Pipeline Improvements

Diversifying & Accelerating the Engineering Transfer in California Community Colleges

Introduction

Why do so few community college students pursue transfer in science, technology, engineering and math (STEM) disciplines? While several reasons certainly exist, the most significant barrier may well be math. The majority of students, especially African-American and Latino learners, enter the community college system with math skills well below college level. As a result, even those who demonstrate an interest in and aptitude for math have literally years of remedial work to complete in this subject before they even reach calculus—the gateway to STEM coursework and the real beginning of the transfer path in these disciplines.

The following series of case studies documents how three California community college engineering departments have developed special initiatives that respond to this challenge, including East Los Angeles College (ELAC), Cañada College, and Cabrillo College.

The RP Group is featuring these projects because they all serve students who have traditionally been underrepresented in the STEM disciplines. Each program employs two main strategies for addressing the transfer problem:

- Strategy 1: Math acceleration and preparation programs for community college students
- Strategy 2: Engineering outreach programs for new students

Each program realizes these strategies in different ways, including how they accelerate math coursework, ways they build skills for college success, how they create community, and how they fortify understanding in key subject areas. Finally, these three colleges benefit from strong MESA (Mathematics, Engineering, Science Achievement) program support.
Currently, 33 California Community College MESA programs serve financially and educationally disadvantaged students interested in math and science majors. These programs provide additional resources for students including academic, career and financial aid advising, transfer assistance, mentorships, field trips, scholarship assistance, and study groups.

Profiles of these colleges’ initiatives follow and are organized by key strategy. Descriptions include a range of information on program components and implementation, participants, and outcomes where possible. Student profiles and perspectives are incorporated throughout.

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Readers can find a table summarizing key information by program at the end of the document.
Strategy 1:  
Math Acceleration and Preparation – Getting Students to the Gate

Practice 1:  
East Los Angeles College  
Math, Physics and Chemistry Boot Camps

Because engineering is a high-unit major with a multitude of requirements for lower-division preparation, the path to transfer is long. This is particularly true for students entering unprepared for college-level work in math. Many, if not most, students are looking at three to six semesters of math coursework before they even reach calculus.

“Our goal was to change this equation,” says Project Director and Assistant Professor of Engineering Professor Kamyar Khashayar who leads a team of innovative engineering faculty members at East Los Angeles College (ELAC) presently testing a fast lane to calculus for a second year. “You get on the fast track by signing up for our boot camps,” Khashayar explained. “It is total immersion, but with a lot of support.”

Purpose. The main goals of the Engineering Transfer Pathway Program are to increase the number of Latino, female and low-income students attaining degrees or transferring in engineering fields, and improving the transfer pathway between ELAC and CSU-Los Angeles (CSULA).

Program. The department’s boot camps offer students a compelling deal: give up just five weeks of summer or winter break and receive two semesters worth of science or math mastery. Depending on their starting point, students choose from three levels of math boot camps, each covering multiple topics:

- Math 1: Introduction to Algebraic Concepts (110), Pre-Algebra (112) and Elementary Algebra (115)
- Math 2: Geometry (120) and Intermediate Algebra (125)
- Math 3: Trigonometry (241) and Pre-Calculus (260)

Each boot camp includes a total of 72 hours of instruction, 20 hours of mandatory tutoring and 50 to 60 hours of open tutoring. Participants can access most of the homework and tutorials online using Course Compass by Pearson Education, Inc. In a typical week, math boot camp participants attend four days of regular lecture with ELAC faculty that include additional discussion and problem-solving sessions followed by optional tutoring, and two days of mandatory tutoring. Two additional five-week boot camps bring students up to college-level chemistry and physics. These boot camps include lab sessions.
Student demographics. In just two years, ELAC has engaged 266 students in this initiative. Approximately one quarter of the 2009-2010 participants were female, and more than two thirds (69%) were underrepresented minorities (African-Americans, Latinos, Pacific Islanders, and Native Americans).

