CALIFORNIA STATE POLYTECHNIC UNIVERSITY, POMONA

STEM Pipeline Project:

Year Two Final Report

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Executive Summary

Background: Cobblestone Applied Research and Evaluation, Inc. was hired by the California State Polytechnic University, Pomona (CPP) to examine the development and implementation of the Title V funded *STEM Pipeline Project*. This report provides a summary of the project's evaluation for the second year of the grant funding period, from October 1, 2009 through September 30, 2010. The grant has been extended to continue for a third year. Therefore, this report provides information about program activities that will change or continue through the next year.

Program Design: The *STEM Pipeline Project* at CPP was designed to ameliorate disparities in the academic achievement and career preparation for Hispanic and low-income students studying in the Science, Technology, Engineering, and Mathematics (STEM) fields. The project has five objectives addressing the most pressing student needs:

(1) Developing a formal STEM faculty learning community to link high school, community college and CPP faculty together to enhance and sustain the STEM pipeline

(2) Enhancing STEM counseling for community college students

(3) Creating a more seamless transfer process for STEM majors

(4) Preparing students for the baccalaureate degree

(5) Preparing students for the future via expanded tutoring services, access to STEM technology upgrades, and participation in a research apprentice program

Study Sample: The study sample included individuals from the community, local high schools, community colleges, and CPP. For example, Component I involved high school teachers and students, CPP faculty, and industry partners. Component II included counselors and STEM students from Riverside Community College (RCC). Components III, IV, and V involved RCC and CPP students and faculty. Much of the focus for many of these components was RCC STEM transfer students enrolled at CPP between the 2007-2010 school years ($n = 119$). It is important to note, however, that not all of these students participated in program activities, and current CPP students participated in multiple program activities. In addition, many participants in these programs were not part of the primary target group (e.g., not all research apprentices were RCC STEM transfer students). Thus, more than 119 students have been served in many of the programs offered through the *STEM Pipeline Project*.

STEM Pipeline Project Evaluation: Evaluation of the *STEM Pipeline Project* has occurred since the first year of program operations and continues currently, despite a change in evaluators during the first year of the program. During Year 1, much of the formative evaluation work involved development of logic models to align program activities and indicators as well as setting up systems for tracking student and faculty data and reporting processes. During Year 2, qualitative data and analytic techniques have been used to extract key themes and findings from data to inform implementation, refine existing measures, and define specific outcome measures. In addition, assessment and reporting processes continued to be refined and recorded. Baseline data established in Year 1 were compared to data from Year 2 to document project progress. As outcome evaluation data on program participants accumulates through the next year, program impacts on participants' satisfaction, research experiences, career preparedness, and academic success in STEM fields will continue to emerge.

Year 2 Key Findings:

The following tables summarize major findings from Years 1 and 2 of the program.

Component I.1: Develop a Formal STEM Faculty Learning Community

Component I.2. Organize a STEM Learning Conference and Corresponding Website

The purpose of this component was to link high school, community college, and CPP faculty in a community that allowed them to enhance and sustain a STEM pipeline. A Summer Professional Development Institute, STEM Learning Conference, and online community comprise this component.

Component II: Enhance STEM Counseling for Community College Students

The goal of this component was to provide appropriate counseling for RCC STEM students as they progress through the pipeline into a 4-year university. To achieve this goal, counselors were assigned to guide RCC students about taking appropriate courses, inform them about the transfer process, provide seminars, and coordinate activities to help students enter STEM fields.

Component III: Create a More Seamless Transfer Process for STEM Majors

The purpose of this component was to allow a seamless transfer process for STEM majors by providing guidance on which courses to take so repetition of courses would not be necessary once they arrived at a 4-year university. This was done through the creation of tailored curriculum sheets between RCC and CPP and the development of online course modules.

Component I.1: Develop a Formal STEM Faculty Learning Community
Component I.2. Organize a STEM Learning Conference and Corresponding Website

	Performance Measure	Goal	Year 1	Year 2
Component I.1: Develop a Formal STEM Faculty Learning Community	**Performance Measure 1.a.** Percent of lessons planned in the Summer Professional Development (PD) Institute that are implemented in the classroom	90% of lessons planned in the Summer PD Institute will be implemented in the classroom	88% of participants implemented lessons	38% of participants implemented lessons in fall 2010; others will implement in spring 2011
	Performance Measure 1.b. Percent of STEM high school teacher groups who participate in the Summer Professional Development Institute and post completed lessons on the website	75% of teachers participating in PD Institute will post completed lessons on the website	88% of groups posted completed lessons on the CPP *STEM Pipeline Project* website	100% of groups posted completed lessons on the CPP *STEM Pipeline Project* website
	Performance Measure 1.c. Percent of STEM high school teachers who indicate increased confidence to implement a STEM lesson with real-world application	80% of STEM high school teachers will indicate increased confidence to implement a STEM lesson with real-world application	88% reported increased confidence to include real-world application in lessons	100% reported increased confidence to include real-world application in lessons
Component I.2. Organize a STEM Learning Conference and Corresponding Website	**Performance Measure 2.a.** Analyze submitted evaluations of college and secondary students who attend the Annual STEM Learning Conference and report increased motivation levels towards pursuing a STEM career.	Specific goal not provided	Was not assessed	44% agreed or strongly agreed that they wanted a career in the STEM fields after attending the conference.
	Performance Measure 2.b. Percent of Annual STEM Learning Conference high school teacher attendees who report significant increases in the areas of STEM-related content and pedagogical strategies regarding student learning.	Specific goal not provided	Was not assessed	76% agreed or strongly agreed that "at this conference, I learned how to implement more inquiry-based lessons in my classroom/school."
	Performance Measure 2.c. Percent of STEM high school teachers who participate in the Summer Professional Development Institute and attend the Annual STEM Learning Conference.	Specific goal not provided	Was not assessed	58% of teachers attended both events

Component IV: Prepare students for the baccalaureate degree

The goal of this component was to provide RCC community college students with an opportunity to participate in a pre-engineering course that would allow them to become more knowledgeable about engineering and comfortable with becoming an engineering major at a 4-year university. A *Principles of Engineering* course and lecture series by CPP STEM faculty were utilized to achieve this goal.

Component V.1: Expand Tutoring Services

The purpose of Component V was threefold: (1) provide tutoring for STEM transfer students through the Math and Science Help (MaSH) and Maximizing Engineering Potential (MEP) programs, (2) provide students and faculty access to new technology and equipment, and (3) provide opportunities for student participation in a research apprentice program.

Component II: Enhance STEM Counseling for Community College Students

	Performance Measure	Goal	Year 1	Year 2
Component II: Enhance STEM Counseling for Community College Students	**Performance Measure 3.a.** Percentage of Riverside Community College (RCC) STEM students who complete CSU/UC transferable courses.	Specific goal not provided	100% of students completed at least 60 CSU transferable units	90% of students completed at least 60 CSU transferable units
	Performance Measure 3.b. Average number of CSU/UC transferable units completed by Riverside Community College (RCC) STEM students that are not applicable to their declared degree.	Decrease number of units completed by RCC STEM students that are not applicable to their degree	Students completed an average of 9.45 unrelated units	Students completed an average of 5.19 unrelated units
	Performance Measure 3.c. Percentage increase in the number of Riverside Community College (RCC) STEM students who apply to CPP STEM programs.	10% increase in the number of RCC STEM students who apply to CPP STEM programs	117 RCC students applied to CPP STEM programs	70 RCC students applied to CPP STEM programs (40% decrease)
	Performance Measure 3.d. Number of RCC students attending Transfer Day activities.	Increase the number of RCC students attending Transfer Day activities	98 students attended Transfer Day activities	4 students attended Transfer Day activities

Component III: Create a More Seamless Transfer Process for STEM Majors

	Performance Measure	Goal	Year 1	Year 2
Component III: Create a More Seamless Transfer Process for STEM Majors	**Performance Measure 4.a.** Number of initial transfer curriculum sheets developed.	Develop six initial transfer curriculum sheets in the College of Science (CoS) and College of Engineering (CoE)	18 transfer curriculum sheets were created (5 in CoS and 13 in CoE)	24 total transfer curriculum sheets were created (11 in CoS and 13 in CoE)
	Performance Measure 4.b. Number of online course modules developed.	Specific goal not provided	The math department developed 42 online modules	The math department developed 42 online modules. The physics department developed 3 online modules
	Performance Measure 4.c. Percentage of RCC STEM students who utilize the transfer curriculum sheets and online course modules with decreased number of transferable units not applicable towards degree.	Specific goal not provided	No RCC STEM transfer students used transfer curriculum sheets or online modules	No RCC STEM transfer students used transfer curriculum sheets or online modules
	Performance Measure 4.d. Number of finalized transfer curriculum sheets developed.	Finalize all 24 initial transfer curriculum sheets developed	No transfer curriculum sheets were finalized	24 transfer curriculum sheets were finalized

Component IV: Prepare students for the baccalaureate degree

	Performance Measure	Goal	Year 1	Year 2
Component IV: Extend the Project Lead The Way (PLTW) Course to RCC	**Performance Measure 5.a.** Number of Riverside Community College (RCC) faculty members who are trained to offer PLTW.	Train 2 RCC faculty members in PLTW	Two RCC faculty members were trained during Summer 2009	Two RCC faculty members were trained during Summer 2010
	Performance Measure 5.b. Percentage of Riverside Community College (RCC) STEM students who indicate an increased awareness of STEM career options.	Specific goal not provided	Was not assessed	75% of students who completed the PLTW course indicated that they had a good idea of career options within STEM fields
	Performance Measure 5.c. Number of Riverside Community College (RCC) STEM transfer students who have participated in PLTW.	30 RCC STEM transfer students will participate in PLTW	Course was not created	27 students initially enrolled in the course
	Performance Measure 5.d. Number of seminars with STEM topics offered by CPP faculty at RCC.	Provide five seminars with STEM topics offered by CPP faculty at RCC	One seminar was offered	Five seminars were offered

Component V.1: Expand Tutoring Services

	Performance Measure	Goal	Year 1	Year 2
Component V.1: Expand MaSH Tutoring Services	**Performance Measure 6.a.** Percentage of RCC STEM transfer students using MaSH or MEP services.	25% of RCC STEM transfer students will use MaSH or MEP services	21% of RCC STEM transfer students used MaSH or MEP services	14% of RCC STEM transfer students used MaSH or MEP services
	Performance Measure 6.b. Increase in number of new courses beyond the introductory level with trained tutors.	Provide tutoring for 13 new courses beyond introductory level with trained tutors	Tutoring was provided for 41 new courses	Tutoring was provided for total of 42 courses
	Performance Measure 6.c. Percentage of MaSH tutors tutoring classes beyond the introductory level with CRLA Level 3 certification.	90% of MaSH tutors will have CRLA Level 3 certification	42% of tutors had Level 3 certification	38% of tutors had Level 3 certification
	Performance Measure 6.d. Increase in GPA of RCC STEM transfer students using MaSH services.	10% increase in GPA of RCC STEM transfer students using MaSH services	There was a .38 average drop in GPA for those 10 students who utilized MaSH services	There was a .02 average drop in GPA for those 16 students who utilized MaSH services
	Performance Measure 6.e. Percentage of tutoring encounters that result in a positive attitude towards MaSH services.	75% of tutoring encounters will result in a positive attitude towards MaSH services	87% of comments indicated positive attitudes towards MaSH services	88% of comments indicated positive attitudes towards MaSH services
	Performance Measure 6.f. Increase in number of units (per quarter) completed towards degree for RCC STEM transfer students participating in MaSH services compared to non-participants	Increase in two units (per quarter) completed towards degree for RCC STEM transfer students participating in MaSH services compared to non-participants	Students using MaSH services had one less unit completed per quarter on average than those not using these services	Students using MaSH services completed the same amount of units per quarter on average as those not using these services

