The STEM Center: Creating a Model for Success in Community College STEM Education

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Anna Camacho joined Cañada College in 2012 in the capacity of Assistant Project Director of Hispanic-Serving Institution-STEM Grant (CalSTEP). In this position, Anna manages all financial aspects of the grant's $1.1 million yearly budget. In addition to handling fiscal matters, Anna also collaborates in program implementation & development and new grant proposals. Prior to joining Cañada College, Anna was a Program Officer at the Hispanic Scholarship Fund where she implemented programs aimed at increasing college going knowledge to underrepresented families in multiple states .

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Danni Redding Lapuz has worked in education and the non-profit sector for over 10 years in both instruction and program development. Since 2009, she has worked with grant-funded programs and initiatives supporting under-represented students studying STEM at Cañada College, including the Health Career Pathways Program, the Student On-Ramp Leading to Engineering and Sciences Project, the Veterans Employment Assistance Program for Engineering, and the National Science Foundation Scholarship Program. As Project Director for a $5.9 million Hispanic-Serving Institution-STEM Grant (CalSTEP), Danni collaboratively spearheaded the creation of The STEM Center, which promotes STEM education through programs, activities, academic/support services, and opportunities for students, faculty, staff, and the greater community.

Danni earned a BA in Music from UC Irvine and an MA in Ethnomusicology from the University of Hawai'i at Manoa. She speaks Indonesian and received fellowship support for her ethnographic research in Indonesia. Currently residing in the Bay Area, Danni continues to perform gamelan music, while raising her two children with her Math professor/musician husband.

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Abstract:

In 2012, President Obama called for 1 million new STEM graduates within the next decade. This call to action was met with a myriad of local and federal educational initiatives, STEM-specific grant funding, and an emergence of STEM programming at every level of our education system. This new momentum also focuses on the under-representation of minorities and women pursuing STEM. As a federally-designated Hispanic-serving community college, our goal of fostering more STEM-educated students is embedded within a complex web of obstacles and challenges.

In response to these challenges, The STEM Center at Cañada College identified four key obstacles faced by a majority of our community college students interested in STEM: 1) exponential attrition – the longer the course sequence the less likely students are to persist, 2) lack of social and academic integration, 3) lack of awareness of academic options, and 4) low self-efficacy – students do not believe that they can succeed in STEM.

In an effort to address these obstacles and integrate all STEM student support services within STEM academic study, we created the STEM Center. Leveraging multiple grants and a variety of STEM programs and services with a unified vision, the STEM Center now provides a one-stop destination for everything from study groups, tutoring, and club meetings to bridge programs (like the award-winning Math Jam), a STEM Speaker Series, STEM specific academic counseling, STEM career exploration programs for high school students, internship and scholarship opportunities, and STEM faculty professional development.

While success of the STEM Center's individual programs is specifically linked to program objectives and outcomes, gauging success of the STEM Center as a whole is done through a broad-based examination of four primary indicators: increased enrollment in STEM courses; reduced time to complete STEM course sequences; increased student engagement, retention, and persistence; and an increase in the number of STEM majors.

This paper will outline STEM Center development, highlight the programs and services that are offered, examine success indicators, and discuss obstacles that have been addressed throughout this process.

1. Introduction

Although the call to increase STEM graduates in the United States has been a topic of much discussion in recent years, its urgency was underscored in 2012 when the President's Council of Advisors on Science and Technology (PCAST) called for an increase of one million graduates with STEM degrees within the next decade to address industry demands.[1] A key strategy

outlined in the PCAST to reach this goal is engaging students from traditionally underrepresented populations in STEM fields, specifically Hispanics and African-Americans. This strategy is particularly important at Cañada College where 42% of full-time students are Hispanic. At the time the PCAST report was issued, Cañada College had been awarded several federal and state grants to increase enrollment and retention of underserved students in STEM fields. This federal call to action led to a reimagining of the manner in which STEM services and programs are delivered on our campus.