Challenges. Many ELAC students are economically and educationally disadvantaged. Their high school courses often do not prepare them for college-level math. It is sometimes difficult to convince them to forgo summer employment to take part in an intensive boot camp program because they have difficulty thinking ahead to the long-term benefits of participation. Encouraging participation in math boot camps is a little bit of a harder “sell” than for the science boot camps. Students in the physics and chemistry boot camps have already done the minimum work in math and just need brush-up work in specific topics. They are mentally prepared for the chemistry and physics challenge—math is “scarier.”

Outcomes. Thus far, boot camp retention rates have averaged 74% and pass rates 83%. Among program completers, 64% successfully moved on to the next level of math—noteworthy statistics in light of the extremely low pass rates generally found among students taking remedial coursework. ELAC is also encouraged by students’ growing demand for boot camp offerings. Winter 2011 chemistry and physics boot camp enrollment was so strong that the department added two additional lab sessions.

Resources. The Engineering Transfer Pathway (ETP) program at ELAC is supported by a $2.5 million federal grant through the Department of Education. The boot camp program is one of the ETP’s major activities. Administrators noted that costs would include the cost of 80 instructor hours per boot camp. Added to that would be the cost of intensive mentoring. There is one paid student tutor for each group of eight to ten students, so there is the additional cost of about 140 hours of tutoring for each boot camp, depending on the number of students enrolled.

Lessons Learned. The sessions need to be intensive so that students absorb and retain as much material as possible. Students need to be available six days a week in order to be able to cover the two to three subjects covered in each session. There are mandatory tutoring sessions on Wednesdays and Saturdays. The Saturday sessions are crucial: if students don’t come in on Saturday, they tend to forget much of what they learned over weekend.

We all gained a little bit of weight and lost a little bit of hair, and walked away with a lot more understanding than if we hadn’t done it. The instructor is with you four days a week, four to five hours per day. There is at least one tutor per class. It is almost like a private college.

Manhong Wong
ELAC Math Boot Camp

I want to take advantage of everything they have to offer before I move on to the next thing...ELAC is the only community college in the area that has an engineering program. You get a lot more attention from the professors there; everything there is small scale, more accessible—you can make friends that help you in your studies.

Alexander Chau
ELAC Math Boot Camp
Practice 2: Cañada College MathJam

Located in Redwood City on the Peninsula midway between San Francisco and the Silicon Valley, Cañada College is in the heart of the Bay Area’s technological innovation zone. The region offers fabulous opportunities, but for those without math and science skills, those opportunities can remain out of reach.

Underrepresented minority students at Cañada have historically exhibited disproportionate interest in engineering—but despite their early enthusiasm, surprisingly few of these students make it to transfer to four-year colleges as engineering majors. So, for instance, from 2006-2010, while Mexican-American students made up more than a third of those taking the math placement test and almost half of those declaring an engineering major, they made up only 19% of those going on to transfer in this field. This drop-off appears to be largely the result of disparities in math preparation: more than 70% of Hispanic and African-American students placed in algebra or pre-algebra (sub-college level math) compared to less than 40% of Asian and Caucasian students, most of whom placed into at least college-level algebra. (See Figure 1 on page 6.) Project director Amelito Enriquez remembers thinking, “The placement test is the way we welcome students. We say ‘come to college… oops, you are not good enough.’ What kind of a welcome is that?”

Purpose. Dr. Enriquez helped to develop a program called the Student On-ramp Leading to Engineering and Sciences (SOLES) program with the goals of increasing the level of academic preparation of students from underrepresented groups, increasing awareness of and interest in engineering as a career, improving the retention of students, and facilitating timely transfer. Dr. Enriquez is a faculty sponsor for the college’s MESA program, which is closely coordinated with these efforts.

Student Profile: ELAC Math, Physics and Chemistry Boot Camps

When Manhong graduated from high school he wanted to pursue a degree in automotive engineering. In pursuit of that goal, he took classes at a total of three community colleges over seven years. Like many students, he attended college part-time so he could work to support himself. However, there were other barriers to completion besides work, the biggest being math. He remembers, “I almost gave up on engineering due to the math requirements. I took Math 115 (Elementary Algebra) twice, Math 125 (Intermediate Algebra) four times, and attempted Trig three times and passed on the third try. Even though I eventually passed 125, it didn’t mean I understood it.”