Component V.2: Expand MEP Academic Excellence Workshops

	Performance Measure	Goal	Year 1	Year 2
Component V.2: Expand MEP Academic Excellence Workshops	**Performance Measure 7.a.** Increase in number of workshops beyond the introductory level.	Specific goal not provided	4 MEP workshops provided	41 MEP workshops provided
	Performance Measure 7.b. Percentage of RCC STEM transfer students participating in workshops.	25% of RCC STEM transfer students will participate in workshops	5% of RCC STEM transfer students used MEP services	1% of RCC STEM transfer students used MEP services
	Performance Measure 7.c. Increase in GPA of RCC STEM transfer students participating in workshops.	10% increase in GPA of RCC STEM transfer students participating in workshops	There was a .37 average drop in GPA for those 2 students who attended MEP workshops	Did not calculate GPA for the one student who attended MEP workshops
	Performance Measure 7.d. Increase in number of units completed towards degree for RCC STEM transfer students participating in workshops compared to non-students.	Increase in two units completed towards degree for RCC STEM transfer students participating in workshops compared to non-participants	The two students who attended workshops completed 1.3 units more per quarter on average than those not attending workshops	Did not make unit comparisons for the one student who attended MEP workshops

Component V.3: Increase Equipment for Student Use at Cal Poly Pomona

	Performance Measure	Goal	Year 1	Year 2
Component V.3: Increase Equipment for Student Use at Cal Poly Pomona	**Performance Measure 8.a.** Percentage of equipment purchased for EGR 100L (unit is equipment type) by the end of second year of grant.	100% of equipment will be purchased for EGR 100L (unit is equipment type)	40% of equipment was purchased by the end of the year	100% of equipment purchased by the end of the year
	Performance Measure 8.b. Percentage of EGR 100L classes using new equipment.	100% of EGR 100L classes will use new equipment	Was not assessed	100% of EGR 100L classes used new equipment
	Performance Measure 8.c. Percentage of equipment (unit is equipment type) purchased for upper-division Science classes by the end of the second year of grant.	100% of equipment will be purchased for upper division Science classes by the end of second year of grant	46% of equipment was purchased by the end of the year	100% of equipment was purchased by the end of the year
	Performance Measure 8.d. Percentage of RCC STEM transfer students using new equipment in at least one course.	80% of RCC STEM transfer students will use new equipment in at least one course	Was not assessed	8% of RCC STEM transfer students used new equipment in at least one course
	Performance Measure 8.e. Percentage of RCC STEM transfer students who use enhanced equipment displaying satisfaction/improved attitude toward STEM disciplines.	75% of RCC STEM transfer students who use enhanced equipment will indicate satisfaction/improved attitude toward STEM disciplines	Was not assessed	No RCC STEM transfer students indicated satisfaction/improved attitude toward STEM disciplines

Summary of Findings, Year 2: Through the end of Year 2, the *STEM Pipeline Project* at CPP has continued its efforts to serve Hispanic and low-income students in the STEM fields. High school students and teachers attended a Summer Professional Development Institute and indicated satisfaction with their experience. Counselors were hired and assigned to assist RCC STEM students plan an appropriate course of study to help ease the transition into 4-year

Component V.4: Increase the number of undergraduate students participating in STEM Research

	Performance Measure	Goal	Year 1	Year 2
Component V.4: Increase the number of undergraduate students participating in STEM Research	**Performance Measure 9.a.** Number of students participating in research apprenticeships.	20 students will serve as research apprenticeships	45 students participated as research apprentices	37 students participated as research apprentices
	Performance Measure 9.b. Percentage of students who indicate an intention to pursue an advanced degree in a STEM discipline.	35% of students will indicate an intention to pursue an advanced degree in a STEM discipline	Was not assessed	89% of students indicated an intention to pursue an advanced degree in a STEM discipline
	Performance Measure 9.c. Percentage of students who give on-campus or regional presentations of their research projects.	95% of students will give on-campus or regional presentations of their research projects	84% of apprentices presented their research at an on-campus or regional conference	89% of apprentices presented their research at an on-campus or regional conference

universities. Transfer curriculum sheets were developed between RCC and CPP, and will be utilized by students in the upcoming year. RCC faculty members were trained to teach a Project Lead the Way Principles of Engineering course, which was implemented during Year 2. Finally, expanded tutoring services were provided to RCC STEM transfer students along with access to new technology and equipment and the opportunity to participate in a research apprentice program. Given the complexity and diversity of the overall program design, the *STEM Pipeline Project* continues to attempt to meet or exceed many of their stated goals.

Project Next Steps: Aims for Year 3: During Year 2, the *STEM Pipeline Project* has continually strived to meet the five program goals and all of the performance objectives reviewed in this report. The grant has been extended to continue for a third year, although not all program components will be offered in their entirety. A summary of the next steps for the *Project* follows.

- **Component 1:** The Summer Professional Development Institute and STEM Learning Conference will not be offered individually. Instead, a hybrid seminar incorporating activities from both conferences will be created. This one-week conference will include presentations and networking opportunities seen in the Learning Conference and Institute, but will not include the internships or lesson plans which were a part of the original Summer Professional Development Institute. Finally, students who participated in the Institute will be asked to complete an online survey six months after participation (February 2011). Changes in attitudes and goals relating to the STEM fields will be assessed at that time.
- **Component 2:** As next steps for the component 2 of the *STEM Pipeline Project*, counseling services will continue to be provided at RCC during Year 3. Data for GPA and units completed for RCC STEM students will be tracked. A Transfer Day specifically for STEM majors will also be offered (as opposed to a general Transfer Day). Finally, the *UDirect* software program will be installed and student implementation will be tracked.
- **Component 3:** Transfer curriculum sheets will be finalized during Year 3. In addition, online course modules will continue to be developed and student usage will be tracked.
- **Component 4:** The Project Lead the Way Engineering Principles course will be offered again at RCC in fall 2010. In addition, a second part of the course series (ENE 5b) will also be offered. Student satisfaction and knowledge derived from this course will be tracked. Satisfaction and awareness of STEM fields will also be assessed. In addition, seminars by CPP faculty will continue to be provided at RCC. Engineering and Science faculty will be recruited to provide these seminars.
- **Component 5:** Tutoring services through the MaSH program and Academic Excellence Workshops presented through the MEP program will continue to be offered. However, RCC STEM transfer students will be targeted more specifically to participate in these programs during Year 3. Academic data about these students will also be tracked at this time. Student and faculty satisfaction with new equipment will continue to be assessed. Finally, students will continue to be provided an opportunity to participate in the research apprentice program. It is expected that research apprentices will be given a slightly larger stipend in Year 3, but also be allowed to work more hours per week. The increased stipend allows students to decrease work commitments outside of school to more specifically prepare for career-initiating positions and/or graduate programs. Research apprentices' attitudes about STEM disciplines and the research process will be assessed with a pre- and post-test.

Introduction

Much effort has been made to educate Hispanic/Latino and other underrepresented minority students, yet significant disparities remain such that retention and graduation of these students in Science, Technology, Engineering, and Mathematics (STEM) disciplines are not at satisfactory levels. It has been shown that the rigor of high school courses is the most effective variable at predicting students' postsecondary choices and college completion rates for underrepresented students and that the lack of high-quality science and mathematics preparation in high school has forced a large percentage of these highly capable minority students out of the pipeline at the transition from high school to college (Adelman, 1999; Commission on the Advancement of Women and Minorities in Science Engineering and Technology Development, 2000).

While many undergraduate programs seek to provide supplemental services to those Hispanic/Latino and other underrepresented minority students who succeed in transitioning to college, many of these students find themselves unprepared for the work world after graduation (e.g., Kane, Beals, Valeau, & Johnson, 2004; Kulik, Kulik, & Schwalb, 1983; Lam, Srivatsan, Doverspike, Vesalo, & Mawasha, 2005). Oftentimes, lower-income and minority students struggle through the most difficult classes, or so-called "gatekeeper" courses that prevent them from advancing to the next level of their academic program (Chen & Carroll, 2005). This often results in lower rates of persistence to their degree (Oakes, 1990). Even if these students do manage to complete such courses with success, they lack other resources such as practical experience in their field of interest, which may prevent them from landing a career-initiating position after graduation. Many of these students work during their time in college but in jobs that are unrelated to their field of study or done out of necessity and not for the purpose of career-building (Pascarella, Pierson, Wolniak, & Terenzini, 2004).

Given the complexity and overlapping nature of these problems, a recently funded initiative supported by the U.S. Department of Education (the College Cost Reduction and Access Act [CCRAA] under Title V) seeks to ameliorate these deficiencies at California State Polytechnic University, Pomona (CPP). CPP is a public and comprehensive institution serving one of the fastest growing areas of the state. Since its inception in 1938 with 110 students, CPP has grown to a current enrollment of 21,000 students studying in more than 65 undergraduate programs and over 20 graduate programs, and offers 13 teaching credentials/certificates in seven colleges and one professional school. CPP was designated an Hispanic Serving Institution (HSI) in 2005 by the U.S. Department of Education in recognition of its substantial Hispanic enrollment and diverse student demographic: in spring 2009, 27.2% of the total enrollment was Hispanic or part Hispanic, 29.7% Asian or Pacific Islander, 3.9% African American, and 25.1% Caucasian. In addition, the cost of attending CPP is relatively affordable compared to nearby UC Riverside (currently $4,551 vs. $8,720 per year for in-state, full-time tuition). Thus the student population at CPP is a prime target of the CCRAA Title V initiative.

The *STEM Pipeline Project* aspires to address the previously mentioned problems, which are unacceptably prevalent among low-income and Hispanic undergraduates by accomplishing five main goals through a variety of relevant activities. These goals address the most pressing student needs.

Goals for the* STEM Pipeline Project *at Cal Poly Pomona

(1) Developing a formal STEM faculty learning community to link high school, community college and CPP faculty together to enhance and sustain the STEM pipeline

(2) Enhancing STEM counseling for community college students

(3) Creating a more seamless transfer process for STEM majors

(4) Preparing students for the baccalaureate degree

(5) Preparing students for the future via expanded tutoring services, access to STEM technology upgrades, and participation in a research apprentice program

Year 2 Status Report

Performance measures related to program implementation and outcomes have been developed for the two-year grant period. The following report summarizes progress on these measures. In addition, we have provided general conclusions related to program activities as well as summarized plans for year two.