While Cañada College offered a range of services to students in STEM, there lacked a unified vision for program delivery and a clear path to access for STEM students. In response, the STEM Center at Cañada College was created to provide a single destination for all academic, outreach, transfer and professional development opportunities. More importantly, STEM services/opportunities were placed under an umbrella to create a continuum aimed at addressing the key obstacles faced by the majority of our community college students: exponential attrition, lack of social and academic integration, lack of awareness of academic options, and low self-efficacy.

Although much research has been conducted on successful recruitment and retention strategies for students at four-year universities, there is scant information on the practices that are successful for community college students. As the STEM Center has moved forward with new initiatives, data collection and research have been key components of all programs and services offered.

2. Exponential Attrition

The PCAST report identified retention efforts in the first two years of college as a key and cost effective strategy for increasing the overall number of STEM graduates.[2] Unfortunately, traditionally underrepresented students experience staggering attrition rates in comparison to their peers. An examination of placement test results provides key insight into one of the main factors that augments attrition: lack of academic preparation in key subjects. Placement into remedial Math and English elongates the course sequence, time to transfer and the completion of a bachelor's degree. The 2013 California Community College Success Scorecard revealed that at the state level only 23.9% of Hispanic students and 14.1% of African-American students who took remedial courses in Math eventually completed a college level course.[3] The statistics for students at the state level who took a remedial course in English are not much different – only 34.5% of Hispanic students and 24.3% of African-American students went on to complete a college level English course. Table 1 shows the results of Cañada students tracked over a six-year period who enrolled in a remedial Math and English courses and completed a college level course. [4]

Table 1: Percentage of California community college students tracked for six years (2006-2012) starting below transfer level courses and completed a college-level course.

Ethnicity	Math	English
African-American	14.1%	24.3%
American Indian/Alaska Native	19.4%	26.1%
Asian	41.2%	56.5%
Filipino	31.2%	46.1%
Hispanic	23.9%	34.5%
Pacific Islander	19.8%	34.9%
White	30.2%	41.6%

The attrition rates in the state of California are mirrored at Cañada College. A recent study conducted by the Cañada College President's office revealed the disparity in one and two-year persistence rates of students by ethnicity.

Table 2: Semester-to-semester two-year persistence rates of Cañada College students by ethnicity.

Persistence by Ethnicity				
	Fall YR 1	Spring YR 1	Fall YR 1	Spring YR 2
Hispanic	100%	59.4%	38.9%	**28.8%**
Caucasian	100%	72.5%	59.7%	54.4%
Asian	100%	76.2%	52.4%	40.5%
African-American	100%	46.7%	33.3%	**20.0%**

Exponential attrition rates, lack of academic preparation and the belief of some researchers' that remedial (or developmental) courses serve as a hindrance, rather than a benefit, led to the creation of a number of programs at Cañada College aimed at improving the academic preparation of students and improving overall retention and persistence.

Math Jam/Physics Jam

Math Jam is a one-week intensive math treatment that offers Cañada College students the opportunity to improve their Placement Test results in Mathematics and/or prepare for math courses that they will be taking. There are three Math Jam opportunities each year, all held during the intersession period between semesters. Math Jam aims to help students complete their Associates Degrees and/or transfer requirements in less time than previously possible, especially those intending to major in Science, Technology, Engineering, or Mathematics (STEM) fields who placed into a college math course below pre-calculus and want to advance to the next math level by scoring higher on the Math Placement Test at the end of Math Jam.

The program began in 2009 as part of the US Department of Education Minority Science and Engineering Improvement Program Grant (MSEIP) and while students often repeat the program multiple times, we have served 1000 unique students participate to date. In addition to assisting students with placements tests, Math Jam has also had a dramatic impact on persistence and retention. Evaluation tools are designed to measure the effectiveness of Math Jam in meeting these goals. This is done by conducting direct assessment of student learning (pre- and post-math tests), a study of student "jump" rates whereby, students "test out" of a math level and examination of math jam participant retention and success in subsequent courses. Tables 3 and 4 illustrate the impacts of the program on retention and academic success for Math Jam participants in next semester Math courses.