He decided that he needed help. He started to go to the math lab at ELAC where he met other engineering students, and was convinced to take one of the engineering program’s math boot camps. He says, “In the boot camp, a tutor connected the subject to real life, and I understood. I never used to understand what a problem was about… They gave much better explanations in boot camp. I wish someone had told me that years ago. Back in high school, there was a lot of memorizing everything, but not making any relationship with it to real life.” As a result of taking the boot camp, he was able to pass pre-calculus in one pass. He also found the ELAC MESA program extremely helpful in picking the right classes, avoiding unnecessary duplication and preparing for transfer to a four-year program. He notes, “I have taken enough classes for at least two people!”
Program. In order to realize these goals, Cañada instituted two summer programs, MathJam and the Summer Engineering Institute, to boost students’ chances at success in math and eventually transferring to a four-year engineering program. These programs began in 2009 and are now in their third summer of implementation.

MathJam is an intensive two-week summer program that allows students who intend to major in science, technology, engineering or mathematics (STEM) to prepare for the math placement test. By taking the MathJam course, these students prepare to retake the math placement test at the end of the course in order to advance to the next math level. The program utilizes an online testing and assessment tool, MyMathTest, which develops for students a customized study plan based on the results of a practice test. MathJam also includes optional afternoon workshops on college orientation, college success resources and skills, problem solving skills, time management skills, test-taking strategies, and overcoming math anxiety. Additional support for students is provided through individual and group study sessions and one-on-one tutoring. Students attend classes five days a week, six hours per day.

Participants must be continuing Cañada students or senior high school students who intend to attend Cañada. They must have taken the math placement test and placed at least in the Pre-Algebra level. Students are offered free lunches, a college starter kit and a MESA/SOLES membership for participation.

A one-week Mini-MathJam is also offered to help continuing students and incoming freshmen prepare to retake the math placement test or take a Cañada College math course in the upcoming semester. Mini-MathJam courses are offered in summer and in January right before the beginning of the semester.

Student Demographics. Since its start in June 2009, more than 376 students have enrolled in MathJam summer courses. More than half of the students in the first two cohorts were female, approximately two thirds were underrepresented minorities, and approximately half were first-generation college students.

Outcomes. In its first two years, MathJam had a pass rate of about 84%. Nearly all students (90%) improved their test scores and 64% to 71% were placed at a higher level in math than where they originally tested. Pre- and post-program surveys help us understand the impact of this program on student aspirations and beliefs. There was a statistically significant increase in students’ confidence about their math study and college success skills at the end of the course.
Likewise, students evidenced an increase in their agreement that they had a supportive relationship with other students and tutors at Cañada.

These attitudes appear to have translated into positive outcomes as MathJam students were found to have higher semester-to-semester persistence rates and higher overall retention and success rates in subsequent math classes. For example, 37% of 2009 MathJam students had a higher success rate in subsequent semester math courses than the course average (62.3% vs. 50.5%). This was especially true for the students who had advanced as a result of participation.

**Resources.** In 2008, Cañada received a $900,000 Minority Science and Engineering Program (MSEIP) grant from the US Department of Education. MathJam is one of several activities funded by this grant. The Engineering program received another $6 million grant in 2011 to work on improving the engineering transfer pipeline from community colleges to the UC and CSU systems.

The program director noted that program costs could vary widely depending on how much support a college wanted to offer. The program uses Pearson Education’s online system MyMathTest. This costs about $7 per student per instructional license, or is free if the instructor uses the accompanying textbook in the course. There are four instructors running the program, one paid student tutor per every five students in the lower-level courses, and one tutor per every ten students in the higher-level courses. The program has also chosen to pay for students’ lunches during the session. The campus is at the top of a hill away from shops and restaurants, and the cafeteria is closed during the summer. The provision of lunch keeps the students on campus and focused throughout the day. This might not be necessary for all colleges and is probably the largest expense of the program. The Dean of Science and Technology at Cañada estimated that it cost about $38,000 per week of instruction for this program.