Component I: Develop a Formal STEM Faculty Learning Community

In the area surrounding CPP, in particular, students are more ethnically diverse, impoverished, and more likely to be English learners than the state average (California DOE, 2006). It is essential, therefore, that teachers in this area be well-trained to teach this diverse group of students transitioning from high school into STEM fields in college. Studies have shown that a lack of high-quality preparation in science and mathematics in high school can force underrepresented minority students out of the STEM pipeline as they transition into college (Commission on the Advancement of Women and Minorities in Science Engineering and Technology Development, 2000). To address this multifaceted issue, the purpose of Component I of the *STEM Pipeline Project* was to provide a Summer Professional Development Institute for teachers that incorporates content enrichment, practical hands-on engaging classroom experiences, and pedagogy via lesson study analysis to produce high-interest, experientially-oriented lesson plans for use in the classroom. Additional component goals include hosting a STEM Learning Conference and creating an online forum to establish a learning community by vertically teaming STEM faculty from CPP with high schools and community colleges that serve underrepresented groups.

Component I Activities

(1) Create a Summer Professional Development Institute for high school teachers

The first goal of Component I of the *STEM Pipeline Project* was to create a Summer Professional Development Institute for high school teachers in the area surrounding CPP. This Summer Professional Development Institute took place in Year 2 of the grant from July 12-30, 2010, and was attended by high school teachers, high school students, and various CPP students and faculty (the institute took place between July 20-August 7, 2009 in Year 1 of the grant). The participating teachers taught biology, chemistry, computer science, mathematics, or physics at their respective high schools and were encouraged to nominate high school students who had an interest in science, technology, engineering, or math to participate in a week-long residential Summer Enrichment Program. More than 70 teachers from the areas surrounding CPP applied to participate and less than half were accepted into the program. The institute was attended by 24 high school teachers and 22 high school students (26 teachers and 25 students participated

Table 1. Summer Professional Development Institute Teacher Demographics (*N* = 24)

		n	%
Gender	Male	11	45.80
	Female	13	54.20
Ethnicity	Hispanic	1	4.20
	Caucasian	17	70.80
	African-American	1	4.20
	Asian	1	4.20
	Other/ Multiple Ethnicities	3	12.40
	Not Indicated	1	4.20
Content Area*	Biology	8	24.24
	Chemistry	11	33.33
	Computer Science	4	12.12
	Mathematics	4	12.12
	Physics	5	15.15
	Other	1	3.04

** Note that participants were allowed to mark multiple responses. Thus, the total number of responses is greater than the number of participants.*

in Year 1). Teachers and students completed pretest and posttest surveys and also participated in a focus group on the last day of the program.

The majority of teachers were primarily Caucasian (71%) and there was an equal distribution of male (46%) and female (54%) participants. See Table 1 for more information related to institute participants.

Prior to beginning the institute, teachers completed an online survey to indicate what they would like to learn during the program. Most participants hoped to network with other educators, learn how to "relate [science content] with real life experiences," and discover new pedagogy to use in the classroom. One teacher, for example, stated that "I'm eager to learn any new pedagogical practice that will help students to "own" the material ... not just memorize it. I'm hoping to discover new [ways] to keep students engaged in learning." During the focus group, teachers reiterated that they came to the institute because they wanted "real world" research experience by working in industry, wanted to learn new things to excite students about STEM disciplines, and wanted to collaborate with other teachers. They also wanted to provide "real world" experiences for their students and work closely with them so they could learn how to utilize them as teaching assistants.

Presentation Topics during Week 1 of the Institute

- Metacognition
- Engage, Explore, & Enhance
- CAL-PRISSM
- NASA Careers
- Chemistry of Crime

Industry partners for the Summer Professional Development Institute included:

AQMD Air Quality
Center for Macromolecular Modeling & Design
Computer Science Lab
Hayward Pool Products
Metropolitan Water District
Oak Crest Science Institute
U.S. Salinity Lab
Weck Laboratories

During the first week of the institute, teachers discussed why they entered a STEM-related career, described the student-teacher dynamic in their classrooms, and shared what they hoped to gain from participating in the program. Participants also attended presentations by fellow high school teachers, CPP faculty members, and other professionals about strategies and activities to incorporate into their classrooms. Most presentations were well-received, and the presentation on *Metacognition* was rated as having the greatest impact on their classroom by the majority of teachers (58%). Teachers enjoyed hearing about study skills and learning strategies that they could incorporate in their own classrooms. For example, one teacher said that "After learning more of "learning strategies" I've begun to see how I can change all of my lessons and classroom activities to better enable my students in achieving success."

In the second week of the Summer Professional Development Institute, teachers interned for one week with local industry partners. During the first day, teachers prepared for their internship placement with fellow institute participants at CPP. The next three days were spent at the internship site, where teachers were able to get hands-on experience in areas related to water purity analysis, soil analysis, engineering and materials, and computer science. The last day of the week was spent sharing internship experiences with other Summer Professional Development Institute participants at CPP.

"The internship gave me a chance to get excited about lab work again. I can now make labs that students can experience and see how it is used in a STEM career. I also was able to get real life examples of different projects or problems they work on."

During the focus group many teachers explained that they had a "phenomenal" experience in their internship and learned a lot. They also gained new ideas that they could implement in their classrooms and enjoyed the opportunity to network with individuals in their industries. One teacher who interned at a non-profit company explained that she had a great experience because she had not considered it a career choice. She could now share information about a career in the non-profit sector with her students. Although most comments about the internship experience were positive, some teachers were disappointed that their industry internships were not within "industry," but were instead on the Cal Poly Pomona campus. Teachers also wanted an opportunity at the beginning of the internship week to research the company they would be visiting so they could be prepared for their experience.

During the third week of the institute, teachers returned to CPP to discuss their experiences and work on unit lesson development with fellow teachers, students, and CPP faculty. In groups ranging from three to five, the teachers created lessons they could incorporate into their own classrooms based on what they learned during week one of the institute and within their internships. A total of seven lessons were created by teachers. Once the lessons were created, each group of teachers presented them to students attending the Summer Enrichment Program while other teachers observed them. They also evaluated the effectiveness of lessons for student learning using action grids (which included focusing on lesson design, content, lesson implementation, and culture).

> *"[Creating lessons] was a validating experience as a young first year teacher. It feels good to feel on the right track but even better to know I am growing and developing new skills that will allow me to continue to inspire my students. The resources, confidence, colleagues, and information given is invaluable."*

Teachers described their experiences with creating lesson plans during the focus group. They also completed a brief survey about this experience. Responses during the focus group and in the survey were mainly positive. For example, participants stated that it was beneficial for novice teachers to collaborate with more experienced teachers. They also enjoyed observing other educators present lessons because they had an opportunity to observe other factors (e.g., student behavior) that are normally not noticed when teaching themselves. Working and teaching with other educators who provided positive feedback was a good experience because it was "confidence-building" in a non-threatening environment. Although teachers enjoyed the lesson creation process, they explained that in "real life" the possibility of five teachers working together to create a lesson, observing each of their classes, and reflecting on their experiences would not be possible given the lack of time and resources in their schools. They also suggested that the process should be condensed to include fewer topics to address during the lesson creation procedure. In addition, teachers wanted more time to collaborate and work with teachers in other disciplines.

Performance Measure 1.a. Percent of lessons planned in the Summer Professional Development Institute that were implemented in the classroom.

The first performance measure assessed the percent of lessons planned in the Summer Professional Development Institute that were eventually implemented in the classroom. Of the seven lessons created, three were implemented in teachers' classrooms during fall 2010. The remaining lessons are meant to be implemented in the spring because of their topics (e.g., a polymers lesson should be presented in the spring of a school year). The Component Director will communicate with teachers to see whether the lessons were implemented. Thus, 38% percent of the lessons planned during the institute have been implemented thus far. In Year 1, seven of eight (88%) lessons were implemented in the classroom.

Performance Measure 1.b. Percent of STEM high school teacher groups who participate in the Summer Professional Development Institute and post completed lessons on the website.

The second performance measure investigated the percent of teacher groups who participated in the Summer Professional Development Institute and posted their lessons on the STEM website. All seven (100%) of lessons planned during the institute were later posted on the STEM website (http://stempipeline.com/STEMLearning.aspx). The goal of having 75% of teacher groups post lessons on the website was therefore surpassed.

While teachers created lesson plans during the third week of the institute, their nominated high school students participated in a week-long residential Summer Enrichment Program. Of the 22 students who attended the program, the majority were female (64%) and Hispanic (46%). Most participating students (59%) expected to graduate in 2011, meaning they would enter their senior year of high school in the upcoming school year. Several incoming juniors (36.4%) and one incoming sophomore also attended the program (see Table 2).

Table 2. Student Demographic Information (*N* = 22)

		n	%
Gender	Male	8	36.4%
	Female	14	63.6%
Ethnicity	Hispanic	10	45.5%
	Caucasian	4	18.2%
	Asian	2	9.1%
	Other	3	13.6%
	Multiple Ethnicities	3	13.6%
Expected Year of Graduation	2011	13	59.1%
	2012	8	36.4%
	2013	1	4.5%

During the program, students lived in the Cal Poly Pomona dorms, took tours of the campus, and participated in daily challenges. They were also taught the new lessons created by their teachers. Before beginning the Summer Enrichment Program, students completed a survey assessing their interest, motivation, and confidence in pursuing a STEM career, support from family and teachers to pursue these careers, and quality of experiences during the enrichment program. They also completed the survey after the one-week program. Data showed that students reported highest levels of agreement about planning to attend college on both pretesting and posttesting. All responses about future education choices increased from pretesting to posttesting. There were also significant increases from pretesting to posttesting on both planning to major in STEM disciplines in college and in having confidence in graduating from a college in a STEM major ($p < .01$). These results are consistent with comments provided during the focus group. Here students indicated that they did not want to attend college more after attending the program. Instead, most students explained that they had a strong desire to attend college even before coming to the Summer Enrichment Program. This is not surprising given that this is a group of teacher-selected and highly motivated students. Also consistent with survey results, students mentioned during the focus group that they were more interested in pursuing a STEM career after participating in the program. See Table 3 for complete information about student responses.

Student Challenges

Solar

Biodisel

Robotics

Physics

Students were also asked to answer questions about receiving support from family and teachers to pursue STEM careers. As indicated in Table 4, students strongly agreed that their family and teachers encouraged them to take science and math courses. Students did not agree as much that their family and teachers encouraged them to pursue a STEM career. Although not statistically significant, students agreed more strongly that their parents encouraged them to take science and math courses and that their family and teachers encouraged them to pursue a STEM career during the posttest. There was an unexpected decrease in agreement that their teachers encouraged them to take science and math classes between pretesting and posttesting. It is important to note for most students there was only one week between pretesting and posttesting. Thus, it is not surprising that there were no significant changes in responses to these questions. The pattern of data do suggest, however, that families and teachers encourage students to take science and math courses but may not provide the same level of encouragement to pursue STEM careers.

