each summer. As the success of the program continued, a third session to accommodate an additional twenty girls was established in 2000. Due to an overwhelming response to TARGET and the desire of the participants to continue in engineering exploration, IWISE (Introduction of Women In Science and Engineering) was developed in 2001, which welcomed 9^{th} and 10^{th} grade girls to participate in advanced hands-on projects. Seventeen previous TARGET graduate participated in the inaugural IWISE summer.

At the conclusion of the 2001 summer program, the OSD was again faced with the overwhelming request for continued exploration from the TARGET and IWISE participants. Thus, in an effort to address this request, a new dimension will be added to TARGET. With the support of the Graduate School of Education at Rutgers University and local community teachers, TARGET graduates will be invited to the Rutgers campus for monthly Saturday seminars during the academic year. This is an exciting new addition to the Academy.

The Academy at Rutgers for Girls in Engineering and Technology is specifically designed to familiarize 7^{th} through 10^{th} grade girls with the various types of engineering disciplines and to instill a feeling of mathematical and scientific accomplishment within the participants. During the summer months, TARGET runs in two, two-week sessions. Throughout the academic year, TARGET will meet for monthly seminars.

Brochures and applications are mailed to middle and high schools in early February with the application deadline in mid April. Acceptance is based on a personal statement, letters of recommendation, and the student's academic standing. In an effort to target a population that was hesitant towards math and science, a conscious effort to accept students who were loosing interest in math and science were identified encouraged to attend the program. Staffing consists of the program coordinator, workshop presenters and four female engineering students, whose responsibilities include aiding in preliminary preparations, guiding the participants through their day, and processing survey data upon completion of the program.

TARGET I is the first session, which is a nonresidential program for twenty-four 7^{th} and 8^{th} grade girls that takes place during the first two weeks of July. TARGET I program curricula and schedule consist of nine days packed with exciting projects and interesting labs. Such activities include an Introduction to Engineering Lab, a Mousetrap Racecar Lab, a Bridge Building Lab, and various labs introducing the different disciplines of engineering. Volunteers of the university faculty, staff, and administration provide instruction for the labs. Trips to the Liberty Science Center, Ortho-Pharmaceutical, Center for the Advancement of Industrial Productivity, and to Middlesex Airport provide an opportunity for the girls to explore different disciplines of engineering at work. Each day is concluded with a Rap Session, which gives the girls an opportunity to talk with women undergraduate and graduate engineering students.

In an effort to develop a cohesive year-round academy, the concept of IWISE will be incorporated under the umbrella of TARGET. Hence, TARGET II is the second session, which is a nonresidential program for twenty 9^{th} and 10^{th} grade girls that takes place during the latter two weeks of July. TARGET II program curricula and schedule consists of ten days packed with interesting engineering labs. Each day is dedicated to a specific discipline. For example, one day is dedicated to the exploration of ceramic engineering.

During this day, the girls will work with female undergraduate and graduate students in the ceramic engineering department to learn and apply the principles of ceramic engineering. The girls will be allowed to work in the undergraduate lab with traditional clay based ceramics where they will learn and apply the entire processing methodology to create a final ceramic product. This methodology includes raw material recognition, batching, processing (slip casting), glazing and firing. Each day is concluded with a Rap Session, which gives the girls an opportunity to talk with female undergraduate and graduate engineering students.

During the once-a-month Saturday seminars, the girls will participate in various hands-on explorations led by specially trained high school and middle school teachers. Not only will TARGET graduates have the opportunity to continue on an engineering track, but also the educators will be afforded the freedom to use innovative and non-traditional teaching methods. Through this instruction, the girls will be developing abstract mathematical abilities, as well as furthering their academic interests, through investigative learning.

In order to assess the success of the program, tracking the participants through high school and onto college is a necessity. At the completion of the program, the girls and parents are invited back in November for a reunion. During the reunion, the girls participate in various activities and the parents are invited to participate in a workshop entitled "Congratulations It's a Girl… Now What?" which provides parents with helpful information about how and why to encourage their girls. As the girls continue on to high school, they are sent surveys and invitations to university tours and events.

TEEM

The Engineering Experience for Minorities (TEEM) is a component of the Engineers of the Future Summer Institute at Rutgers University, School of Engineering. TEEM is designed to offer insight into engineering as a profession, while also exposing students to intellectual challenges presented at the college level. The program follows a graduate research model, with students researching and developing a group project and presenting their results to a panel of engineers.

