

**2006-619: CREATING COMMUNITY OUTREACH PARTNERSHIPS THAT HELP IMPROVE THE PIPELINE OF UNDERREPRESENTED MINORITIES IN ENGINEERING**

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Creating Community Outreach Partnerships That Help Improve the Pipeline of Underrepresented  
Minorities in Engineering

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Abstract

The Center for Student Success (CSS) is designed to improve the recruitment and retention of women and underrepresented minorities in the College of Science and Engineering at Loyola Marymount University (LMU). In 2001, LMU wanted to do more to improve our chances of recruiting underrepresented students and created *The Science and Engineering Community Outreach Program (SECOP)*. SECOP is a two-week residential summer program with an engineering focus. It is a partnership between LMU and five academic enrichment programs including Young Black Scholars in Inglewood and American Indian Clubhouse in Downtown Los Angeles. Since inception, 100 students from 40 high schools have participated with outstanding results. After collecting data on 59 students who attended SECOP and graduated from high school, 44% selected engineering majors (26/59) and 38% are female engineering majors (15/39). These statistics are three times higher than the national average of underrepresented engineering students (12%) and twice as high for female engineering students (20%). This article discusses the methods used to develop a valuable and meaningful program that supports our community, improves the pipeline of engineering students and benefits our University.

## I. Introduction

The Science and Engineering Community Outreach Program (SECOP) is a two-week residential summer school program for students entering their sophomore or junior year in high school who have a strong aptitude and desire to study science, engineering or mathematics. SECOP is a collaborative partnership between LMU and five academic enrichment programs in Southern California: Young Black Scholars (YBS), College Bound (CB), Boyle Heights College Institute (BHCI), American Indian Clubhouse (AIC), and The Blazers. Since 2001, one hundred students from forty inner city high schools have participated in SECOP. By working with community organizations we have reached highly motivated students who have a strong aptitude for science and mathematics. These organizations are valuable sources of inspired students who are tailor-made for recruitment into a science, engineering or mathematics department. We found funding to support our partnership from private corporations and foundations with similar goals; to improve the representation of African American, Latino, Native American, and females in engineering majors. SECOP focuses on introducing low income students to science, technology, engineering, and mathematics (STEM) careers and improving students' content knowledge in these topic areas. The goal of SECOP is to address the shortage of African American, Latino and Native American and female students studying science, mathematics, engineering, and technology at college level by introducing students to pre-engineering and advanced mathematics classes early in their academic careers.

The objectives of SECOP include:

- increasing awareness of opportunities available in science, engineering and technical fields;
- increasing students' confidence to grasp mathematics, technology and science subjects;
- improving student achievement in mathematics, technology and science;

- mentoring students through the process of applying to college; and
- increasing the pipeline of underrepresented minorities in STEM majors.

The American Association for the Advancement of Science (AAAS) discusses the benefits of summer school programs for minority students and women in their study, “Investing in Human Potential: Science and Engineering at the Crossroads.” The study recommends, “providing residential campus experiences such as overnights, summer programs, and bridge programs” (p.3) to help expand the base of participation in science, engineering and mathematics. None of the academic intervention programs listed above offer summer school classes to their participants. During SECOP, students take courses in pre-engineering, computer graphics, physics, chemistry, mathematics, and SAT Preparation.

## II. Assessment of Need

Historically, America’s racial and ethnic minorities have been underrepresented in higher education in the science and engineering fields. Technology-based industries such as biomedical engineering, aerospace and computers are the nation’s fastest growing and make up one-sixth of the total United States economy (Barret, 1997). Today, the United States is the world leader in the global Science, Technology, Engineering and Mathematics (STEM) enterprise. While national engineering baccalaureate production grew in 2003 by 9.3% from 68,053 to 75,031, the fractions of this total awarded to African Americans, Latinos, and American Indians, respectively, all declined. Degrees earned by these three historically underrepresented groups peaked-in percentage terms-in 1999-2000 (11.6%), and have drifted downward ever since, reports the National Action Council for Minorities in Engineering, Inc. (NACME).

Currently, African American, Latino and American Indian only make up 11.3% of the engineering undergraduate degrees. These same race/ethnic groups are projected to make up

33.9% of the U.S. population graduating from high school in 2014. Engineering degrees awarded to women have followed a similar trajectory-growth through the 1990's with a percentage peak in 2000 at 20.6% of the total. In 2003, women represented 20.1% of the baccalaureates awarded in engineering (Society of Women Engineers).