Table 4: Total Student Performance in Fall 2011 Math course

	N	**Retention**	**Success**
2011 Math Jam Participants	56	93%	77%
Not 2011 Math Jam Participants	1692	77%	53%
	1748	*p=.005* (Difference is statistically significant at .05 level)	*p<.001* (Difference is statistically significant at .05 level)

Table 5: Hispanic Student Performance in Fall 2011 Math course

	n	**Retention**	**Success**
2011 Math Jam Participants - Hispanic	31	94%	74%
Not 2011 Math Jam Participants - Hispanic	629	75%	47%
	660	*p=.017* (Difference is statistically significant at .05 level)	*p=.003* (Difference is statistically significant at .05 level)

Math Jam promotes increased academic preparation in Math and provides students with skills need to be successful in their following Math course. In achieving these results, Math Jam addresses the problem of attrition amongst underrepresented students in STEM fields. The remarkable success of Math Jam led to the creation of a similar program aimed at strengthening student performance in Physics courses.

Physics Jam was created out of recognition that Physics courses are a significant barrier for many students in STEM majors. Physics Jam focuses on introducing math tools and basic physics concepts students need to succeed in a physics course.

The program is currently offered three times a year during intersessions. While Physics Jam was originally designed and implemented as a one-month program offered during the summer for six hours a day, it was discovered that this model led to high program attrition and was not the most effective method of implementation. Since its inception in 2012, the program has been

redesigned and is now offered three times per year, in January for one week two weeks in July and August. The program utilizes a custom designed curriculum with online resources in a self-paced format with a physics instructor and tutors available to assist. The program starts with a review of mathematical concepts and transitions to tools necessary in physics. As with Math Jam, pre- and post-tests are administered to gauge a student's growth and understanding of these concepts. The program then shifts to introductory physics concepts where students are again administered pre- and post-tests, in this case, the standard Force Concept Inventory (FCI).

Students who participated in the Summer Physics Jam saw an average improvement of 12% in their FCI scores. In addition, qualitative data of all Physics Jam participants indicate that students feel more confident in their physics skills and their performance in future physics courses. While this data is encouraging, a larger data set is necessary to prove the efficacy of the program with statistical significance. Future iterations of the program will include increased and targeted recruitment, shorter program duration, and multiple offerings during the year.

Math and Physics Jam address attrition through self-paced programs where students gain mastery of funadamental concepts they need in future Physics courses. Both programs give STEM majors academic tools needed to succeed in subsequent major specific courses and develop their confidence.

Accelerated Courses

A growing number of researchers believe that developmental courses are a major contributing factor to attrition at the community college level. A study of over 50 community colleges found that student completion rates in Math and English decrease with each additional level of remedial coursework required. Researchers found that students who placed three levels below transfer level math went on to pass a college level class only 10% of the time. [5] The table below illustrates how attrition affects students in developmental courses.

Table 5: Exponential Attrition

Steps below "College Level"	**Enrollment**	**Attrition if 60% pass and persist to the next level**
4 stages below (semester 1)	100	40
3 stages below (semester 2)	60	24
2 stages below (semester 3)	36	14
1 stage below (semester 4)	22	9
College level course	13	

A recent analysis of Math placement test results of 697 students who declared STEM majors from 2006-10 found that 32.9% would have to take at two developmental Math courses and another 26.7% had to take one developmental Math course. Using the format of Table 5, it can be determined that of 229 students that had to take two development Math courses, only 55 would eventually complete a college level Math course. While this number is alarming, there is further cause for concern considering that this is an aggregate number over four years indicating that yearly enrollment in a college level class for students who took two developmental math courses could be in the single digits.