**Lessons Learned.** One of the key lessons learned from the initial four years of implementation was the importance of pacing. The conclusion is surprising. Community college faculty, staff and administrators used to think that if a student was having difficulty with math, the answer was to slow the process down and break it into smaller components. However, the opposite may be true.

“Students can actually absorb a lot more than we give them credit for…they do better if you give them a lot of math a lot faster. They learn it better and they absorb more,” Dr. Enriquez reports. A strong part of the dynamic is the group ethic of the students who study together and help each other to learn.
Practice 3: Cabrillo College
Pre-Calculus Preparedness Seminar (PREP)

Cabrillo College is located in the beach town of Aptos just south of Santa Cruz. While the general vibe of the area is that of a laid-back surfer town, Cabrillo College is anything but laid back. An innovator in a number of different disciplines, Cabrillo has a track record of enhancing student success and improving access for underrepresented students.

In 2007, Cabrillo College STEM faculty decided to write for an NSF grant whose primary objective was to increase the number of degrees and transfers in STEM majors by recruiting new students to STEM majors. They developed a new multi-component program, STEEP (Science, Technology and Energy: Expanding Potential). STEEP is intended to attract students who might not have initially thought of themselves as potential STEM majors by involving them with sustainable technologies to address global warming. As one administrator noted, “I chose energy because I realized it was a rich, endless and engaging topic.”

Now in its fourth year, the project includes multiple components, including a summer Energy Laboratory Academy; placement in summer research and/or industry internships; counseling, mentoring, and tutoring support through the campus MESA program; and a Pre-Calculus Preparedness Seminar (PREP).

While getting students engaged is an important first step, program administrators noted that pre-calculus in particular tends to serve as the gatekeeper to enrollment in the sciences. Too often, Cabrillo students have found it an effective barrier to further participation: between Fall 2000 and Fall 2006, 54.7% of the Cabrillo students who enrolled in pre-

Student Profile: Cañada MathJam

Javier graduated high school in Mexico City, where he did very well in school. However, when he arrived in the United States, he spoke little English and found school a real challenge. He says, “I have always been inspired by science; I am very curious about things. I am always breaking things apart to see all the small parts and how they work and putting them back together.” However, when he took the math placement exam at Cañada College, he tested into pre-algebra, which meant he had to take a sequence of three math courses before he even reached a transfer-level class. He steadily worked his way through pre-algebra, elementary and intermediate algebra and trigonometry. He was about to take pre-calculus when he heard about MathJam.

MathJam “helped me to review everything I already knew but forgot I knew…. (The second time) I was pretty comfortable taking the placement test, even though English was not my first language." He scored 100% on the placement test. “Compared to when I started when my score was 28% to 30%, it was a huge jump.” As a result of attending a summer MathJam session, he was able to skip directly to Calculus I. He found that MathJam not only made his math skills stronger, but it helped him to communicate what he was learning better—to “speak math”. He notes, “I go back to Cañada and the ESL classes and share my story. I try to convince my fellow Mexicans to go into science and not something like sociology.” He tells them, “I have been there….I know how hard it is, I was sitting there where you are four to five years ago.” He intends to transfer to UC Berkeley or UC Santa Cruz in material science and bioengineering.
calculus either failed or withdrew. While some students do repeat the course, three quarters of these students never succeed at passing the course while at Cabrillo. This is why program faculty decided to offer the PREP program along with the other initiatives in order to facilitate student’s entry into STEM programs.

Purpose. According to the program website, “While all components of STEEP are aimed to prepare STEM students for academic success and attract new students to these fields, the curriculum strives to offer a learning experience that is not only content-based but also creates a transformational experience.” Objectives include increasing the number of students who declare STEM majors, especially underrepresented minority students, and improving the retention and transfer rates of these students.

