

The Academy at Rutgers for Girls in Engineering and Technology (TARGET)

Evelyn Hanna

School of Engineering at Rutgers, the State University of NJ

Abstract

Today, a necessity for an increase in the number of women in the fields of engineering, mathematics, and science is prevalent. Early exposure to such fields, is an effective way to motivate young women to pursue professions in these fields. The Office of Special Programs at the School of Engineering at Rutgers, the State University of NJ prides itself on the many successful programs run throughout the summer months. One such summer program is The Academy at Rutgers for Girls in Engineering and Technology (TARGET). It is the desire of this office to present the TARGET program to the American Society of Engineering Educators (ASEE).

TARGET is designed to increase awareness in middle school girls of the career opportunities available in engineering. The objectives of TARGET are to familiarize girls with different engineering disciplines and destroy negative stereotypes concerning their ability to do well in math and science. TARGET is a commuter program that runs during the summer in two, two-week summer sessions, with twenty girls in each session. Girls who will be in 7th and 8th grades in the next academic year and reside in Middlesex, Somerset, and a small section of Burlington counties are eligible to apply. TARGET highlights include various workshops and activities such as Ropes Course, Mousetrap Racecar, trip to Liberty Science Center, Bridge Building Lab, Team Building, Panel Discussion with Women Engineers, Farm Tour, Robot Workshop, and a closing banquet. Overall, the program has been quite successful and TARGET 2000 will introduce an improved program featuring two additional sessions.

I. Introduction

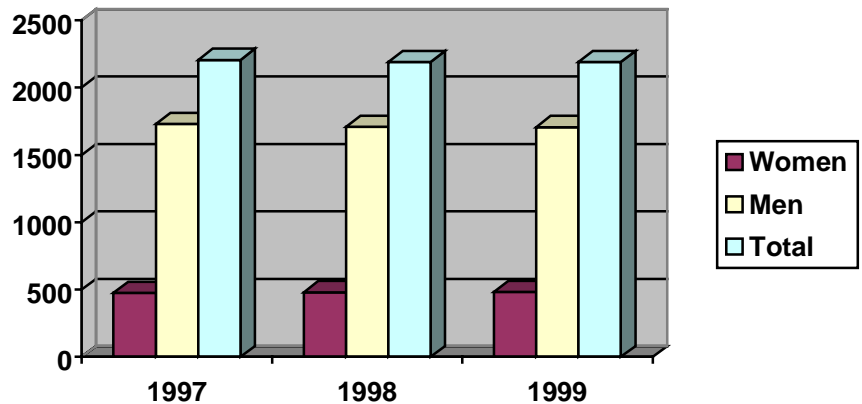
With the age of technology upon us, as well as the increasing desire to diversify Corporate America with young talented individuals, one extremely underrepresented minority group in the fields of engineering, science, and mathematics happens to be women. At the School of Engineering at Rutgers University, women represent approximately twenty seven percent of applicants, thirty percent of admitted students, and only twenty two percent of the school population¹ (see Table 1). In accordance with these figures, the Engineering Workforce Commission reported that in the fall of 1998, women represented a mere twenty percent of the undergraduate engineering population². 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. Why do women lack interest in the fields of engineering, science, and mathematics and how can we, as program administrators, positively advocate these fields to young women?

The Academy at Rutgers for Girls in Engineering and Technology (TARGET) was designed by the Office of Special Programs at the School of Engineering at Rutgers University to address the issue concerning the lack of women in the engineering discipline. Research indicates girls in the 7th and 8th grades begin to lose interest in the math and sciences and cease continuing onto advanced courses in such subject areas. 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 in 1997.

TARGET is geared towards involving 7th and 8th grade girls in the world of engineering and technology through hands-on projects and attending various workshops. The purpose of this paper is to investigate the need for pre-college programs geared towards middle school girls, define the TARGET program, and to explore program refinements.