Conversely, there is evidence that supports the efficacy of accelerated courses in bringing academically underprepared students up to speed while keeping attrition rates lower than developmental courses. Chabot College created an accelerated English course for students to take in place of two developmental courses. The results are noteworthy, particularly for Hispanic and African-American students. Hispanic and African-American students who enrolled in the accelerated English course were twice as likely to complete a college level English course in comparison to their peers who enrolled in traditional developmental courses.

In an effort to reduce attrition and offer students a way to complete their course requirements in a more expedient manner, Cañada College created an accelerated course called Fast Track to Calculus (FT2C). FT2C is a 9-unit course designed to allow students to complete both trigonometry and pre-calculus in just one semester. Students receive access to additional support and tutoring to help them focus on learning math and complete both of these courses successfully. Students enrolled in the course are required to meet with a retention specialist or STEM counselor to discuss class requirements and semester schedule.

Math faculty had implemented other subject combinations in the past but upon further discussion and examination, it was determined that the trigonometry/pre-calculus combination was the most logical from a curriculum standpoint. The Science/Technology division has integrated the course into regular course offerings at the campus level.

The course enrollment for Spring 2013 was 25 students. Of these 25, 19 students were successful in the Trigonometry portion of the course (a 76% success rate). Of the 19 students that continued in the Pre-calculus portion of the course, 17 were successful (89.5% success rate). The overall success rate for the FT2C course was 68% with 17 of 25 students completing both courses.

Supplemental Instruction

To further address the exponential attrition rates that plague underrepresented students in community college, the STEM Center at Cañada College launched a Supplemental Instruction (SI) program based on the University of Missouri-Kansas City model for transfer level math, chemistry and physics courses during the Fall 2013 semester. While supplemental instruction has been extensively used in four-year institutions to improve course retention in historically

challenging courses, results have been less consistent at community college level. The aim is to target "at-risk" courses instead of "at-risk" students to provide an in-class presence and out-of-class academic support. Study sessions are held weekly to help teach students how to be successful in the course and provide a low-stress and less intimidating environment for to ask questions about course material. In Fall 2013, supplemental instruction was offered in all section of five courses: Trigonometry, Pre-Calculus/Trigonometry, Calculus I, Chemistry 1 and Physics with Calculus.

Each SI supported course had a student SI leader who attended the class assigned to them and hosted three 1-hour sessions a week as well as pre-exam review sessions. During SI sessions students received support to their questions about the course material and learned the tools needed to succeed from a peer who had already successfully completed that course. SI sessions were held in study rooms in the STEM Center. In this regard, SI served as a bridge to tutoring and resources for students who were not previously connected to the STEM Center. This was advantageous because in the event that no one attended an SI session, SI leaders could serve as drop-in tutors for students studying in the STEM center.

After one semester of SI implementation, the STEM Center team noted that while the program as a whole was extremely effective, there were aspects of it that did not fit in the community college setting. One obstacle faced was recruiting students that were qualified to serve as SI leaders. At four-year institutions SI leaders are typically junior or senior level students with more course and student interaction experience. At the community college level there is a more limited pool of students and the model needs to be adjusted. The SI leaders that had the most impact (based on student participation and feedback) were faculty recommended students who received an A in the course they were leading, overall GPA of 3.5 or better, had outgoing personalities, and were able to recruit students to attend their sessions. An overwhelming majority of students that attended an SI session for their course attended multiple sessions throughout the semester.

Another obstacle in implementing a successful SI program is faculty participation. Students were most likely to attend the out-of-class study group sessions if they were encouraged by their instructor. Highest attendance occurred in classes where the instructors gave SI leaders assignments or worksheets to go over in their session. Problems arise with adjunct faculty who are frequently commuting between multiple campuses to get a full teaching load and do not have extra time at the college to work with their SI leaders or create extra assignments.

Further analysis is underway to determine if students in courses with an SI leader sought out more tutor help from STEM tutors than in previous semesters without the SI leaders. Beyond the academic support, students who actively participate in SI study sessions tend to become more integrated into STEM Center and campus activities, which in turn increases student capital and engagement.