TEEM began at Rutgers as MITE, the Minority Introduction to Engineering. MITE was part of a national program (JETS) to introduce the field of engineering to underrepresented high school students just finishing their junior year. The program was geared towards students who were academic high achievers and as such, the graduate research model provided a stimulating venue for these students. We are proud of the many accomplishments of our MITE/TEEM alumni, our most famous being Mr. Randall Pinkett, a Rhodes' Scholar and President of MBS Enterprises. For administrative reasons, the name of the program was changed to TEEM in 1990. Additionally, in 2001, the program moved from being a program for rising seniors to one for rising juniors. This change came about in order to maintain the consistency and flow of our pipeline.

TEEM is challenging and competitive and is oriented towards students who have demonstrated the necessary ability to pursue a college education. The program is limited to two 24-member sessions of New Jersey high school students of African American, Hispanic, or Native American heritage, who have completed their sophomore year and will be high school juniors in the next academic year. Selection is based upon course content, recommendations, grades, PSAT scores, and a personal essay.

Participants live in university residence halls (excluding weekends) with a staff of full-time counselors. There is a $200 fee for the program and financial assistance is available on a need-basis. Daily meals are provided, as are the necessary supplies for projects and classes. Course instructors are drawn from Rutgers faculty as well as doctoral level candidates at the University.

Each two-week session is engaged in researching engineering design projects, which the students propose and defend. Projects revolve around six different engineering disciplines. Working in small teams formed around common interests and engineering disciplines, students research and design a product with attention to details such as technical feasibility, need, cost, safety, and environmental concerns.

Based on their discipline, students research his or her engineering field here at Rutgers University. Also students are responsible for other workshops and projects that challenge them within other disciplines of engineering. The program culminates in the presentation, by each group, of their engineering project before a panel of professional Engineers who determine the feasibility and reality of the project. Workshops, lab tours, and lectures have been designed to assist students in their research and design project.

By attending TEEM, students are exposed to the various disciplines available in engineering, along with the demands faced in these diverse and exciting fields. Through full and challenging weekly schedules, students become familiar with the rigors, efforts and rewards encountered by students in an engineering curriculum. By working in small groups, students experience the synergistic benefits of teamwork. Finally, the research model of T.E.E.M. prepares students, not only for the opportunities available with an undergraduate engineering education, but also to begin to consider graduate school as an additional option.

THE NEW JERSEY GOVERNOR'S SCHOOL OF ENGINEERING & TECHNOLOGY

In 1999 the OSD was invited to submit a proposal to host a newly planned Governor's School of Engineering and Technology. We were awarded that proposal and in July of

2001 hosted one hundred students in the first class of the NJ Governor's School of Engineering and Technology. There are currently five different Governor's Schools running across the state of New Jersey.

In 1983, then Governor Tom Kean chartered the NJ Governor's School. The purpose of the Governor's School was to develop, create and implement a comprehensive summer residential enrichment program of study for the state's "best and brightest". The first school, School of Public Issues at Monmouth University, began with one hundred thirteen students. In 1984, two additional programs were added, School of the Sciences at Drew University, and School of the Arts at The College of New Jersey. In 2001 the School of Engineering and Technology was added at Rutgers University, School of Engineering. The Governor's School of New Jersey is a unique summer program

committed to meeting the educational needs of artistically or academically talented high school students who completed their junior year.

The Governor's School of Engineering and Technology (henceforth referred to as the Governor's School) places emphasis on engineering and information technology for high school juniors who possess outstanding skills and display unusual abilities and interests in the field. Students participate in stimulating and challenging courses, laboratory workshops, research projects, tours and trips, elective courses and colloquium series. Through these courses, projects, labs, trips and other activities, students receive an understanding of cutting edge technology in engineering. At the same time, students have numerous opportunities to improve their scholarship, leadership, communication, problem solving and team building skills.

Our first year of the Governor's School was a great success. High-ranking faculty members and deans were impressed with the caliber of the students and their work, while the students were impressed with the program and the facilities offered at Rutgers School of Engineering. It is our hope that many of these students will attend Rutgers School of Engineering. As it stands now, an amazing 74 percent of the students who attended the Governor's School have applied to Rutgers. Clearly, the Governor's School is earning its place in our engineering pipeline.

EDUCATIONAL OPPORTUNITY FUND A.K.A ENGINEERS OF THE FUTURE

The EOF program is the foundation of our Scholars Institute. Established at the School of Engineering in 1978, the New Jersey Educational Opportunity Fund program is a statewide program that provides access to higher education for students from financially and educationally disadvantaged backgrounds. By law, ten percent of all first-year, full-time students enrolled at a college must be EOF students.