Program. The PREP program is comprised of a two-week intensive program with semester-long follow-up totaling 80 hours of math activities. PREP is targeted towards students who have enrolled in pre-calculus and/or algebra and have either taken the course previously and not completed, or are deemed at risk of not successfully completing. Poor algebra skills and lack of exposure to trigonometry are particular barriers to student success in pre-calculus. Hence this summer session focuses primarily on algebra review, achieved by students researching and presenting to peers on each review topic. The curriculum also includes a brief introduction to right angle trigonometry. The first two weeks are dedicated to reviewing math concepts that students are supposed to already know. Students meet for four hours each day, five days a week. Students are divided into small groups of 3 to 4 students with a teaching assistant (TA) for each group. The program emphasizes peer mentoring, games and activities so that students do not necessarily associate the material with “math”. After meeting throughout the summer session, the cohort meets every Friday through the semester as students progress together through the pre-calculus class. Students receive a $1,000 stipend for successful completion. In a secondary, but important parallel activity, transfer-ready STEM students act as teaching assistants, obtaining valuable experience acting as mentors, role models, tutors, facilitators and teachers themselves. They receive stipends of approximately $1,500 for 100 hours of work.

Student Demographics. Approximately 60 students to date have taken part in the PREP program, which started in 2009 and will continue until at least 2013. Overall, 190-220 students are expected to participate through 2013. Approximately 34% of students in all STEEP programs are female, and 50% are Latino.

Outcomes. Preliminary outcomes suggest that participants were as likely or more likely to successfully complete a subsequent pre-calculus course (52% avg.) as other students despite being at risk of failing. Participants in the 2010 session were slightly more likely to succeed at...
pre-calculus than students who had not participated in PREP. Although the difference is not statistically significant, the findings are promising (see Figure 2).

**Funding:** This program, the Summer Energy Academy, and associated internships are funded by an NSF STEP award. This program costs roughly $70,000 per iteration. A large part of this cost goes to student stipends. Stipends make it possible for students to forego employment during the session and participate more fully. The grant provides for five years worth of programming, after which program activities will be incorporated into existing curricula. The student stipends will likely not be sustainable past the end of the grant.

**Challenges.** Obtaining accurate, detailed data to track student progress and success is the primary challenge. This makes it more difficult to develop the evaluation reporting required by the NSF. While data on the number of students who have transferred to most four-year institutions is available, it is not sorted by major and the information available on student majors is highly inaccurate. The effort required to obtain, analyze, and report on these data is time-consuming for research and budget staff at community colleges, which often lack resources to support grant activities. Finally, finding a source of institutionalized funding is problematic.

**Lessons Learned.** Program administrators Karen Groppi and Sue Tappero attribute program success to the fact that the program is activity- rather than lecture-based. There is a lot of peer mentoring and team building in the sessions, and students are expected to give presentations and critique each other’s presentations. As they noted, “We do a lot of team building. Students need to be able to criticize each other’s work. This gives them ‘mathematical maturity’. They should be able to have an honest assessment of how much time it takes to master a topic and develop a study plan for how they are going to work to get the grade they deserve. We want to empower them in that way—they are really in charge of their education.”
Strategy 2:  
New Student Outreach – Building Interest in STEM Careers

Administrators and faculty at all three programs recognize that students will do better in science majors if they enter college with math literacy. Educators are finding that by the time students enter college, it may be too late to help many of them gain the math and science skills needed to succeed. If students enter college ready for college-level math, their path to transfer will be much shorter. Yet, to become math literate, students need to understand why math is important and not wait until college to take key math classes. One interviewee compared science preparation to cooking: you chop the onions, which takes some time and may even make you cry. However, once everything is cooked, the taste pleasure added by the onion far exceeds the extra work required in preparation. Math is the onion. Engineering programs have developed hands-on special programs in applied engineering to give high school students and undecided college students a taste of the field of engineering, and encourage them to get chopping.

Practice 1:  
East Lost Angeles College (ELAC)  
Junior Engineering and Technologies Academy (JETA)

ELAC’s team of innovators in engineering education have developed several introductory engineering courses: Robotics, Renewable Energy Systems and Engineering Graphics. The goal of this program is to foster high school students’ interest in engineering and increase the number of underrepresented students who pursue engineering degrees.