Students were also asked questions about their future careers on the pretest and posttest. Responses about future career choices did not change significantly from pretesting to posttesting (See Table 5). However, there were slight increases in agreement with several questions after the completion of the Summer Enrichment Program, specifically questions about interest in STEM fields, wanting a career in the STEM fields, and enjoying a career in the STEM fields. All of these responses were more positive during the posttest. These responses are also consistent with comments received during the focus group, where

Table 3. Student Future Education Choices (*N* = 22)

Question	Pretest Mean Score *(SD)*	Posttest Mean Score *(SD)*
I plan to attend college.	4.86 (.66)	5.00 (.00)
I plan to major in a STEM (Science, Technology, Engineering, and Math) discipline in college.	3.95 (.92)	4.59 (.59)*
I am confident that I will graduate from college in a STEM major.	3.95 (.92)	4.50 (.60)*
I plan to attend graduate school (Masters of Science or PhD) or medical school (MD).	4.05 (.99)	4.09 (.92)
I am confident that I will complete graduate school or medical school.	4.05 (.99)	4.24 (.77)

Scale: 1 = Strongly Disagree, 5 = Strongly Agree

$^*p < .01$

Table 4. Encouragement for STEM courses and careers (*N* = 22)

Question	Pretest Mean Score *(SD)*	Posttest Mean Score *(SD)*
My family encourages me to take science and math courses.	4.33 (.86)	4.48 (.68)
My family encourages me to pursue a STEM career.	3.75 (.91)	3.95 (.92)
My teachers encourage me to take science and math classes.	4.65 (.59)	4.41 (.67)
My teachers encourage me to pursue a STEM career.	3.80 (.89)	4.23 (.87)

Scale: 1 = Strongly Disagree, 5 = Strongly Agree

Table 5. Student Future Career Choices (*N* = 22)

Question	Pretest Mean Score *(SD)*	Posttest Mean Score *(SD)*
A career outside of a STEM field would be enjoyable.	3.76 (.70)	3.68 (.84)
STEM fields are interesting to me.	4.50 (.61)	4.64 (.49)
I am confident that I can succeed in a STEM-based career.	4.67 (.48)	4.55 (.60)
I have always wanted a career in the STEM fields.	3.70 (.80)	3.82 (.96)
I would enjoy a career in the STEM fields.	4.20 (.70)	4.45 (.67)
I have no interest in pursuing a career in the STEM fields.	1.90 (1.07)	1.45 (.73)

Scale: 1 = Strongly Disagree, 5 = Strongly Agree

students did not indicate a change in career choice after attending the program.

When asked to indicate the best part of their experience during the focus group, several themes appeared in student responses. Overwhelmingly, students enjoyed gaining hands-on experience in labs and experiments, especially in scientific disciplines such as Chemistry and Physics. These labs felt more "legit" because students used good equipment and were able to wear lab coats. This made them feel more like a scientist. Students also enjoyed meeting fellow students and interacting with teachers. Finally, students enjoyed having a glimpse into college life through living in dorms and participating in advanced study of scientific domains. Student also reported the aspect of the Summer Enrichment Program that best prepared them for serving as a teaching assistant or course tutor. Several students felt that gaining strategies in "inquiry-based learning" was helpful. Students also felt that preparing and performing the labs that they would be helping to facilitate was an important aspect of their own preparation. However, students expected to interact and work more with their nominating teachers and were disappointed by their lack of contact with them.

> *"The best part about the program was being able to have fun while we are learning. The teachers always made everything enjoyable."*
>
> *"The best part of this summer enrichment program has been confirming my passion for science, mainly biology."*
>
> **- Student Participants**

Performance Measure 1.c. Percent of STEM high school teachers who indicate increased confidence to implement a STEM lesson with real-world application.

While the students participated in challenges and prepared for an awards presentation, teacher participants completed a survey about their experiences. These participating teachers were asked to complete a pretest prior to attending the institute. We first analyzed pretest data to see the distribution of teacher responses. It appeared that teachers initially rated many items very high. Given this, we also decided to provide the opportunity for teachers to complete a retrospective pretest at the time they completed the posttest. A retrospective pretest is often administered to allow individuals to make judgments about their previous attitudes or experiences in contrast to current attitudes or experiences. This allows individuals to make more accurate judgments about what they did or did not know prior to participation in an event. This methodology can yield more accurate judgments in light of current experiences, instead of just relying on true pretest reports. Therefore, Table 6 shows scores for pretests collected prior to the start of the institute; judgments from a retrospective pretest after completion of the institute (which asks participants to make judgments about their attitudes before the institute); and posttest scores.

During the posttest, teachers were asked to indicate how much they agreed with statements about their experiences both *before* and *after* attending the institute. Paired samples t-tests indicated statistically significant increases for all questions. For example, teachers felt more confident that they could include real-world applications from their lesson/laboratory presentations in their classrooms after attending the institute, felt they knew more information about STEM fields, planned to use more experientially-oriented lesson plans in their classrooms, and planned to provide their students with more information about careers in STEM fields.

The next performance measure assessed the percent of teachers who indicated increased confidence to implement a STEM lesson with real-world applications. Of the 23 teachers who responded to the question "After attending the institute I feel confident that I can include real-world applications in my lesson/laboratory presentations in my classroom" all (100%) either agreed or strongly agreed with the statement. In contrast, only 16 (67%) of teachers agreed or strongly agreed to this statement before attending the institute. Thus, the goal of 80% of teachers who indicate feeling more confident was surpassed. Overall, results suggest that teachers felt they strongly benefited from the experiences gained at the Summer Professional Development Institute.

Table 6. Teacher Survey Results (*N* = 24)

Question	Mean Score Pre-test *(SD)*	Mean Score Before *(SD)*	Mean Score After *(SD)*	*t-value*
I feel confident that I can include real-world applications in my lesson/laboratory presentations in my classroom.	4.46 (.72)	3.67 (1.09)	4.78 (.43)	-5.30*
I knew/know information about STEM fields that I can share with students.	3.74 (1.01)	3.29 (.91)	4.71 (.46)	-7.88*
I knew/know strategies to engage a diverse group of students in my classroom/school.	4.08 (.72)	4.08 (.58)	4.54 (.58)	-4.41*
I felt/feel confident that I can engage a diverse group of students in my classroom/school.	4.25 (.79)	4.17 (.76)	4.50 (.66)	-3.39*
I knew/know how to implement inquiry-based lessons in my classroom/school	3.61 (.94)	3.58 (.93)	4.54 (.51)	-7.52*
I used/plan to use students as Teaching Assistants (TA's) in my classroom	3.14 (1.39)	3.26 (.96)	4.35 (.63)	-5.49*
I used/plan to use experientially-oriented lesson plans I my classroom.	3.74 (1.10)	3.79 (.93)	4.70 (.47)	-6.26*
I liked/like to collaborate with other teachers to plan lessons.	4.71 (.46)	4.08 (1.06)	4.52 (.66)	-2.91*
I provided/plan to provide my students with information about careers in STEM fields.	3.39 (1.16)	3.33 (.96)	4.70 (.47)	-8.53*

Scale: 1 = Strongly Disagree, 5 = Strongly Agree
$*p < .01$

Teachers were then asked to respond to questions about their industry internship experience along with other questions about learning new ideas and implementing them in the classroom. Responses suggest that teachers strongly agree that they are motivated to implement lessons developed during the institute in their own classrooms and that they will continue to collaborate and communicate with teachers they met during the institute. However, responses also indicate that teachers are slightly less confident that the length of time spent in the industry internship was appropriate and that they now have new ideas for utilizing students as Teaching Assistants in their classrooms (see Table 7).

Teachers were also given the opportunity to explain about how they felt their experience in the institute affected their professional development as a STEM instructor. One main theme that emerged was the ability to incorporate real-world applications of scientific ideas in their classrooms, such as connecting concepts to possible career opportunities. Teachers also felt they learned new ideas for future lessons and felt a renewed sense of excitement with science and their instruction.

> *"This has been, by far, the best overall educational conference I have ever attended. Almost everything presented was relevant and can be easily incorporated in my lessons. It's also provided some amazing contacts both professionally and for my students."*
>
> **–Biology teacher**

Table 7. Conference-specific responses from Teacher Survey (*N* = 24)

Question	Mean Score *(SD)*
The length of time spent in the industry internship was appropriate to incorporate ideas into my classroom lessons.	3.96 (1.12)
I am motivated to implement a lesson developed during the Summer Professional Development Institute in my own classroom this coming academic year.	4.75 (.68)
I have new ideas for utilizing students as Teaching Assistants (TA's) and/or Course Tutors in my classroom.	3.87 (.92)
I plan to continue communicating and sharing ideas with other teachers I have met during this Summer Professional Development Institute.	4.63(.49)

Scale: 1 = Strongly Disagree, 5 = Strongly Agree

Teachers felt that their students would benefit from their experience at the institute in several ways. First, teachers reported that their increased ability to portray the relevance and connection between science and real-world application would make the content more interesting and engaging for students. Second, teachers also felt they could pass on information to their students about careers in STEM fields.

Teachers were then asked reflect on which aspect of the experience they liked the most. Participants overwhelmingly reported that the aspect of the event that they liked the most was the opportunity for collaboration with fellow teachers, as well as the speakers. For example, one teacher explained that she enjoyed "having the opportunity to spend so much great quality collaborative time with other teachers and doing labs with them that I can bring back and use." Teachers also enjoyed networking with their peers to share experiences and ideas. One teacher explained that he liked "being able to share knowledge in many different areas of expertise and seeing how they are related."

Finally, teachers were asked to provide possible changes or improvements that could be made to the event. One main theme emerged: teachers wished they had more opportunities to be involved in the training of their student teaching assistants who attended the Summer Enrichment Program. For example, one teacher stated that "I would have liked to work with my student (that I brought) more directly so we could 'gel' together since I am using her as a co-teacher this year OR provide a model or timeline on how to make that more effective." Other suggestions included not scheduling two lesson presentations at the same time so all presentations could be observed, and providing more time for various disciplines (e.g., chemistry and computer science) to collaborate. Finally, teachers wanted to get more information about STEM careers and colleges to pass on to students.

In general, responses were overwhelmingly positive regarding the Summer Professional Development Institute. Seventy-five percent of teacher participants would "definitely attend" this event if offered again in the future and the remaining 25% would "possibly attend." Ninety five percent of teachers (23 out of 24) would recommend this event to other teachers. Students were asked to respond to the same questions. Similar to the teachers, the majority of students found the Summer Enrichment Program to be "extremely valuable" (82%). The same percentage of students agreed that they would "definitely attend" if this event was provided again in the future. The large majority of students would recommend this event to other students at their school (86%).

Overall, the STEM Professional Development Institute and Summer Enrichment Program were both highly rated by teacher and student participants. Although some suggestions for improvements were made, participants indicated that they would attend the program if it were provided again.