According to *Science* (Culotta 1993), a publication of the American Association for the Advancement of Science, there are several reasons why African American, Latino, and Native American students remain underrepresented in science and technology fields. These reasons include:

- inadequate academic preparation;
- low expectations by teachers;
- image problems due to low minority representation at most universities; and
- limited knowledge of mathematics and science professions.

Loyola Marymount University seeks to help low income students overcome the barriers they encounter while trying to enter into science, engineering and technology fields by improving academic preparation and expanding students' knowledge of the myriad of opportunities available for science and engineering majors. The University has the resources and intent to help students clear these obstacles by providing supplemental education with experienced teachers, state-of-the-art classroom facilities and supportive college students who act as counselors and mentors. Additional attention in advanced math and science courses such as calculus and physics before students enter college is an effective means of ensuring preparedness for science and engineering degrees. While low income minority high school students from Title 1 Institutions statistically take less advanced mathematics and science courses such as physics, SECOP encourages all of our participants to take a fourth year of math and physics in high school to be prepared for Freshman engineering courses. This extra

guidance provides the necessary and critical pre-college counseling that can positively affect learning outcomes.

“SECOP has given me the opportunity to experience science and engineering on a first hand basis. I think it is a very challenging and rewarding career, and I feel that it is something I’d want to do.” Student from Class of 2003 Sacred Heart High School in Boyle Heights

### III. Program Description

The Science and Engineering Community Outreach Program (SECOP) is a partnership between Loyola Marymount University and five local academic enrichment programs: Young Black Scholars, College Bound, Boyle Heights College Institute, American Indian Clubhouse and The Blazers. Loyola Marymount University works directly with each organization to select the participants. SECOP participants are underrepresented minority students who have demonstrated an aptitude for mathematics, science, or engineering and wish to enhance and strengthen their academic abilities.

Three faculty members teach courses in pre-engineering, computer graphics (AUTO CAD), physics, chemistry, mathematics and SAT Prep. Nine minority Loyola Marymount University undergraduate students studying science and engineering are counselors for the Program. Their roles include being teachers’ aids during classes, project leaders for each of the group projects, and resident assistants in the dormitories.

Parents visit SECOP on two occasions for Family Night Events. The events include dinner and discussions on important topics including financial aid and scholarships for college and future jobs in science, technology and engineering. Guest speakers from Jet Propulsion Laboratory, NASA, Boeing, Southland Industries and the Metropolitan Water District of Southern California inform SECOP participants about engineering career possibilities on Career Day. Different science and engineering-based field trips to the Petersen Automotive Museum,

Disney's Imagineering, Ballona Wetlands and Northrop Grumman give students a first-hand look at the day-to-day work of engineers and scientists. Students are housed on campus in Rains Dormitory and have their meals in the Lair Dining Hall. In the evening and on weekends students utilize the Fritz Burns Recreation Center for basketball, working out, tennis, and swimming.

#### A. Components of Program

The summer school program has five (5) components that enable young scholars (and their families) to visualize themselves as college students studying mathematics, science or engineering.

##### 1) Academic Preparation for Engineering and Science Degrees Component

The results of the Third International Mathematics and Science Study (TIMSS) show that, as a nation, we are not adequately preparing our high school students for college science and math courses. High school seniors in the United States placed 28<sup>th</sup> in mathematics and 17<sup>th</sup> in science (Barrett 1997). During the SECOP, Loyola Marymount University will focus on giving the students in-depth learning experiences.

Students work together in a team with the support of Loyola Marymount University engineering and science student mentors to design, and produce a project. The projects each summer include:

- building a wind generator;
- producing a balsa wood bridge;
- robotics using LEGOS Mindworks and;
- building a catapult.

The students present their projects the last day of the program. They share their results with the other students. Additional benefits of the group projects include improving team working skills and public speaking ability.