TABLE 1: School of Engineering Rutgers University Population



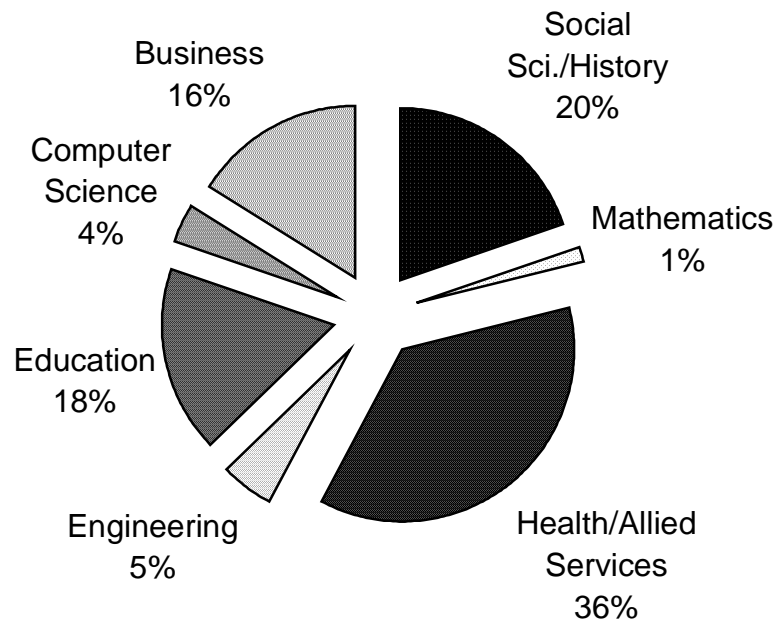
II. The Need For TARGET

In 1992, the American Association of University Women (AAUW) commissioned a report entitled *Shortchanging Girls, Shortchanging America*³, which assessed self-esteem, educational experiences, interest in math and science, and career aspirations of girls and boys ages 9-15 by conducting a nationwide poll. The findings of this research sparked a nationwide concern of what was happening to our girls. Data indicates girls begin first grade with comparable skills and ambitions to boys, but by the time girls finish high school, most have suffered a disproportionate loss of confidence in their academic ability. Also, this report found a strong positive correlation between perceived math and science skills and adolescent self-esteem. As girls begin to fit into their societal given

role as “not good” in subjects like math and science, their sense of worth and aspirations diminish.

As a follow up in 1998, the AAUW commissioned *Where Schools Still Fail Our Children*⁴ to study any changes made within the six year period. While some alterations were made in school systems, a persistent gender gap is prevalent. The funneling of students into “gender appropriate” fields reinforces gender inequities in the work force. Women seem to cluster in only twenty of the more than four hundred job categories (see Table 2), and two out of three minimum wage earners are women. At young ages, young women must be exposed to various types of career choices. TARGET is a concrete method to introduce the world of technology to women at an early age.

Table 2: Percentage of Intended College Majors (of female SAT Takers)



*Only majors pertinent to this document are shown above.

The Women in Engineering Programs and Advocates Network (WEPAN) conducted a climate study entitled *Exploring the Environment for Undergraduate Engineering Students*⁵. In this research, demographic trends indicate that by the year 2000, 68% of the new entrants into the US labor force will be women and minorities. Yet, the field of engineering has traditionally been and continues to be primarily occupied by men, with women representing just 8% of the engineering workforce. One sure way to infuse

women into the engineering workforce is to foster young females to pursue academic careers in such areas as engineering, science, and mathematics.

Girls, as well as boys, begin to “dislike” math and science, at the middle school level, but the percentage of decline is greater in girls than in boys³, which is where TARGET comes into play. One of the main objectives of TARGET is to destroy negative stereotypes concerning girls’ ability to do well in math and science. Achievement of this goal is assessed through a questionnaire answered before and after participation in the program (see Appendix 1). In addition to destroying negative stereotypes, TARGET is useful in encouraging girls to aspire to technical careers, which in turn, will increase the number of women seeking higher education in technical curricula and working towards a career in an engineering type workforce. Upon completion of the program, most girls walk away with a greater sense of confidence to do well in math and science and ready to take on challenging projects.

III. TARGET

The Academy at Rutgers for Girls in Engineering and Technology is specifically designed to familiarize girls with the various types of engineering disciplines and to instill a feeling of mathematical and scientific accomplishment within the participants. In defining the program, such areas as preparation, program curricula and schedule, and tracking procedures will be discuss.

Preparation for the summer program begins in November with fundraising. Organizations and corporations such as the American Society of Mechanical Engineers are solicited for monetary contributions. An expected budget of \$9,000 (see Appendix 2) requires fundraising in the amount of \$10,000. During the month of January, brochures and applications are mailed to middle schools in the three adjacent counties. During the month of April, applications are processed and acceptance letters are mailed. Acceptance is based on a personal statement, letters of recommendation, and the student’s academic standing. Staff interviewing, hiring, and training is conducted during the month of March. The staff consists of 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 program curricula and schedule consists of nine days packed with exciting projects and interesting labs (see Appendix 3). 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-McNeil Pharmaceutical, CAIP, and to Newark 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.