The second purpose of Component I was to create a STEM Learning Conference. Currently, there are few opportunities for teachers, administrators, and other individuals in the STEM fields who are critical to student success to collaborate. The purpose of this objective is to encourage partnerships between high school teachers, faculty from CPP, and faculty from local community colleges to develop strategies and practices to help prepare students to succeed in the STEM fields. An annual STEM Learning Conference and online forum were proposed to bring these individuals together.

In Year 2 of the program, the STEM Learning Conference was offered twice (January 30 and August 14, 2010). During the first day-long conference, most participants were middle or high school teachers and students. During the second conference, sessions were targeted to elementary school teachers. Because this conference took place during the summer and students in elementary school were too young, they were not invited to attend the conference. A summary of both conferences is provided below. Note that student data are provided only for the first conference.

Students from various schools attended the STEM Learning Conference at the beginning of 2010. Most of the students were in middle or high school (74%), Hispanic (56%), and female (61%). See Table 8 for a summary of student demographic information.

Table 8. Student Participant Demographics

		n	%
Grade Level	Elementary School	6	10.5
	Middle/High School	42	73.7
	CPP	9	15.8
Ethnicity	Hispanic	32	56.1
	African American	12	21.1
	Asian	4	7.0
	Caucasian	7	12.3
	Native American/Pacific Islander	0	0
	Unknown	2	3.5
Gender	Male	20	35.1
	Female	35	61.4
	Unknown	2	3.5

Performance Measure 2.a. Analyze submitted evaluations of college and secondary students who attend the Annual STEM Learning Conference and report increased motivation levels towards pursuing a STEM career.

This performance measure assessed whether students had increased motivation to pursue a STEM career after attending the event. To assess this, a student survey asked participants about interest, motivation, and confidence in pursuing a STEM career (see Table 9). Results indicated that students agreed that after attending the conference they were more informed about careers in the STEM fields and that they were more confident and motivated to pursue a STEM degree. Specifically, on a 5-point Likert scale where 1 = Strongly Disagree and 5 = Strongly Agree, students strongly agreed that they felt more motivated to pursue a STEM degree in college ($M = 4.53$, $SD = .59$) and more confident that they can succeed in a STEM-based career ($M = 4.21$, $SD = .62$) after attending this conference. Of the 57 students who attended the STEM Learning Conference in January, 25 (44%) agreed or strongly agreed that they want a career in the STEM fields. It is noteworthy that not all students "always" wanted a career in a STEM discipline, suggesting that students educated and inspired about the possibilities of a STEM-based career even if they had not always viewed themselves as a scientist.

Although Cal Poly Pomona was often (but not always) their first choice for college, most students indicated that they were impressed with the science facilities at CPP and would consider attending Cal Poly Pomona for college.

Students also answered questions about receiving encouragement from teachers and family in relation to STEM courses and careers (see Table 10). The results indicated that both family members and teachers were more encouraging in terms of taking science and math courses than pursuing a STEM career. This is particularly interesting because students were attending a STEM-related event that they were encouraged to participate in by their teachers. This is noteworthy, as it provides a basis for conference organizers to fill in the gaps to encourage interest in STEM careers in comparison to just encouraging completion of math and science courses.

> *"[I liked] that we did hands-on training instead of seeing other people…and we experimented ourselves."*
>
> **–Middle School Student**

Finally, students were asked to report what they liked most and least about the conference. Many students stated that they enjoyed participating in hands-on activities such as making bottle rockets and solar cells, getting a

Table 9. Student Survey Results: Attitudes

Question	Mean Score *(SD)*
After attending this conference, I feel more informed about careers in the STEM fields.	4.28 (.58)
After attending this conference, the STEM fields are more interesting to me.	4.43 (.50)
After attending this conference, I feel more confident that I can succeed in a STEM-based career.	4.21 (.62)
After attending this conference, I feel more motivated to pursue a STEM degree in college.	4.53 (.59)
After attending this conference, I am more interested in pursuing a graduate degree (e.g., Masters, Ph.D., etc.) in a STEM field.	4.30 (.59)
I have always wanted a career in the STEM fields.	3.65 (1.04)
I would enjoy a career in the STEM field.	4.27 (.77)
I would consider going to Cal Poly Pomona for college.	4.13 (.81)
Cal Poly Pomona is my first choice for college.	3.14 (1.10)
I am impressed with the science facilities at Cal Poly Pomona.	4.45 (.50)

Scale: 1 = Strongly Disagree, 5 = Strongly Agree

Table 10. Student Survey Results: Encouragement

Question	Mean Score *(SD)*
My family encourages me to take science and math courses.	4.14 (1.13)
My family encourages me to pursue a STEM career.	3.72 (1.35)
My teachers encourage me to take science and math courses.	4.17 (1.12)
My teachers encourage me to pursue a STEM career.	3.95 (1.34)

Scale: 1 = Strongly Disagree, 5 = Strongly Agree

tour of the CPP campus, and meeting new people. For example, one high school student stated that she "really liked learning how to create a solar cell and how nano and microtechnology will change inventions as a whole," while another student explained that she "like[d] that we learned something and had fun at the same time." There were few suggestions for improvement, for example "mak[ing] the event longer so everyone could experience all the stations." Overall, the majority of students believed the event to be extremely valuable (77%), and 83% would "definitely attend" if they had a chance to attend an event like this again.

Teacher Participants. Along with students, the event was also attended by teachers from local schools. Of the 66 teachers attending the STEM Learning Conference in January 2010, the majority taught middle or high school (56.1%). In August 2010, however, the conference was targeted to K-8 teachers, and consequently, the majority taught elementary school (62.3%). The majority of participants were Caucasian, although there was a good representation of teachers of various ethnicities. Finally, the majority of participants were female during both conferences. See Table 11 for more information about teacher participant demographic information.

Table 11. STEM Learning Conference Teacher Participant Demographics

		January 2010 *n* = 66		August 2010 *n* = 66	
		n	%	*n*	%
Grade level	Elementary School	–	–	43	62.3
	Middle School	12	18.2	20	14.5
	High School	25	37.9	6	8.7
	School Administrator	5	7.6	2	2.9
	CPP Faculty	9	13.6	–	–
	Other	12	18.2	8	11.6
	Unknown	3	4.5	–	–
Ethnicity	Hispanic	5	7.8	21	30.4
	African American	14	21.2	2	2.9
	Asian	5	7.8	6	8.7
	Caucasian	29	43.9	28	40.6
	Native American/Pacific Islander	2	3.0	3	4.3
	Other	–	–	3	4.3
	Unknown	11	16.7	6	8.7
Gender	Male	24	36.4	10	14.5
	Female	41	62.1	48	69.6
	Unknown	1	1.5	–	–

Performance Measure 2.b. Percent of STEM high school teachers who participate in the Summer Professional Development Institute and attend the Annual STEM Learning Conference.

The next performance measure assessed the percent of teachers who attended both the Summer Professional Development Institute and the STEM Learning Conference. Of the 26 teachers who attended the Summer Professional Development Institute in Year 1 of the grant, 15 (58%) also attended the STEM Learning Conference in January 2010. A few of these teachers were also presenters at the Learning Conferences. Teachers from the second year of the Summer Professional Development Institute did not attend the Learning Conference in August 2010 because activities were targeted to K-8 instructors and they taught middle and high school. Thus, the event was not relevant to their career. However, some of these teachers (along with those from Year 1 of the Summer Professional Development Institute) were presenters at the August event.

Performance Measure 2.c. Percent of Annual STEM Learning Conference high school teacher attendees who report significant increases in the areas of STEM-related content and pedagogical strategies regarding student learning.

The next performance measure assessed the percent of teachers who felt more knowledgeable about STEM-related content and strategies after attending the STEM Learning Conference. To measure this, participants were asked to complete a survey about their experiences at the conference. Teachers and administrators were asked to assess what they learned at the conference, including strategies to use in the classroom. Table 12 below shows how strongly teachers and administrators agreed with statements about their STEM Learning Conference experience. Results are encouraging, as teachers agree, and often strongly agree, with these statements. For example, of the 41 teachers who completed the survey at the January 2010 conference, 35 (85%) agreed or strongly agreed that "at this conference, I learned information about STEM fields that I can share with students." In addition, of the 38 teachers who responded to the question, 29 (76%) agreed or strongly agreed that "at this conference, I learned how to implement more inquiry-based lessons in my classroom/school." Results were similar, if not more positive, during the August 2010 conference.

In January 2010, participants were informed that CPP was interested in establishing an online learning community by teaming STEM faculty from Cal Poly Pomona with STEM teachers/administrators from high schools and community colleges serving those from underrepresented groups. They were then asked to indicate which opportunities they would participate in if the online community were to be developed. Table 13 shows that most participants (85%) were interested in downloading lesson plans, sharing demonstrations/procedures/materials with other members (72%), and learning about additional summer opportunities (72%). These data provide a good basis for the direction of the online learning community to be established by CPP.

> *"I loved interacting with other teachers! They are all so motivating and it's so nice to talk to other teachers in the field! I liked the demos at lunch, the workshops were amazing!"*
>
> **–High School Teacher**

Open-ended comments indicated that teachers enjoyed the lunchtime demonstrations, learning about hands-on activities, and getting the opportunity to interact and network with other teachers. For example, one teacher indicated that she liked "the variety of options for BOTH teachers and students" that were available while another

Table 12. STEM Learning Conference Teacher/Administrator Survey Results

Question	January 2010 Mean Score *(SD)*	August 2010 Mean Score *(SD)*
At this conference, I learned information about STEM fields that I can share with students.	4.39 (1.07)	4.75 (.47)
At this conference, I acquired strategies to engage a diverse group of students in my classroom/school.	4.46 (.93)	4.63 (.54)
I feel more confident that I can engage a diverse group of students in my classroom/school after attending this conference.	4.37 (.99)	4.51 (.64)
At this conference, I learned how to implement more inquiry-based lessons in my classroom/school.	4.16 (1.22)	4.59 (.60)

Scale: 1 = Strongly Disagree, 5 = Strongly Agree

Table 13. Teacher Preferences for Participation in an Online Community*

Question	*n*	%
Blog	13	33.3
Listserv	3	7.7
Downloading lesson plans	33	84.6
Sharing demonstrations/procedures/materials with other members	28	71.8
Communicating with Cal Poly faculty	22	56.4
Communicating with other STEM teachers/administrators	27	69.2
Learning about additional summer opportunities	28	71.8
Learning about scholarships	21	53.8
I would not be interested in using the online community	1	2.6

** Note that participants were allowed to mark multiple responses. Thus, the total number of responses is greater than the number of participants.*

appreciated "the pacing and intellectual diversity of the day." Comments also indicated that teachers enjoyed the resources and free materials given at some sessions and the enthusiasm of the presenters. For example, one teacher commented that she "loved hearing about different inquiry based lessons we could implement in our classroom" while another appreciated "the variety and the expertise." Components to be changed or improved included a shorter lunch break, better workshop descriptions (specifically for the After School Activities session), serving bottled water throughout the day and especially at lunch, and extending the conference to multiple days to allow for participants to attend more workshops.