3. Lack Of Social And Academic Integration

Community college students are particularly affected by factors that contribute to attrition by the simple fact that this population is vastly different than the traditional four-year students. At Cañada College, 78.3% of the student population is over 20 years old. A large percentage of this group has characteristics not shared by the population of four-year students fresh out of high school. Many community college students have families to support, a full-time job (or more than one part-time job), face a language barrier, did not start college immediately after high school and have limited financial resources to support their educational goals.

Previous research suggests that the degree to which a student becomes engaged in, or becomes integrated into, the fabric of their college is an important factor in student persistence.[6] As Alfonso and Bailey explained:

> Much of the research and thinking on retention has been based on the concepts of student engagement and integration with the college. These concepts are likely to be most powerful with residential students, who represent a small minority of the student population at community colleges which are primarily commuter schools. But what differentiates the community college student body is the predominance of part-time students. Only 36 percent of community college students attend full-time, while 71 percent of four-year college students are enrolled on a full-time basis. In addition community college students tend to be older, are more likely to be working, and are more likely to interrupt their enrollments. Policies designed to retain 18-year-old students living in dorms are not likely to be as effective for part-time working students and especially for adults with families and full-time jobs. [7]

As a result of these differences, researchers have suggested that social integration, as it is traditionally defines at four-year institutions, may be a less significant factor in the retention of community college students than their peers at four-year institutions.[8] Given that community college students may be less likely to become "integrated" in the campus through what is traditionally thought of as social integration, researchers have suggested that community colleges may benefit from encouraging integration through different means, such as student involvement in the classroom or through activities which promote academic integration.

In consideration of the unique characteristics of community college students, the STEM Center at Cañada College endeavors to create and implement programs and activities that cater to the unique needs of non-traditional students. Long before students have to seek out professors, the STEM Center offers opportunities for engagements through the Jams programs. Math and Physics Jam are promoted as academic preparation programs and of the unintended (and welcome) results are social engagement – it serves as a bridge for services and platform for social engagement. At its inception, Math Jam was envisioned as a one-time preparatory program that would help students improve their placement scores but what has evolved is outside anyone's expectations. A unique aspect is that students return to the program higher level Math sections have been added to the program. In addition to the substantial "jump" and persistence

rates, students who participate in Math Jam form social bonds with their peers, faculty and staff that last beyond the duration of Math Jam. Informal cohorts are formed as a result of mutual experiences in Math Jam and Physics Jam that extend into subsequent classes. These peer cohorts arrange informal study sessions, exchange information regarding scholarship and professional development opportunities, create and join clubs, and provide overall encouragement and support.

To remove barriers to accessing services such as tutoring or counseling, these services were consolidated under the STEM Center umbrella. For example, rather than having students attempt to receive tutoring services outside their availability, the STEM Center offers tutoring from 8am to 9pm and adjusts the number of tutors based on demand semester to semester. Furthermore, every semester, all STEM faculty members are invited to host their office hours at the STEM Center where they can be a visible and accessible resource to students who may find it intimidating or difficult to follow the traditional process for accessing professors.

While Math Jam and Physics Jam have become a bridge to engagement, the STEM Center supports students year round by promoting STEM clubs and events and organizing STEM-related field trips as well as trips to four-year institutions. The center hosts a Welcome Day at the beginning of each semester that encourages new-to-campus and returning students to visit the STEM Center. At these events students learn about resources and opportunities in STEM, become official members of the STEM Center. In addition to Welcome Days, the STEM center also organizes scholarship and transfer application workshops, internship and career-exploration panels. The STEM Center, in collaboration with the Mathematics, Engineering, Science Achievement (MESA) program, organizes a number of field trips with the intent to expose students to educational and career opportunities in STEM. Students receive information about available scholarships, internships, field trips and job opportunities through a weekly email augmented by targeted posting on social media (Facebook) and the STEM Center's webpage as well as physical on-campus media campaigns. STEM Center programs and media outreach are meant to overcome the obstacles non-traditional students face by providing a multitude of communication channels and opportunities.