Unlike the other two colleges, ELAC offers its outreach programs during the regular school year as well as during the summer via concurrent enrollment at seven local high schools.

The ELAC engineering program has also partnered with and recruits from the Escalante Program—a summer program intended to engage inner-city disadvantaged junior high and high school youth in a rigorous math preparation program to bring their math skills up to the college level by the time they graduate from high school. The engineering program has integrated engineering projects into the Escalante curriculum.

Instructors, guest lecturers and others engaged in delivering the JETA courses underscore over and over again the need for students to complete as
many math and science courses as possible in high school. All courses include hands-on labs and projects and tutoring. Typically, high school juniors enroll in these teaser courses, completing projects such as Rocket Bottle launch, Paper Bridge, Solar Tricycle (see photo on page 11) and the Robotic Contest.

Project Director and Assistant Professor of Engineering Professor Kamyar Khashayar notes, “This is how we lure them into engineering! At what angle is that rocket going? They get excited about that and are willing to go through the program. If they understand the application of what they are studying, they are going to want to be part of the program.”

The JETA program started in 2008/2009. By its second program year, these courses were attracting large numbers of students: Fall 2009 - 137 students; Spring 2010 – 334 students; Summer 2010 – 112 students.

Combined with other innovations such as the Math, Physics and Chemistry boot camps, these efforts have more than doubled enrollment in ELAC’s Engineering and Technologies Department from 697 in the base year of 2007-08 to more than 1,500 in 2010-11. Moreover, during the same period, enrollment in engineering courses of Hispanic/Latino students increased by 60% (253 to 400) and enrollment of female students increased by 125% (62 to 140).

**Practice 2:**
**Cañada College**
**Summer Engineering Institute (SEI) at San Francisco State University**

SEI courses at San Francisco State University give high school and community college students a chance to experience engineering study at a four-year institution. The goals of this two-week residential program at San Francisco State University are to introduce students to the engineering educational system and the engineering profession, to recruit students into an engineering field and to increase student awareness of the resources and skills needed for student success.

During a typical day, students attend lectures in the morning, participate in group projects and hands-on workshops in the afternoon, and do additional work on group projects in the evening. Topics include Bridge Design (see photo to right), Renewable Energy, Thermodynamics, iPhone Development, Microncontrollers, and Robotics. Students also take a number of field trips—for example, for the section on Bridge Design, students took a field trip to the new Bay Bridge construction site. One participant noted that the Summer Engineering Institute was a “life changing experience.”
Combined with other engineering initiatives, these summer sessions have helped to spur increased enrollment in transfer-level STEM courses amongst all students, but have resulted in significantly higher increases amongst minority students. Differences between increases in minority and non-minority enrollment were highest in engineering, physics and math. For example, between Fall 2008 and Fall 2010, minority student enrollment in transfer-level engineering classes increased by 200% compared to 80.5% for non-minority students.

The program owes part of its success to the fact that it is a residential program with a “captive audience” able to partake in related activities from morning through evening. However, the costs for food and lodging can be substantial, and there are additional costs for vans for field trips.

This program is intended for high school seniors planning to attend Cañada College or SFSU as engineering majors in the fall semester, current Cañada students majoring in engineering and engineering students from any Bay Area community college intending to transfer to SFSU. However, due to concerns about catching students early in their career, this program will be slowly transitioned to lower grades. Starting in 2011-12, the program will also take high school juniors and eventually it may accept students as young as eighth grade.