Statewide, EOF set the pace for many initiatives which today are widely incorporated into college life. Among the many powerful strategies implemented by EOF are pre-college articulation, basic skills testing and remediation, systematic retention efforts, peer counseling and peer tutoring, academic support courses, multicultural curricula and human relations programming, student leadership development, and outcomes-based program evaluation.
EOF has also been a leader and a linchpin in the higher education system's effort to increase diversity. While participation is not limited to minority students, EOF

sponsors more than one-third of the African American and Latino students at the state colleges and New Jersey's independent institutions, and over one-quarter of

the African American and Latino students enrolled at New Jersey colleges and universities participate in the EOF program. EOF enrolls about 12.5% of the first-time, full-time New Jersey freshmen who enter the state's colleges and universities each fall. Students apply for EOF as a regular part of their admission process to any college or university in the State.

At the School of Engineering, EOF students receive advising, tutoring, academic support, leadership, personal and professional development and funding. Students who are admitted to the School of Engineering as EOF students are admitted with the condition that they successfully complete an intensive five-week pre-college summer program. During the summer program, students live on campus and take courses in math, physics and computer programming. They also take an Introduction to Engineering course for which they receive credit.

Over the years, our EOF program has steadily grown from a class of twenty students in 1978, to a program that now consistently maintains about 275 EOF students at any time and admits about 55 students each year. The retention and graduation rates of our students are equal to that of the regularly admitted student population. Our EOF students move on to graduate school, become professors, corporate executives and leaders in industry. We are proud of the fact that we are now seeing the children of our early EOF students coming into the School of Engineering as regularly admitted students. It is proof that the mission of the NJ EOF program is being met.

About ten years ago we decided to call our EOF program the Engineers Of the Future program. This was specifically done to ameliorate the stigma that some students experienced as a result of being identified as EOF students. Incredibly, within one year, there was a positive change in the perception and status of the program. With the name change came an increased awareness of the program and an increased level of pride and professional awareness. Whereas before the students felt that other students and even faculty may have looked down upon them, they now felt that they were looked upon as students who came in with something special. They were already establishing their identity as engineers and were beginning to reap the benefits of it.

Concurrently, we also began to receive more attention from the administration for this program, as well as the

TEEM program that we had been coordinating. With the addition of TARGET in 1997, it became obvious that what we were running each summer was indeed an Engineers of the Future Summer Institute. Had we not had the background and experience of administering these programs, we never would have been in a position to be awarded the opportunity to host the NJ Governor's School of Engineering and Technology. The Governor's School has been an incredible addition to our Institute and one that has brought along a great deal of prestige and attention. All of our programs have benefited from this extra attention. We have received increases in funding, respect and awareness, which benefit all of the students we work to serve.

We have just one more name change to include. We recently changed EOFSI from Engineers of the Future Summer Institute to Engineers of the Future Scholars Institute. This is because we have recently added two more programs to the Institute that do not take place during the summer. Very briefly, we have incorporated RUWELL, (Rutgers University Women in Engineering Leadership League) an ongoing program for currently enrolled female engineering students that utilizes e-mentoring and seminars to maintain their leadership abilities throughout their academic careers and beyond; and JSHS (Junior Science and Humanities Symposium) a national scholarship program which allows high-ability secondary school students to develop their interest in science, engineering and mathematics by promoting original research and by providing public recognition and scholastic rewards for research achievement.

None of these programs would be here today had we not had the original Educational Opportunity Fund Program.

CONCLUSION

The OSD has provided access into graduate school for underrepresented minorities and has increased the percentage of women and underrepresented minority students in the School of Engineering. The OSD has heightened the awareness of minority influence among faculty and staff at the School of Engineering and has had an impact on hiring underrepresented minorities to the faculty. The office has also had significant impact on the curriculum to accommodate student needs with our involvement in establishing preparatory Physics, mathematics and computer programming classes and other early intervention approaches. Finally, the OSD has provided an improved network between corporations and students, beyond that offered by traditional career services.

Under the Engineers of the Future Scholars Institute umbrella, the Office of Student Development is making a conscious effort to recruit talented young individuals. We have created a pipeline through which we are able to track and maintain connection with the students. Through this recruiting effort, students have the opportunity to explore the various disciplines of engineering and technology. Above all, these young students partake in self-esteem boosting and academically rewarding summer experiences, which stimulate their creativity and desire to continue explorative activity in the fields of science, mathematics, engineering and technology.