The STEM Center team has come to realize that marketing and outreach is a continuous process – in other words, the success of any program or event cannot be left to the belief that word of mouth alone will result in its' success. For this reason, highly visible and continuing outreach though multiple means is a standard aspect of the STEM Center's marketing strategy. In the last semester, the STEM Center has maximized a new tool – in class announcements by students, faculty or staff. A generic script is provided to the aforementioned entities and a schedule created in order to reach all sections of targeted courses. The results have been extremely successful and helped enrollment for Math and Physics Jam, Speaker Series and Welcome Day attendance.

4. Lack of Awareness of Academic Options

Engaging students is one of the many steps necessary to place them on track to transfer and graduate. Another unique characteristic of community college students is that they lack information on the academic options available to them in STEM fields. This is partially due to a lack of information and/or misinformation experienced at the high school level that carries on into college. The confusion of academic options is amplified in the community college setting since it involves major and transfer options in addition to career options.

In California the complexity is magnified by the recent diversification of transfer requirements among institutions in the state's two university systems, California State Universities (CSUs) and Universities of California (UCs). In the past, community college students were able to follow the 2+2 model, a format that allowed students to complete their lower division requirements at a community college and complete their bachelor's degree requirements at a four-year institution. The 2+2 model was strengthened by a common set of lower-division courses offered across many community colleges and required by four-year universities. The present diversification includes such variables as different requirements in one particular major depending on the university of transfer. For students applying to multiple schools for transfer, meeting the varied course requirements of these institutions can be confusing. The result has been a noticeable decline in the number of students transferring from community colleges to four-year universities and an extended stay in community colleges for STEM students in order to satisfy the varying requirements for their majors and transfer institution.[9]

In response to these obstacles, the STEM Center has developed a three-pronged approach to reduce students' confusion around STEM careers and transfer requirements. The first aspect of this approach is the presence of STEM counselor, focused only on STEM students, who offers a range of services from advice on course selection, student education plans and transfer guidance. STEM majors and students who express an interest in STEM are encouraged to meet with the STEM counselor at least once per semester to review their options and ensure they are on track to satisfy their Student Education Plan. In addition, the STEM Center also provides Transfer support, TAG assistance and campus visits are also part of transfer support.

The second part of this approach is to expose community college students to the variety of STEM career paths and options. It is clear that while many students express a desire to study STEM majors they do not always have a robust understanding of the many career paths available in these fields. The STEM Speaker Series was created in Spring 2013 to offer students new ideas and perspectives on careers in STEM. The STEM Speaker Series is a seven to eight-week program offered in Fall and Spring semesters that features local professionals working in a STEM fields. Speakers are invited to share their educational experiences and struggles, job history, current research or projects and impart advice to students. The STEM Center works to recruit speakers that mirror our student population, share similar educational paths (including community college), and represent a variety of career options and STEM fields.

The third aspect of this approach is providing opportunities for internships and research at the community college level. As defined by the STEM center, the goal of an internship is to increase a student's knowledge of and exposure to STEM careers. Community college students and first generation students in particular benefit immensely from personal relationships with STEM professionals. Experiences in STEM workplaces solidify their area of interest and provide them with research and work experience that will strengthen their transfer applications. In order to provide this resource to Cañada College students, the STEM Center has developed multiple options for paid experiences at 4-year university research labs. To encourage students who may not envision themselves in a research or industry setting, the STEM Center has adopted a multi-faceted approach that encourages students to begin with a group experience that allows them to enter a foreign environment with their peers (we currently have partnerships with NASA AMES and San Francisco State University for engineering and biological science internships), followed by another research experience with a local institution or one that actively seeks community college students, and concludes with a research experience at a national level through a Research for Undergraduate Experiences (REU) program. The results of adopting this strategy have been astounding. Six years ago only three Cañada College students pursued STEM research internships and in 2013, more than 40 students were in paid research internships – a 1300% increase.