Overall, teachers and administrators enjoyed the conference and learned more information about STEM fields and how to engage their students. Of those that completed the survey, the majority (88%) thought attending the event was "extremely valuable" and if it were provided again, 93% would "definitely attend." Ninety-eight percent of attendees would also recommend the event to other teachers and administrators at their school.

Finally, the online community is currently being developed. Based on teacher comments about what they would like to see on the online community, the Component Director hopes to have a new website completed in Year 3 of the grant.

Key Findings: Component I Summary

Overall, the goal of hosting a Summer Professional Development Institute for high school teachers that incorporated content, practical experience, and pedagogy to produce inquiry-based lesson plans for use in the classroom was met. Twenty-four teachers participated in the three-week program by networking with other teachers and CPP faculty, participating in internships, and creating and implementing innovative lesson plans in Year 2 (26 teachers participated in Year 1). After attending the institute, teachers felt more confident and motivated to integrate the information they learned into their classrooms. Of the seven groups of teachers, all (100%) posted the lessons created during the institute on the STEM website. Incorporation of these lessons into their own classrooms is currently being tracked. Twenty-two high school students also participated in a week-long Summer Enrichment Program (25 attended in Year 1). After attending the program, students felt they would enjoy a career in the STEM field and would get a job in the STEM field more than before participating in the program. The STEM Learning Conference took place twice during Year 2 and was enjoyed by both teachers and students. The online forum is currently in development and will be described in the final report for the next year.

Key Findings

	Performance Measure	Goal	Year 1	Year 2
Component I.1: Develop a Formal STEM Faculty Learning Community	**Performance Measure 1.a.** Percent of lessons planned in the Summer Professional Development (PD) Institute that are implemented in the classroom	90% of lessons planned in the Summer PD Institute will be implemented in the classroom	88% of participants implemented lessons	38% of participants implemented lessons in fall 2010; others will implement in spring 2011
	Performance Measure 1.b. Percent of STEM high school teacher groups who participate in the Summer Professional Development Institute and post completed lessons on the website	75% of teachers participating in PD Institute will post completed lessons on the website	88% of groups posted completed lessons on the CPP *STEM Pipeline Project* website	100% of groups posted completed lessons on the CPP *STEM Pipeline Project* website
	Performance Measure 1.c. Percent of STEM high school teachers who indicate increased confidence to implement a STEM lesson with real-world application	80% of STEM high school teachers will indicate increased confidence to implement a STEM lesson with real-world application	88% reported increased confidence to include real-world application in lessons	100% reported increased confidence to include real-world application in lessons
Component I.2. Organize a STEM Learning Conference and Corresponding Website	**Performance Measure 2.a.** Analyze submitted evaluations of college and secondary students who attend the Annual STEM Learning Conference and report increased motivation levels towards pursuing a STEM career.	Specific goal not provided	Was not assessed	44% agreed or strongly agreed that they wanted a career in the STEM fields after attending the conference.
	Performance Measure 2.b. Percent of Annual STEM Learning Conference high school teacher attendees who report significant increases in the areas of STEM-related content and pedagogical strategies regarding student learning.	Specific goal not provided	Was not assessed	76% agreed or strongly agreed that "at this conference, I learned how to implement more inquiry-based lessons in my classroom/school."
	Performance Measure 2.c. Percent of STEM high school teachers who participate in the Summer Professional Development Institute and attend the Annual STEM Learning Conference.	Specific goal not provided	Was not assessed	58% of teachers attended both events

Component II: Enhance STEM Counseling for Community College Students

Students who start their STEM careers at a community college often do not have enough information about which sequence of courses to take for their degree until after they enroll in a 4-year university. Unfortunately, community college counselors are relatively ineffective in assisting students as a result of having only a superficial level of information regarding the transfer process (Townsend & Wilson, 2006). Without proper guidance, STEM transfer students arrive at 4-year universities without having completed the requisite foundation courses. These courses must be taken in sequential order, where certain courses must be completed before a student can progress onto the next course. This mismanagement in a student's academic planning can lengthens the degree process. Without a "roadmap" to follow, they take an additional three to six years to complete a degree. Given the specific nature of the curriculum, STEM transfer students can benefit from a counseling program tailored to their needs.

Admissions Counselor Goals

(1) increase the number of students who transfer to Cal Poly Pomona from either of the campuses within STEM majors
(2) increase the number of Transfer Center Visits and College Fairs held at RCC
(3) increase the visibility of Cal Poly Pomona STEM majors
(4) increase the knowledge of faculty and staff at RCC about STEM majors and other co-curricular opportunities available at Cal Poly Pomona
(5) increase opportunities for RCC students, staff, and faculty to engage in activities and initiatives at Cal Poly Pomona
(6) increase STEM marketing materials for RCC

The *STEM Pipeline Project* proposed creating counselor positions at CPP that focused on developing a comprehensive approach to advising community college STEM students.

In Years 1 and 2 of the grant, two admissions counselors were assigned to spend 40% of their time at the Riverside Community College (RCC) main and Norco campuses. In addition to the assigning new counselors to work at RCC, the Coordinator of Transfer Outreach and Recruitment was assigned to coordinate the annual Transfer Day to ensure inclusion of STEM students from RCC.

Marketing Strategies

STEM banner
Flyers
Postcards
Bookmarks
Flash Drives
Mouse Pads
Flash Emails

In Year 2 of the grant period, CPP counselors continued their weekly visits to the RCC main and Norco campus transfer centers and advised prospective students about the opportunities available at CPP. While the majority of time from December 2009 through March 2010 was spent processing applications from RCC students for the 2010-2011 school year, counselors also promoted CPP STEM programs at College Fairs and Transfer Days. In addition, they continued to serve on the RCC Transfer Advisory Committee. Finally, additional methods of marketing such as STEM banners, flyers, postcards, bookmarks, flash drives, and mouse pads were developed. These were distributed to students and faculty at RCC. For example, STEM postcards containing visitation dates, times, and locations were posted and disseminated throughout high traffic areas on campus to enhance visibility. RCC faculty and counselors were contacted to inform them about CPP counselors' presence on campus and about their interest in scheduling classroom presentations. STEM mouse pads were provided for the Transfer Center and computer labs. STEM bookmarks were supplied to the campus and to students during one-on-one sessions and during classroom presentations. Finally, CPP materials such as a list of majors, transfer admission requirements, and STEM applications were made readily available. Table 14 shows various activities and presentations that CPP counselors conducted at RCC.

Table 14. Activities/Presentations Conducted by CPP Counselors at RCC

Year 1 (2008-2009)	Year 2 (2009-2010)
54 visits to RCC campuses	28 visits to RCC campuses
One-on-One advising for 270 students	One-on-One advising for 365 students
5 college fairs	11 college fairs
7 classroom presentations	4 classroom presentations
4 STEM workshops	3 STEM workshops

Performance Measure 3.a. Percentage of Riverside Community College (RCC) STEM students who complete CSU/UC transferable courses.

The following sections describe specific performance objectives for Component II of the *STEM Pipeline Project* at CPP. Performance measures relate to number of RCC STEM students who apply to CPP and attend STEM activities.

In Year 1 (2008-2009), 105 unique RCC students applied to CPP STEM programs. However, transfer data were available only for 88 students. Of these students, 88 (100%) completed at least 60 CSU transferable units (the minimum number of units required to transfer to a 4-year university). Thus, 100% of students whose data were available completed at least 60 CSU transferable units when applying to CPP.

In Year 2 (2009-2010), 70 unique RCC students applied to CPP STEM programs. Transfer information was available for 61 students. Of these students, 55 (90%) completed at least 60 CSU transferable units. Thus, the percentage of RCC STEM students who completed at least 60 CSU transferable courses decreased between Years 1 and 2 of the grant.

Performance Measure 3.b. Average number of CSU/UC transferable units completed by Riverside Community College (RCC) STEM students that are not applicable to their declared degree.

In Year 1 of the grant, data were available from 88 of the 105 applicants to CPP. On average, these students completed 9.45 units beyond the 60 units that were CSU transferable that were not related to their declared degree. In Year 2 of the grant, data were available from 61 of the 70 RCC applicants. On average, these students completed 5.19 units beyond the 60 CSU transferable units not applicable to their degree. These data suggest that students are minimizing the number of units taken at the community college level that do not apply to their declared degree when transferring to Cal Poly Pomona.

Performance Measure 3.c. Percentage increase in the number of Riverside Community College (RCC) STEM students who apply to CPP STEM programs.

In Year 1 of the grant (2008-2009), 117 RCC students applied to CPP STEM programs (note that there were 105 unique students because some applied in multiple quarters). In Year 2, there were 70 applicants, indicating a 40% decrease. It is important to note, however, that due to state-wide budget cuts and budget issues throughout the entire California State University system, CPP only accepted applications in the fall quarter during Year 2 (whereas applications were accepted during all four quarters in Year 1). Changes in the application procedure may, therefore, explain the decrease in applications. Comparing the number of applications during the Fall quarter in Year 1 to the Fall quarter in Year 2 may provide a better representation of the application process. The data show that 53 RCC STEM students applied to CPP in fall 2008, whereas 70 students applied in fall 2009. This indicates a 32% increase when only comparing fall quarters.

Performance Measure 3.d. Number of RCC students attending Transfer Day

In addition to Open Houses, the Coordinator of Transfer Outreach and Recruitment organized an annual Transfer Day. This event allowed community college students to experience the CPP campus and familiarize themselves with CPP programs and services. Specifically, Transfer Day activities were organized to orient students to CPP, provide information about the critical next steps in the enrollment process, introduce CPP faculty, students, and staff, and introduce admitted students to the various support programs available at CPP to facilitate their graduation and educational experiences.

In Year 1, Transfer Day was attended by 98 RCC students. During the next year, all students interested in CPP STEM programs were encouraged to attend. In Year 2, Transfer Day took place on May 27, 2010. An effort was made to specifically target the 42 RCC STEM students who were admitted to CPP for fall 2010 (Year 3 of the grant). However, only four of these students attended Transfer Day activities. It is important to note that only students who were already admitted to CPP STEM programs were invited to attend, not all students interested in the programs as had been invited in previous years. Students were asked to complete a survey about their experience and satisfaction with the event. All four students agreed or strongly agreed that after attending Transfer Day they felt more informed about career options in science/engineering, had a greater interest in pursuing a career in these fields, and felt they knew more CPP's enrollment process and STEM majors. They were also more interested in attending CPP for college.

In addition to the above performance measures, a *UDirect* software program was purchased in Year 2 of the grant. Originally planned for purchase in Year 1, acquisition of the program was delayed due to unforeseen difficulties. The program is currently being developed to work with existing student data system at CPP. This program will provide students with an individualized electronic roadmap that provides accurate information regarding which courses to take and in which sequence. The goal is to have all STEM transfer students use this program to create a personal roadmap for their college career in the next year. It is anticipated that this system will eventually be implemented for use with all students at CPP.