“SECOP not only made a difference in the participants’ lives, SECOP has forever changed me as well. I know that no matter how busy my schedule may get, I will always make time to encourage those following in my footsteps. I can truly make a difference in someone’s life.” LMU Biology Major Class of 2003

## 2) Career Component

Female and minority students tend to have limited knowledge of the array of career options in mathematics and science fields (Clewell, Anderson and Thorpe 1992). Malcolm, Hall, and Brown (1986) noted that the majority of the nation’s Black scientists were first-generation scientists with very few role models to encourage them and to facilitate their success. During SECOP, students study different African American, Latino and female scientists, mathematicians and engineers. Their mathematics groups are named after Maria Agnesi, a famous female mathematician who wrote a textbook on calculus, *Instituzioni Analitiche* in 1750 and Lewis Howard Latimer, a famous African American electrical engineer who in 1882 made the electric light bulb marketable by creating a more efficient filament that would not burn out.

The program Director, Dr. Barbara Christie, plans a Career Day during SECOP. The guest speakers work for engineering -based organizations and all are African American and Latino leaders in mechanical, civil and electrical engineering fields. Several field trips to different science and engineering-based companies exposed students to different career opportunities. In the past, the field trips have included visiting Disney’s Imagineering, Northrop Grumman Space Park, Collision Dynamics, and Ballona Wetlands

“SECOP has definitely influenced my feelings on studying engineering. At one point in time I did not really know what engineering was. Now I feel a lot more aware of what engineering is all about.” Class of 2004 King Drew H.S.

## 3) Family and College Preparedness Component

The support and understanding of parents is very important to first-generation college students. Parents need information on ways to foster math and science interests and persistence



in their children (Clewell, Anderson and Thorpe 1992). Once a week we will invite the family members of participants to attend a College Life seminar and dinner. Each week we focus on a different aspect of college life.

- Week 1: “How to Prepare for College Financially”, (families will be given a list of foundations that offer scholarships such as the American Chemical Society or American Society of Mechanical Engineers).

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- Week 2: “Benefits of College and the Success Rates of College Graduates in Science, Engineering and Technology Careers”.

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“I’m so pleased my daughter had the opportunity to participate in the SECOP program. She needed the first hand experience to gain an understanding of the types of issues/problems she’ll be asked to solve as an engineering student/engineer. She really enjoyed the friendships she made and worked very hard to tackle the assignments. You are providing an invaluable service for both LMU and the underserved segments of the community.” Mother of 2001 SECOP participant who is currently a sophomore engineering student at Stanford University.

#### 4) College Life Component

First-generation college students often do not have examples of what college life is and are more likely to be intimidated by a college or university campus and lifestyle than students from families who are second or third generation college graduates. Attending SECOP provides students insight into the college experience. Students have the benefit of computer equipment and other technology that their high schools cannot provide.

#### 5) SAT Preparedness Component

The gap in performance on college entrance exams between African American and Latino students and their white counterparts widened in 1999 (Cooper and Groves 1999).

Delaine Easton, of the California Department of Education, has stated: “Students who take more college preparatory courses clearly do better on the SAT exam.” Therefore, students who attend

SECOP should have an advantage on the SAT exam. SAT exam skills training is included in the curriculum once a week.

#### B. Description of Academic Intervention Programs Partnering with LMU

The participants in the SECOP program are recruited primarily from the following academic enrichment programs:

1) Young Black Scholars (YBS) is a youth-focused academic intervention program established in 1983 to address the needs of African American high school students in Greater Los Angeles. The Young Black Scholars program's main goal is to encourage Black teenagers to excel academically and thus to become eligible for admission to colleges and universities throughout the United States.

The participants are selected from over seventy public and private academic institutions located in and around Los Angeles County including: Banning H.S., Belmont H.S., Inglewood H.S., Culver H.S., King-Drew Medical Magnet H.S., and Manual Arts H.S.

2) College Bound (CB) was established in 1990 to provide academic enrichment to African American students in grades 4-12. The program is designed to improve academic success through education intervention. The director and founder of College Bound, Ms. Johnnie Savoy, created CB to help families prepare their children to attend college.

College Bound participants are chosen from throughout Southern California. Over three hundred students participate in weekend classes offered at Loyola Marymount University and Cal Poly Pomona. Classes meet on the first and third Saturday of each month, September through June. Along with providing students with academic enrichment, CB also works closely with parents. College counselors work closely with the families and students providing

assistance in completing the applications for admissions, writing an effective essay, and preparing for standardized tests.

3) Boyle Heights College Institute (BHCI) provides academic, parental and mentoring support for under-served students in the Boyle Heights community, one of the most economically impoverished neighborhoods in Los Angeles. Over 95% of the participants are Latino, either recent immigrants or second and third-generation Mexican-American. The Institute was established in 1992 with the objective to serve students from Sheridan Street, and Bridge Street Elementary School and follow them through their academic careers at Hollenbeck Middle School and Roosevelt High School. BHCI is helping to enrich the lives of over one hundred participants.