Practice 3:
Cabrillo College
Summer Energy Academy

The Summer Energy Academy is a month-long course targeted towards high school students, college students who have not yet chosen a career direction and those that have a STEM focus but have just started their coursework. The goal is to interest them in STEM careers through a hands-on learning experience in solar, wind and other renewable energy technologies. Although the staff involved in direct ‘instruction’ have engineering and physics backgrounds, the intention is to expose and attract students to any STEM major, with a special focus on increasing the number of underrepresented minority students in STEM programs. The Energy Academy introduces students to ideas about what is happening with the climate crises, why it should matter to them, its effects on the environment and human populations and how people are addressing it. Hands-on lab activities make up 80% of the course. Students learn to build things that use electricity in order to understand photovoltaics. They complete many small design projects that require invention and troubleshooting. Students also attend field trips (see photo to right of students visiting a solar-powered home in Santa Cruz).
Part of the Energy Academy is completing a community service project in education, so students are already becoming part of the solution as they learn. The message is that science is fascinating, that it is accessible, that it requires creative thinking and that it serves a critical societal need.

Students receive a $1,000 stipend for successful completion of the program. Students may also participate in an energy internship on- or off-campus as a follow-up to the Summer Energy Academy. This program, along with the PREP and associated internships, is funded by an NSF STEP award. This program costs roughly $70,000 per iteration, a large part of which is comprised of student stipends, although there were some initial start-up costs for equipment. The stipends play a vital role in making it possible for students to forego summer employment to participate. An important aspect of the Energy Academy is that there are teaching assistants (TAs)—one for every three or four students—who are usually themselves students pursuing STEM careers. The TAs serve as both role models and tutors. TAs facilitate small group work, addressing questions in the moment and keeping students participating and engaged. This experience serves as an internship in the teaching profession—an experience that has convinced some participants to pursue this career path.

Student surveys revealed a high rate of student satisfaction with the Energy Academy. They also revealed a change in student aspirations: in 2009, only 5% of students had declared a STEM major at the start of the summer, but 32% had declared a STEM major by the end of the session. While 38% had an interest in a STEM career at the start of the summer, 46% were interested in a STEM career by the end of the summer.

These intentions may be translating into action: Energy Academy participants had a higher rate of enrolling in math courses the following semester than a comparison group and were more likely to complete transferable STEM math courses (35% v. 12% in 2009). Enrollments in STEM calculus are up college-wide from 2007-2010, and the percentage of students reporting a STEM major has also increased.
**Table 1. Comparison of Math Preparation and Acceleration Programs**

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<th>ELAC Boot Camps</th>
<th>Cañada MathJam</th>
<th>Cabrillo PREP</th>
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<tr>
<td><strong>Subjects</strong></td>
<td>Math, Chemistry and Physics</td>
<td>Math</td>
<td>Math &amp; Trigonometry</td>
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<tr>
<td><strong>Purpose</strong></td>
<td>Reduce time to transfer by accelerating path through math and science sequence; Increase the number of Latino, female and low-income students attaining degrees or transferring in engineering fields</td>
<td>Increase the level of academic preparation of students from underrepresented groups, Reduce time to transfer by accelerating path through math sequence</td>
<td>Increase the number of students who declare STEM majors, especially underrepresented students. Provide students the tools to succeed in these majors by preparing them to succeed in pre-calculus</td>
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<td><strong>Program Components</strong></td>
<td>Lectures, tutoring, online tutorials and homework, math assessment and placement exams Three levels of math boot camps</td>
<td>Lectures, tutoring, online testing and assessment, workshops on college success skills and overcoming math anxiety, group study sessions</td>
<td>Math review and small group sessions, peer mentoring, student-directed learning, games and applied projects. Peer support sessions through pre-calculus courses Stipends for completers</td>
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<tr>
<td><strong>Schedule</strong></td>
<td>Summer and Winter Breaks</td>
<td>Summer and Winter Breaks</td>
<td>Summer Break and following semester</td>
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<td><strong>Time Commitment</strong></td>
<td>5 weeks, 4-5 days/week</td>
<td>2 weeks, 6.5 hrs/day</td>
<td>4 weeks, 4 hrs/day</td>
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<td><strong>Duration</strong></td>
<td>2009-2011+ (ongoing)</td>
<td>2009-2011+ (ongoing)</td>
<td>2009-2013 (ongoing)</td>
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<td><strong>Target</strong></td>
<td>Students interested in STEM disciplines</td>
<td>Freshmen students and ongoing students testing at least at the pre-algebra level</td>
<td>STEM majors who are at risk of not being successful in pre-calculus</td>
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### Table 2. Comparison of Math Preparation and Acceleration Programs Continued…