Key Findings: Component II Summary

Two admissions counselors (40% time) and one transfer coordinator (20% time) from the Office of Admissions and Outreach were designated to provide services at the RCC main campus and Norco campus. The transfer coordinator was responsible for coordinating Transfer Day and other transfer-related activities, including training of community college personnel. The admissions counselors were responsible for increasing the number of Transfer Center visits and college fairs, meeting with RCC faculty, and increasing marketing of CPP STEM programs at RCC. These activities were conducted throughout the second grant year.

Although there was a decrease in the percentage of RCC STEM students who completed CSU/UC transferable courses, data suggest that students are minimizing the number of units taken at the community college level that do not apply to their declared degree when transferring to CPP. Despite the overall decrease in the number of RCC STEM students who applied to CPP STEM programs between Years 1 and 2 of the grant period, there was an increase in applicants when quarterly comparisons were made.

Several presentations were made to students and faculty about STEM programs on RCC campuses. In addition, a Transfer Day took place in March 2010 that specifically targeted RCC students who were admitted to CPP STEM majors. The four RCC students who attended the event reported being more informed and interested in CPP's STEM programs. Finally, the *UDirect* program will continue to be developed to work with existing student programs at CPP to provide students with an individualized electronic roadmap that provides accurate information regarding which courses to take and in which sequence. It is expected that this program will be available for use in the near future.

Key Findings

	Performance Measure	Goal	Year 1	Year 2
Component II: Enhance STEM Counseling for Community College Students	**Performance Measure 3.a.** Percentage of Riverside Community College (RCC) STEM students who complete CSU/UC transferable courses.	Specific goal not provided	100% of students completed at least 60 CSU transferable units	90% of students completed at least 60 CSU transferable units
	Performance Measure 3.b. Average number of CSU/UC transferable units completed by Riverside Community College (RCC) STEM students that are not applicable to their declared degree.	Decrease number of units completed by RCC STEM students that are not applicable to their degree	Students completed an average of 9.45 unrelated units	Students completed an average of 5.19 unrelated units
	Performance Measure 3.c. Percentage increase in the number of Riverside Community College (RCC) STEM students who apply to CPP STEM programs.	10% increase in the number of RCC STEM students who apply to CPP STEM programs	117 RCC students applied to CPP STEM programs	70 RCC students applied to CPP STEM programs (40% decrease)
	Performance Measure 3.d. Number of RCC students attending Transfer Day activities.	Increase the number of RCC students attending Transfer Day activities	98 students attended Transfer Day activities	4 students attended Transfer Day activities

Component III: Create a Seamless Transfer Profess for STEM Majors

Students assume that the courses they take at a community college will fulfill requirements for their intended major at a four-year college. However, this assumption is not always correct. Many of the community colleges in the area are on the semester system, while CPP utilizes a quarter system. This difference makes it impossible for community college courses to be exactly equivalent to CPP courses. At best, equivalency can be established for year-long sequences of courses. In addition, course content is not always consistent with respect to the order presented (e.g., vectors are taught before sequences and series in some calculus books). This variance makes course-by-course articulation even more complicated and results in some courses not being equivalent between schools. Thus, in spite of established articulation agreements that are in place between CPP and area community colleges, students are frequently required to repeat courses already taken at a community college when they arrive at a 4-year college.

Performance Measure 4.a. Number of initial transfer curriculum sheets developed.

One goal of the grant was to address the problem of repeating courses by creating a seamless transfer process that will allow students to complete 50% of their degree requirements at RCC and 50% of their degree requirements at CPP, with little to no additional coursework required at CPP. Creating formal articulation agreements between the two schools that would inform RCC students about transferable courses would allow for a streamlined procedure from RCC to CPP to graduation with a STEM degree.

The first step in this process was to have CPP and RCC STEM faculty meet to discuss courses taught at the two campuses. These meetings would result in agreement on courses that were equivalent and could be articulated between the College of Science and the College of Engineering at CPP with RCC. Initially, only six articulation agreements were proposed: five for the College of Science and one for the College of Engineering. However, upon closer analysis it was concluded that specific articulation agreements needed to be completed for each of the 13 engineering majors (see Table 15). Thus, 18 initial articulation agreements were proposed to be developed during Year 1 of the grant cycle. All initial articulation agreements were completed, and the goal was met.

In spring 2010 (Year 2 of the grant), it was determined that "articulation agreements" was an incorrect way of identifying these documents because they are not academic roadmaps as they do not indicate course sequences, only course requirements. A more appropriate name for these documents would allow students who utilized them to understand their purpose and to use them more effectively. Thus, the documents were renamed "transfer curriculum sheets." Faculty from CPP worked to develop user-friendly transfer curriculum sheets by using techniques such as differentiating courses at both colleges with different colored fonts. Students could, therefore,

Table 15. Articulation Agreements for the College of Science and the College of Engineering

College of Science	College of Engineering
Biology	Aerospace Engineering
Chemistry	Chemical Engineering
Computer Science	Civil Engineering (Environmental Option)
Mathematics and Statistics	Civil Engineering (General Option)
Physics	Civil Engineering (Geospatial Option)
	Computer Engineering
	Construction Engineering
	Electrical Engineering
	Electronics & Computer Engineering Technology
	Engineering Technology
	Industrial Engineering
	Manufacturing Engineering
	Mechanical Engineering

easily identify a course at RCC and its equivalent course at CPP. While these new transfer curriculum sheets were being created, it was determined that other departments (besides engineering) needed more specific documents. Specifically, 13 sheets would be needed for engineering majors, 6 for biology, 2 for chemistry, 1 for computer science, 1 for mathematics and statistics, and 1 for physics, as well as additional curriculum sheets. A total of 24 transfer curriculum sheets were created instead of the original 6 proposed in the grant.

Performance Measure 4.b. Number of online course modules developed.

After creating transfer curriculum sheets for courses that could be aligned, the next step was to discuss options for those that could not articulate because essential content could not be accommodated within courses at either CPP or RCC. In this situation, it was proposed that the faculty would work together to create online modules that would provide students with the opportunity to learn the material independently and demonstrate knowledge in the area. Thus, a student could take a course at RCC along with an online module, complete an assessment, and receive credit at CPP for an equivalent course. After the 18 initial articulation agreements were created, faculty at both schools reviewed conceptual gaps in their programs for RCC STEM transfer students. At the end of the first grant year, faculty in the Mathematics and Statistics department identified 56 conceptual gaps and developed 42 of these as online modules (e.g., http://video.csupomona.edu/JMSwitkes/U-Substitutions-655.asx). The rest of the online math modules are being developed in Year 3. The Physics department identified 3 conceptual gaps and developed these as online modules. Students are RCC were asked to review some of these modules for accessibility and understandability. Their feedback will be used to make the modules more user-friendly. Currently, other departments are continuing to identify conceptual gaps, after which modules will be developed as needed.

The purpose of creating online modules was to allow RCC students to independently review the module and complete an assessment for course credit at CPP. Unforeseen obstacles arose when it was time to create assessments for those modules that were already developed. Specifically, it was unclear who would create the assessments and who would grade them for credit. Although it would be possible for current faculty members at both schools to participate, it was important to institutionalize this procedure so students several years later could also complete the same assessment and receive credit without depending on a specific faculty member to still be available at either college for grading purposes. Currently, key faculty members and component directors of the CCRAA grant at both schools are developing a plan of action so that it will be easily feasible to administer and grade an online assessment for credit.

Performance Measure 4.c. Percentage of RCC STEM students who utilize the transfer curriculum sheets and online course modules with decreased number of transferable units not applicable towards degree.

Since no RCC STEM transfer students used articulation agreements or online modules to guide their course of study during Years 1 and 2 of the grant, it is not possible at this time to calculate results for Performance Measure 4.c., which seeks to understand the percent of RCC STEM students who utilize the articulation agreements and online course modules with decreased number of transferable units not applicable towards degree. It may be possible to examine these results once transfer curriculum sheets and online course modules have been implemented in Year 3 of the grant.

Performance Measure 4.d. Number of finalized transfer curriculum sheets developed.

The last goal of this component was to finalize the transfer curriculum sheets that were developed during Year 2. CPP evaluators and the Component Director met with RCC counselors and administrators on February 1, 2010 to discuss progress of curriculum sheets and how they will be utilized at the community college. Once the initial sheets were submitted to RCC faculty and STEM counselors, they were revised and are currently being finalized. It is expected that the 24 transfer curriculum sheets will be finalized and utilized in Year 3 of the grant.

Key Findings: Component III Summary

Overall, the goal of creating initial transfer curriculum sheets (originally referred to as tailored articulation agreements) between CPP and RCC was met. Of the 24 areas identified within the College of Science and College of Engineering, all 24 (100%) were created in Year 2. Only the math and physics departments created online modules for RCC courses that required additional information to qualify as being equivalent courses at CPP. Assessments and the logistics of grading them are currently being discussed and finalized between faculty from RCC and CPP. Due to the timeline of module development and deployment, it was not possible to measure the percentage of RCC STEM students who utilized articulation agreements and modules with a decrease in the number of transferable units that were not applicable towards their degree, although some students provided informal feedback about the modules. This evaluation will be completed once the online modules are finalized and implemented during Year 3. Finally, transfer curriculum sheets continue to be modified and will be finalized by the end of Year 3 of the grant.

Key Findings

	Performance Measure	Goal	Year 1	Year 2
Component III: Create a More Seamless Transfer Process for STEM Majors	**Performance Measure 4.a.** Number of initial transfer curriculum sheets developed.	Develop six initial transfer curriculum sheets in the College of Science (CoS) and College of Engineering (CoE)	18 transfer curriculum sheets were created (5 in CoS and 13 in CoE)	24 total transfer curriculum sheets were created (11 in CoS and 13 in CoE)
	Performance Measure 4.b. Number of online course modules developed.	Specific goal not provided	The math department developed 42 online modules	The math department developed 42 online modules. The physics department developed 3 online modules
	Performance Measure 4.c. Percentage of RCC STEM students who utilize the transfer curriculum sheets and online course modules with decreased number of transferable units not applicable towards degree.	Specific goal not provided	No RCC STEM transfer students used transfer curriculum sheets or online modules	No RCC STEM transfer students used transfer curriculum sheets or online modules
	Performance Measure 4.d. Number of finalized transfer curriculum sheets developed.	Finalize all 24 initial transfer curriculum sheets developed	No transfer curriculum sheets were finalized	24 transfer curriculum sheets were finalized

Component IV: Prepare Students for the Baccalaureate Degree

To spark interest in engineering and related disciplines and prepare RCC students to succeed at CPP, Component IV extended PLTW activities on campus. The result of Component IV activities will be increased faculty and student awareness of the engineering and related STEM departments and programs at CPP, an increased number of engineering and STEM transfer students from RCC, and higher retention rates for participating students.