The Boyle Heights College Institute provides support for after-school academic enrichment. Students receive personal attention from tutors, attend computer workshops, and have a quiet location to complete their homework assignments. The Computer Learning Center consists of workshops designed to develop academic skills through the use of comprehensive computer curricula. Workshops are offered in Mathematics, Writing Skills, SAT I, Computer Basics, and Elementary Computer Enrichment.

4) The Blazers is a support program for low income students in South Central Los Angeles. The Director founded The Blazers in 1994. He has an undergraduate engineering degree and an MBA. The Blazers offers after-school and weekend events for students. The Blazers provide tutorial services, cultural and civic educational activities as well as organized sports. SECOP will be a beneficial program for the Blazer students with strong mathematics and science abilities.

5) American Indian Clubhouse (AIC) provides academic support for over 150 Native American students attending public school in Downtown Los Angeles. Los Angeles has the highest number of American Indians living in an urban area. AIC works with students from several Title I schools in low socio-economic geographic areas including: Belmont H.S., Jefferson H.S., Garfield H.S., South Gate H.S., and Bell Gardens H.S. These students are potential SECOP participants for SECOP 2006. American Indian Clubhouse receives support from United American Indian Involvement (UAI). The Clubhouse is a location where students in first through twelfth grade can receive help with their homework. AIC offers tutoring services, weekend field trips, art programs, Friday night social events, and cultural programs. There is a major focus on improving students' self-esteem and improving academic achievement, and citizenship.

#### C. Funding Sources and Budget

The funding sources of SECOP included private corporations and foundations. Most were from the Los Angeles Area such as Medtronic Foundation and Crail-Johnson Foundation. Each of these organizations provided between \$10,000-\$15,000. SECOP has received larger sums of money from national sources such as the Verizon Foundation. Each of the foundations who donated funds had the goal of improving the pipeline of underrepresented students in engineering. Most engineering corporations are very interested in a more diverse future workforce and are very eager to support programs that involve improving the percentage of minorities and female engineers. It was important to seek funding during the fall and winter to obtain the money before March or April. During the spring, the planning stages of the Program take place. The different partner organizations are notified of how many students they could invite. Normally, each organization can invite 3-5 students.

The cost of producing a two-week residential program is quite high. The budget must include dormitory costs, food, transportation, salaries for staff and faculty, recreation, and materials. The cost per student is approximately \$1,500 for the two weeks. This included three professors, eight LMU student counselors, dormitory costs of \$16/night, food cost of \$25/day, recreation costs of \$100/student, transportation for field trips, \$1,200 and material fees of \$40/person. Depending on how much money was awarded to SECOP between December-February, we would invite as many students as we could afford.

#### D. Demographics and Descriptive Narrative of Loyola Marymount University

Loyola Marymount University has a strong commitment to encourage participation in programs that provide enriched learning opportunities for underrepresented students pursuing STEM majors. The University enrollment for 2005 is approximately 5500 undergraduates. The demographic profile of the University strongly mirrors the multicultural environment of Los Angeles. Minority students make up 42% of the LMU student body (19% Latino, 8% African American, 14% Asian American, 1% Native American). The College of Science and Engineering at Loyola Marymount University offers selected undergraduate, graduate, and teaching degree programs. Under the direction of the Dean, Dr. Richard Plumb, the College offers undergraduates programs in biochemistry, biology, chemistry, physics, engineering physics, mathematics, computer science and civil, electrical, and mechanical engineering. Master of Science and Master of Science in Engineering degrees are also offered. The 802 undergraduate students in the College receive personal attention from 60 full-time faculty members. For the 2005/2006 academic year, the College's student body demographics show LMU's dedication toward having a student body that represents our community with 48% women and 30% underrepresented minorities.

#### IV. Program Evaluation and Future Support

Participants are given a pre-test in mathematics on the first day of the Program. At the conclusion of SECOP, the students will take an identical post-test. Statistical analysis determines the effectiveness of our mathematics courses. Loyola Marymount University evaluates SECOP by conducting written evaluations through surveys and interviews with the participants. LMU teachers typically conduct exit interviews at the end of the Program. Students have the opportunity to give feedback on the effectiveness of the cognitive and affective learning experiences.