One main objective of the program is to enable the participants to build a sense of academic ability in the areas of mathematics and science. To achieve this objective, instructors from the Rutgers University community prepare one-hour workshops to provide the students with the tools necessary to successfully participate in labs and competitions. In order to provide a nurturing learning environment, female college undergraduates that currently major in mathematics, science, or engineering accompany the TARGET students. Organized tours to corporations expose the young middle school girls to corporate woman who have completed a degree in engineering and who are currently succeeding in Corporate America. These tours serve to be both rewarding to TARGET participants as well as to the working women.

Throughout the program, students participate in various self-esteem-building activities. For example, a Ropes Course Workshop is conducted, which entails group activities, trust exercises, strength exercises, and critical thinking games. Since the purpose of the Ropes Course Workshop is to build confidence and friendships, this activity is conducted on the second day of the program. In addition to the Ropes Course, participants are required to participate in a Bridge Building and Mousetrap Racecar competitions. The students are divided into groups in which they must work to create a Balsa Wood bridge and a mousetrap racecar. Throughout the program, the students are taught the necessary physics and mathematical concepts of bridges and racecars through participation in labs taught by university faculty. On the final day of the program, the competitions are conducted and prizes are awarded based on several different criteria such as maximum strength held by a bridge and furthest distance achieved by a racecar.

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 onto high school, they are sent surveys and invitations to university tours and events. Some comments on recent surveys include:

"TARGET showed me that girls/women can be whatever they want to be. TARGET also showed me some of the many engineering fields. TARGET was an interesting experience and it made math and science more interesting."

-Megan 7th Grade

"I used some of what I learned over the summer and applied it to school."

-Christina 7th Grade

"TARGET increased my interest about a career in engineering."

-Leslie 7th Grade

"TARGET has made me more interested in math and science."

-Stephanie 8th Grade

(TARGET) has made me want to study in the science and technology field."

-Alexandra 8th Grade

“TARGET allowed me the opportunity to interact with my peers as well as college students. It gave me more confidence in math and science and allowed me to take challenging courses.”

-Amanda 11th Grade

“It (TARGET) got me more interested in math, science, and engineering. It encouraged me to take more math classes.”

-Evelina 11th Grade

IV. TARGET 2000 & Beyond

As the new millennium approaches, a new and improved TARGET will be introduced. The improvements will include an additional two sessions to accommodate forty more participants. Improvements will be made to the areas of academics, funding and involvement with other universities.

More hands-on workshops will be incorporated into the TARGET curricula. For example, we will involve the Ceramic Engineering discipline by introducing a Ceramics Lab that will enable the students to learn about materials by creating a ceramic object, which they will be able to keep as a souvenir. In order to sharpen academic skills, math and science review classes will also be introduced.

In regards to financial assistance, corporations will be asked to sponsor a two-week session. During this corporate sponsored two-week session, only the daughters, granddaughters, and nieces of the corporation's employees will be invited to attend. This round of TARGET will be altered to incorporate family involvement in some activities.

As the age of technology is upon us, we would like to incorporate a teleconferencing session with other universities that run programs such as TARGET. As a project, the girls would set up the hardware and software needed to run the teleconferencing. For forty minutes at the end of the day, the girls will have an opportunity to connect with other girls around the world that are participating in similar programs.

V. Conclusion

Our daughters are calling out to us with heart-breaking cries of low self-esteem, academic poverty, and discriminatory injustice. As program administrators, we need to develop concrete programs to help young women out of this poverty and into a world of opportunity and equality. The Academy at Rutgers for Girls in Engineering and Technology not only provides girls in the 7th and 8th grade with two weeks of intensive projects and activities but also empowers these young women to believe in themselves and their ability to achieve greatness.

Appendix 1: TARGET Questionnaire – Pretest & Retest

Please answer the following questions as honestly and quickly as possible. Your answers will be kept strictly confidential and will in no way affect your standing in the TARGET program.