Education research has found that students' perceptions of campus environment impact their adjustment, performance and eventual persistence.[7] The STEM Center's effort to provide a continuum of services that prepare students for their future education and careers not only addresses the key obstacles faced by many of our students, but also creates a welcoming and inclusionary environment for the study of STEM.

5. Low Self-efficacy

Self-efficacy refers to a person's beliefs regarding his or her ability to perform a task or behavior. The concept of self-efficacy, first developed by psychologist Albert Bandura, is the development of a conceptual framework "…that specified the nature, structure, and function of efficacy beliefs…"[10] In doing so he identified four factors which contribute to self-efficacy:

- Enactive Mastery Experience, previous task experience and performance;
- Vicarious Experience, learning through observing others perform tasks;
- Verbal Persuasion, others' judgments, feedback and support;
- Physiological reaction, an individual interprets his or her emotional and physical states to determine his or her self-efficacy beliefs.

STEM Self-Efficacy

Students receive negative and positive impacts depending on the cause of each source of self-efficacy. These causes include the results of their previous performance in STEM, their observations of those around them, feedback and judgment from parents, teachers and peers, and the emotional and physiological states of the student.[11] It was found that students with positive influences and high science self-efficacy beliefs are more likely to increase their effort to succeed in science activities, whereas students with low science self-efficacy beliefs are more likely to put forth less effort and avoid science activities.[12] Researchers expanded on this framework and applied it to self-efficacy in STEM.

Based on this research, the STEM Center has incorporated the development of self-efficacy into its program offerings.

- Math Jam/Physics Jam – the self-paced nature of these programs breeds success by allowing a student to focus only on concepts they have not mastered and giving them multiple opportunities to try as well as a variety of means of content delivery.
- Supplemental Instruction – brings students into the STEM Center for group study sessions and individual tutoring, helping students create social bonds therefore bridging the gap between the academic and social.
- STEM Speaker Series – highlights successful speakers with similar backgrounds/profiles to the student body allowing them to see themselves in similar roles and believe they can achieve the same level of success and achievement.
- First internship – allows students to experience research in a group setting with peers, helping them realize research is something they can accomplish.
- Scholarships – redefines how students view their potential, after earning the first scholarship they are able to adopt the following belief 'if someone else believes in me, then maybe I should.'
- Tutoring and SI – when students are recommended by faculty, selected, hired/trained and paid for their academic knowledge – they develop a new sense of self-worth.

6. Measuring Success

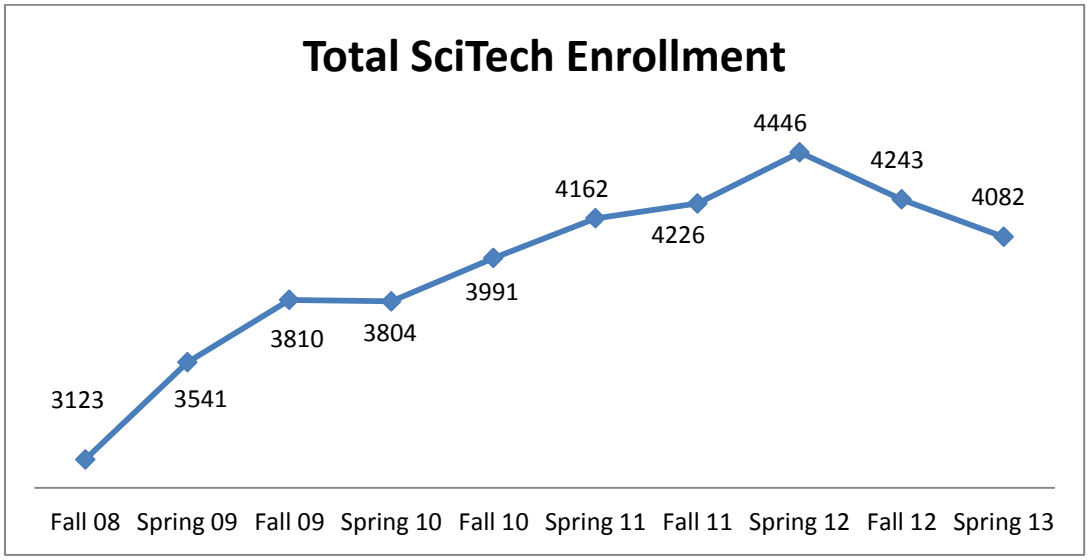
Each of these programs is meritorious on its own, but in order to gauge the overall impact of the STEM Center on student success and the development of STEM at the campus level the STEM Center has implemented a broad-based examination of four primary indicators: increased enrollment in STEM courses; reduced time to complete STEM course sequences; increased student engagement, retention, and persistence; and an increase in the number of STEM majors.