Course grades and SAT Exam scores of participants are placed in a database for future reference. The Director of SECOP tracks students four years after they have graduated from high school. We are in close contact with the leaders from the five academic intervention programs throughout the year. Dr. Christie attends group meetings regularly and assists during college counseling events at the various locations. Of the students who participated since the summer of 2001 who graduated from high school, 100% of the students contacted by our study have entered college (N=59). Thirty-eight of the students have selected STEM majors (65%), 26 are engineering majors (44%).

The tables below show the results of majors selected from 3 years of SECOP participants.

Table 1: Student statistics from 2001-2003 SECOP high school graduates (N=59)

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Of the total participants, 38 are majoring in Science, Technology, Engineering or Mathematics (STEM Degrees) (65%)

9	Science (15%)
26	Engineering (44%)
3	Mathematics (5%)

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Table 2: Female statistics from 2001-2003 SECOP high school graduates (N= 38)

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25 of the 38 female participants chose STEM degrees (66%)

7	Females Science (18%)
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15	Female Engineering (40%)
3	Female Mathematics (8%)

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The SECOP participants have an SAT overall average, which is 250 points above the average for African American students nationally (1110 compared to 860). The SECOP GPA's are significantly higher than the national average for African American students. (According to The High School Transcript Study: A Decade of Change in Curricula and Achievement, 1990-2000 - a publication by the National Center for Education Statistics, the mean GPA of African American high school graduates on the graduation year of 2000 is 2.63. This publication can be accessed at <http://nces.ed.gov/>.)

Results from the 2003 College - Bound Seniors: A Profile of SAT Program Test Takers are below. This report can be accessed from The College Board website.

Average Verbal SAT score for AA males: 430, Average Verbal SAT score for AA females: 432

Average Math SAT score for AA males: 436, Average Math SAT score for AA females: 420)

## V. Conclusion

Developing methods to recruit students is normally the duty of the admissions office on a college campus but the admission office goal is to recruit students to apply to the university in general, not within targeted majors. In order for engineering departments to recruit the best and brightest students they must find innovative and efficient methods to reach out to the high school community. SECOP has accomplished many of its objectives over the past five years.

Improving mathematics scores was measured through pre and post testing. The scores of the mathematics pre and post-tests showed that 65% of the students increased their scores by 10% or more. The other 35% of the participants were within 10% of their original pre-test scores. These scores are encouraging and indicate that SECOP has helped improve significantly the participants' mathematics achievement. SECOP alumni have consistently taken four years of

math and a year of physics in high school, thereby preparing them to undertake STEM major in college. Students’ exit interviews have demonstrated positive outcomes in several academic and affective areas, notably those mentioned in the following table.

Table 3: Responses from the student evaluation (N=82):  
(1 strongly disagree, 2 disagree, 3 average, 4 agree, 5 strongly agree)

	1	2	3	4	5
The instructors improved my understanding of what engineers do.	0%	0%	10%	34%	56%
SECOP helped improve my mathematics skills.	0%	0%	20%	56%	24%
I would recommend this Program to a friend.	0%	0%	6%	18%	76%
The computer class helped improve my understanding of computers and their capabilities.	0%	0%	16%	36%	48%

As we have shown, SECOP has encouraged many underrepresented students to pursue science and engineering majors. Together, LMU and our community partners, hope to continue to work toward achieving the critical goal of improving the participation of underrepresented students and women in science, engineering, and mathematics degrees and careers.

#### Author Biography

Barbara A. Christie, Ph.D., Director of the Center for Student Success (CSS) in the College of Science and Engineering has a strong practical and theoretical background in the area of minority and gender representation in the fields of science and engineering. CSS provides several services to LMU science and engineering students including career development, counseling services (academic, financial aid, graduate school, and professional school) and community outreach. Dr. Christie is the Founding Director of the Science and Engineering Community Outreach Program (SECOP). SECOP has provided summer enrichment to 100 students since the summer of 2001. Dr. Christie taught science for 14 years prior to her administrative position at LMU.



Her first teaching position was in Ghana, West Africa with the US Peace Corps. Her Ph.D. is in Instruction and Learning with an emphasis in Science Education from the University of Southern California. She has two children, ages 16 and 13. E-mail address: bchristi@lmu.edu.

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