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<th>ELAC Boot Camps</th>
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<th>Cabrillo PREP</th>
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<tbody>
<tr>
<td>Demographics</td>
<td>25%+ female 69% underrepresented minorities (African-Americans, Latinos)</td>
<td>60% female 60% Latino 45% first-generation college students</td>
<td>34% female 50% Latino</td>
</tr>
<tr>
<td>Enrollment</td>
<td>266 students</td>
<td>376 students</td>
<td>190 to 220 students projected</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Completion Rate: 68-78% 90% improved math placement scores 56-65% of completers moved to a higher level of math Fall-to-fall persistence rates among engineering students increased from 2007-2008</td>
<td>Completion Rate=83% 90% improved math placement scores 64-71% placed at a higher level of math Participants had a higher success rate in subsequent semester math courses than course average (62.3% vs. 50.5%) First-time freshmen participants have a higher fall-to-fall persistence rate than other Cañada FTF students (2009)</td>
<td>Participants average 49%+ success rate at second attempt at pre-calculus (students recruited from those determined to be at risk of failing) Success rate at or higher than that of non-participants (average of around 43%)</td>
</tr>
<tr>
<td></td>
<td>ELAC JETA</td>
<td>Cañada SEI</td>
<td>Cabrillo SEA</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------------------------------------------------------</td>
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</tr>
<tr>
<td><strong>Purpose</strong></td>
<td>Foster high school students’ interest in engineering; Increase the number of Latino, female and low-income students attaining degrees or transferring in engineering fields</td>
<td>Recruit students into engineering; increase awareness of and interest in engineering as a career, improve retention, facilitate timely transfer, especially for underrepresented students</td>
<td>Increase the number of STEM majors at Cabrillo College; especially underrepresented students</td>
</tr>
<tr>
<td><strong>Program Components</strong></td>
<td>Lectures, Guest speakers, Hands-on labs and projects, Tutoring</td>
<td>Lectures, Guest speakers, Group projects, Hands-on workshops, Field trips</td>
<td>Lectures, Educational games, Hands-on projects, Field trips, Group discussions, Community service, Internships, Stipends for completers</td>
</tr>
<tr>
<td><strong>Schedule</strong></td>
<td>School year via concurrent enrollment</td>
<td>Summer Break, 2 weeks</td>
<td>Summer Break, 4 weeks</td>
</tr>
<tr>
<td>Locations</td>
<td>High schools and ELAC</td>
<td>Residential program at SF State University</td>
<td>Cabrillo physics lab</td>
</tr>
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</tr>
<tr>
<td><strong>Target</strong></td>
<td>High school juniors at seven local high schools</td>
<td>High school seniors planning to attend Cañada College or SFSU as engineering majors in fall</td>
<td>Recent high school graduates who plan to attend Cabrillo in the Fall</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Current Cañada College students majoring in Engineering</td>
<td>Continuing Cabrillo students who have not yet chosen a career direction or those that have a STEM focus but have just started their coursework</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engineering students from any Bay Area community college intending to transfer to San Francisco State University</td>
<td></td>
</tr>
<tr>
<td><strong>Outcomes</strong></td>
<td>Enrollment in Engineering &amp; Technologies has more than doubled</td>
<td>80.5% increase in enrollment in engineering for non-minority students</td>
<td>More likely to complete transferable STEM math (35% v. 12% in 2009) than matched comparison group</td>
</tr>
<tr>
<td></td>
<td>Latino student enrollment in engineering courses increased by 60% and female student enrollment increased by 125%</td>
<td>200% increase for minority students</td>
<td>Increases in STEM majors and completions overall and for underrepresented minorities</td>
</tr>
</tbody>
</table>

For more information on the CTE Transfer Research Project, visit [www.rpgroup.org](http://www.rpgroup.org), or contact Eva Schiöring, Project Director, [eschiöring@rpgroup.org](mailto:eschiöring@rpgroup.org).