Chemistry	0	1	2	3	4	5	6	7	8	9	10
Economics	0	1	2	3	4	5	6	7	8	9	10
Pharmacy	0	1	2	3	4	5	6	7	8	9	10
Computer Systems Engineer	0	1	2	3	4	5	6	7	8	9	10
Computer Science	0	1	2	3	4	5	6	7	8	9	10
Sociology	0	1	2	3	4	5	6	7	8	9	10
Civil Engineering	0	1	2	3	4	5	6	7	8	9	10

Assuming you were interested and motivated to do your best, how confident are you that you could complete each of the following tasks (Circle appropriate number)?

Task	Not at all Confident	Somewhat Confident	Moderately Confident	Very Confident	Completely Confident						
Design and build a homepage on the internet.	0	1	2	3	4	5	6	7	8	9	10
Design and build a bridge.	0	1	2	3	4	5	6	7	8	9	10
Design and build a racecar.	0	1	2	3	4	5	6	7	8	9	10
Present a technical report in front of 60+ people.	0	1	2	3	4	5	6	7	8	9	10
Take apart a mechanical or electrical device and put it back together so that it still works.	0	1	2	3	4	5	6	7	8	9	10

Please indicate whether you like, dislike, or are indifferent in each of the following activities listed below by circling the number underneath the most appropriate column.

Activity	Dislike	Indifferent	Like
Reading scientific books or magazines	1	2	3
Solving a math puzzle	1	2	3
Taking a science class	1	2	3
Taking a math class	1	2	3
Visiting a science museum	1	2	3
Attending a lecture by a famous scientist	1	2	3
Solving computer problems	1	2	3
Attending a science fair	1	2	3
Joining a science club	1	2	3
Solving a card/magic trick	1	2	3
Using math to solve a practical problem	1	2	3
Trying new computer programs	1	2	3

Name (optional)

Appendix 2: TARGET Budget

ITEM	AMOUNT
Backpacks	\$ 530
Workshop Materials	\$1300
Printing	\$ 500
Team Leader Payroll	\$4000

Food	\$2000
Museum Trip	\$ 500
T-shirts	\$ 400
Total	\$8930

Appendix 3: TARGET Schedule

Week 1

	Monday	Tuesday	Wednesday	Thursday	Friday
9:30-10:30	Introduction To Program	CAIP Tour	Ropes Course	Intro to Industrial Engineering	MSLC/ Physics Tour
10:45-11:45		Robot Lab		Physics Tour	
12:00-1:00	Lunch	Lunch	Lunch	Lunch	Lunch
1:15-2:15	Introduction to Engineering Lab	Intro to Bio-resource Engineering	Ropes Course	Mousetrap Racecar Lab	Mousetrap Racecar Lab
2:30-3:30		Farm Tour			
3:45-4:15	Rap Session	Rap Session	Rap Session	Rap Session	Rap Session

Week 2

	Monday	Tuesday	Wednesday	Thursday	Friday
9:30-11:45	Liberty Science Center Trip	Ortho Pharmaceutical Tour	Bridge Building Lab	Scientific Scavenger Hunt	
12:00-1:00	Lunch	Lunch at Ortho	Lunch	Barbecue	
1:15-3:30	Liberty Science Center Trip	Bridge Building Lab	Intro to Aerospace Engineering (Airport Visit)	“My Life as an Engineer” Panel Discussion	

3:45-4:15	Rap Session	Rap Session	Rap Session	Bridge Building/ Mousetrap Car Races	
				Closing Banquet	

Bibliography

1. Dean Bernath. School of Engineering at Rutgers, the State University of NJ Engineering. Dean's Office 98 Brett Road Piscataway, NJ.
2. *Engineering and Technology Enrollments - Fall, 1998*. Engineering Workforce Commission of the American Association of Engineering Societies, Inc.
3. *Shortchanging Girls, Shortchanging America*. The American Association of University Women (1992).
4. *Where Schools Still Fail Our Children*. The American Association of University Women (1996).
5. *Exploring the Environment for Undergraduate Engineering Students*. Women in Engineering Programs and Advocates Network (1999).

EVELYN HANNA

Evelyn Hanna is a Counselor at the Office of Special Programs at the School of Engineering at Rutgers University. She is currently an undergraduate at Rutgers University working towards a B.A. in Mathematics. Upon completion of the bachelors, she will continue onto graduate school at Rutgers University working towards a Masters of Education, Mathematics. Career goals will focus on minority and women equality in the areas of mathematics, science, and engineering.