It is of paramount importance to each of these programs and the STEM Center as a whole to have an evaluation framework in place for all programs in order to analyze data and make improvements/changes as necessary. Since its inception, the center has dedicated a significant amount of resources to develop an evaluation plan that not only meets the reporting requirements

of funding sources but provides a long term infrastructure through which meaningful longitudinal data can be collected and analyzed.

Enrollment:

STEM enrollment has steadily increased since Math Jam in 2009. Total students enrolled in STEM courses went from 2074 in 2008 to 2974 in 2012, a 43% increase. Enrollment in STEM transfer-level courses has increased: math +189%, chemistry +148%, engineering +126%, physics +69.3%, and biology +24.5%. The percentage increase in minority student enrollment in these courses is significantly higher for both engineering (233.3% for minority vs. 87.8% for non-minority) and mathematics (224.4% for minority vs. 173.3% for non-minority). The growth in STEM is even more evident when compared to the overall college enrollment increase of 5% from 2008-2012.



Jump Rates: Math Jam students typically state one of three goals for program participation: review past math concepts, prepare for an upcoming math course, or improve their Placement Test score in hopes of "jumping" to a higher math level. For the latter group, predominantly students testing into remedial courses, Math Jam has been highly effective with an average of 62% "jumping" to the next level math course or higher.

Reduced Time to Completion: Accelerated Math shortens time needed to complete the math sequence for STEM majors, in some cases by as much as one year.

Retention & Success: Analysis of students' performance in next semester math courses shows significantly higher retention (93% vs. 77%) and success (77% vs. 53%) rates among Math Jam participants compared to non-participants. The impact is more evident among Hispanic Math Jam participants versus Hispanic non-participants (Retention: 94% vs. 75% and Success: 74% vs. 47%). Further evidence suggests the Math Jam experience impacts long-term retention, as

exhibited by our 2009 cohort with 78% of Math Jam students still enrolled after four semesters vs. 32% of all first-time students.

In addition to increasing persistence and retention rates, STEM Center has also substantially increased substantially its membership. In 2012, 179 students joined the STEM Center and by 2013 that number had grown to over 300 STEM Center members. Considering the dramatic increases in STEM courses, it can be theorized that there is also an increase the number of STEM majors, however targeted data collection and analysis is required to accurately assess this assertion.

7. Conclusion

Students attending two year institutions need extra incentive and encouragement to get involved on campus and promote their academic success. They are frequently under-prepared for STEM courses and this consequently leads to lower retention and persistence levels. There are many factors that need to be considered when implementing academic support programs. As a result of the recognition of community college students' unique circumstances, the STEM Center at Cañada College moved to consolidate programs under a single, recognizable entity and create a continuum of resources designed to support students at every stage of their education.

In addition to making adjustment and improvements to all programs, the STEM Center envisions expanding key services to accommodate the increased number of members of the center. Among those key services are: academic assistance, counseling services, financial assistance help with the transfer process. In the coming year, the STEM Center staff will also determine a course of action to accommodate the increased STEM student population and ensure they are receiving the services and assistance they need.

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