> ***Component IV Activities***
>
> **(1)** Establish a pre-engineering course at RCC
>
> **(2)** Present a lecture series for RCC students by CPP faculty providing information about STEM majors and careers

To address the first activity, a pre-engineering course (ENE 5A & 5B, Engineering Principles I & II) was developed. This course was established using Project Lead the Way (PLTW), a program that allows students to learn about engineering and other STEM disciplines via project-based, hands-on experiences. Ability to provide PLTW depends on registering one's institution with the nationally recognized program. CPP was selected to be one of the PLTW regional centers in California to provide PLTW curriculum training to middle school, high school, and community college teachers during the Summers of 2009 and 2010. Component IV funded this training for RCC faculty so students at the community college level could get hands-on experience in the STEM fields.

The purpose of the RCC Engineering Principles course was to allow students to utilize new equipment and technology. Equipment and computers were purchased and installed before the start of the course during Year 2 of the grant (see Table 16).

Along with getting access to new equipment, students in this course were invited to visit CPP's Colleges of Engineering and Science. Here, they met CPP faculty, toured labs, and learned about the Maximizing Engineering Potential (MEP) program. CPP's MEP program is the largest program in California, enrolling underrepresented minority engineering students (see Component V for a description). The following sections describe specific performance objectives for Component IV of the *STEM Pipeline Project* at CPP. Performance measures relate to the Engineering Principles course offered at RCC and RCC faculty and student awareness and motivation to pursue an engineering degree, especially at CPP.

Table 16. Equipment purchased for RCC for the Engineering Principles Courses

Item	Quantity	Total
HP Printer and Feeder	1	$1,589
Fischhertechnick Kits (including 2 pneumatics kits)	6	$16,452
Mobile floor racks for Fischhertechnick kit parts	2	$220
Dell Optiplex Computers	28	$40,102
Tensile test machine, components, and consumables	1	$3,878
Computer with monitor for tensile test machine	1	$949
Digimatic Mini-Processor and Caliper Package	1	$620
Material for 3-D printer	1	$9,395
Auto Desk Software package	1	$4,384
Total		**$77,589**

Performance Measure 5.a. Number of Riverside Community College (RCC) faculty members who are trained to offer PLTW.

The first step in developing the pre-engineering course was to train RCC faculty by certified trainers from the PLTW organization. Two faculty members from RCC participated in the PLTW Summer Training Institute 2009, Principles of Engineering session, at CPP. One of these faculty members taught the Engineering Principles course (ENE 5A) at RCC starting in spring 2010 (Year 2 of the grant). Prerequisite for RCC faculty participation was institution registration as a PLTW school with the national PLTW organization. RCC completed institution registration in March 2009. Two RCC faculty members attended PLTW summer training in 2010 (for Year 3 of the grant).

Performance Measure 5.c. Number of Riverside Community College (RCC) STEM transfer students who have participated in PLTW.

The Engineering Principles (ENE 5A) course was first implemented at RCC in the Spring 2010 semester. The goal was to enroll 30 students but only 27 students registered for the course and completed a pre-test survey about their attitudes and knowledge about engineering. Although the initial goal was not met, it is important to

Table 17. Student Demographics in ENE 5A, Spring 2010 Semester

		Participants	
		N = 27	%
Gender*	Male	14	52
	Female	10	37
Ethnicity	Caucasian	6	22
	Hispanic/Latino	7	26
	Asian/Pacific Islander	3	11
	Other	11	41
Enrollment Status*	Full-time	15	56
	Part-time	11	41

**Note that the numbers provided within each group do not add up to the total number due to missing data.*

note that the capacity of the room in which the course was held was limited. Thus, the maximum number of students allowed to enroll in the course was 28. By the end of the semester, 13 of the original 27 remained enrolled in the course and completed a post-test survey. The following section provides a summary of student responses.

Of the 27 students who enrolled in the course at the beginning of the semester, 52% were male and more than three-quarters were minority students (e.g., 26% indicated their ethnicity as Hispanic/Latino; see Table 17). A little over 50% of the students were enrolled at RCC as full-time students.

Engineering Interests

After providing demographic information, students were asked about their interest in specific engineering majors. Results indicated that prior to taking the course, students were most interested in mechanical engineering, followed by aerospace and civil engineering (see Table 18). The lowest-rated majors included industrial and manufacturing engineering.

Performance Measure 5.b. Percentage of Riverside Community College (RCC) STEM students who indicate an increased awareness of STEM career options.

The main purpose of the survey was to assess student attitudes towards engineering as a career and their perspectives on required skills and training. Questions were answered on a 5-point scale, where 1 = strongly disagree and 5 = strongly agree. Results indicated that prior to taking the course, students on average agreed that engineering was a respectable (mean = 2.85) and rewarding career (mean = 4.58) that merited the necessary effort required to obtain a degree (mean = 4.64; see Table 19). They also believed that engineers were creative (mean = 4.58) and required great communication and writing skills (mean = 4.62).

In addition to questions about engineering, students answered questions regarding their education path. Students expressed interest in continuing their education at a 4-year university (mean = 4.67), although interest in pursuing a degree in engineering was not as evident (mean = 3.91). Students agreed that they would consider Cal Poly Pomona as an option (mean = 4.00), but the university did not seem to be a first-choice for most students (mean = 2.69).

Students who completed the ENE 5A course:

- Were more confident in their ability to design and build
- Believed they had stronger problem solving skills
- Knew more about what an engineer does
- Knew more about what engineering majors are available at CPP and the requirements to be admitted to these programs
- Were more interested in transferring to a 4-year university

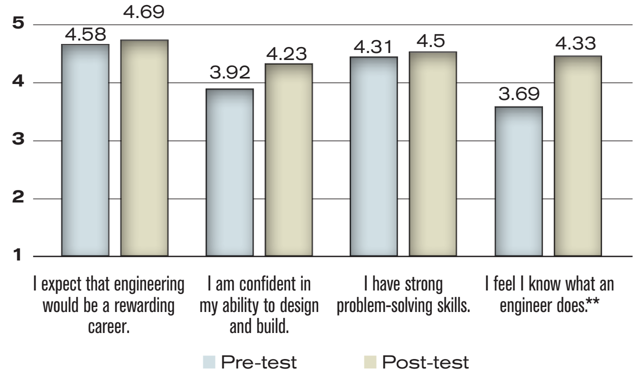
A post-test survey was administered to those 13 students who completed the course to understand whether student attitudes and perspectives regarding engineering and education changed over the duration of the course. It is important to note that although only 48% of students completed the course, this attrition rate is typical at RCC. Results indicated that completing the PLTW course allowed students to gain more confidence in their ability to design and build (mean = 3.92 at pre-test and mean = 4.23 at post-test), as well as to increase their problem solving skills (mean = 4.31 at pre-test and mean = 4.50 at post-test; see Figure 1). After completing the ENE 5A course,

Table 18. Engineering Interests for Engineering Principles Course Students, Pre-Test Survey

Engineering Majors	Student Interest (*N* = 27)
Mechanical Engineering	11
Aerospace Engineering	8
Civil Engineering	8
Computer Engineering	6
Chemical Engineering	5
Electronics & Computer Engineering Technology	5
Construction Engineering Technology	4
Electrical Engineering	4
General Engineering Technology	4
Industrial Engineering	1
Manufacturing Engineering	0

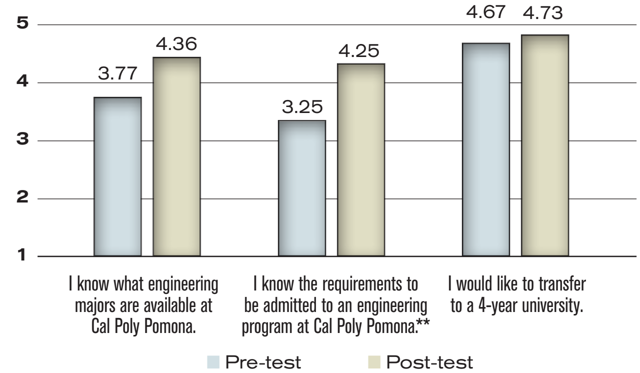
**Note that students were allowed to express interest in more than one major.*

Figure 1. Student Attitudes, Pre- and Post-test Survey*



**Scale: 1 = strongly disagree and 5 = strongly agree*
***p < .01*

Figure 2. Student Attitudes, Pre- and Post-test Survey*



**Scale: 1 = strongly disagree and 5 = strongly agree*
***p < .01*

students also expanded their understanding of what an engineer does (mean = 3.69 at pre-test and mean = 4.33 at post-test).

Exposure to engineering resources and faculty gave students a better understanding of the various engineering majors available at Cal Poly Pomona and also the requirements for admission into CPP. For example, students were more aware of engineering majors available at CPP after the course (mean = 4.36) than before the course (mean = 3.77; see Figure 2).

Students also answered additional questions about engineering and 4-year universities. Results showed that responses were more positive after the course for most questions (see Table 19). Although not statistically significant, students confidence in their ability to succeed in engineering surprisingly decreased after participating in the course (mean = 4.08 at pre-test and mean = 3.83 at post-test). Perhaps students' decrease in confidence can be explained by their increase in understanding of what an engineer does. Specifically, after taking the PLTW course, students' now understand how challenging and rigorous the academic path is for engineers, which may make them less confident in their ability to succeed in this career.

Performance measure 5.b. assessed the percentage of RCC STEM students who indicated an increased awareness of STEM career options. To answer this question, students were asked to respond to the following question on the pre- and post-test: *"I have a good idea of different career options within the field of engineering."* Twenty-five students answered this question on the pre-test. Of these students, 19 (76%) either agreed or strongly agreed with this statement. On the post-test, 12 students responded to this question. Of these, nine (75%) either agreed or strongly agreed with this statement. Although there was a slight decrease in the percentage of students who indicated an increased awareness of career options between pre- and post-test, it is important to note that this decrease was not statistically significant. In addition, the low number of students who completed the course and answered this question on the post-test means that the results should be interpreted with caution.

Overall, the results suggest that students are generally well-informed about engineering careers and the skills and training required to enter the field. In addition, it seems that the PLTW course helped students in building their core competencies required for success in pursuing an engineering degree. The ENE 5A course will continue to be provided at RCC in Year 3 of the program, and pre- and post-test data will collected at that time. In addition, an ENE 5B course will also be offered for students who completed the first part of this course series.

Performance Measure 5.d. Number of seminars with STEM topics offered by CPP faculty at RCC.

The second purpose of Component IV was to provide students with an opportunity to attend a lecture series delivered by CPP faculty and students. This lecture series provided information about STEM topics as well as information about CPP and its engineering programs. Only one seminar was offered in Year 1 of the program. In Year 2, five seminars were offered. Similar to those students enrolled in the Engineering Principles course, a survey of student awareness of CPP engineering programs and motivation to pursue a career in engineering was used. Note that only lectures by CPP engineering faculty have been provided thus far. Faculty members from the College of Science are currently being recruited to participate in Year 3 of the program.

The first faculty lecture for Year 2 of the grant was held on February 2, 2010 at RCC's Norco campus. There were four additional lectures in March and April 2010 at RCC's main campus. The following section provides a summary of student responses on the satisfaction survey.

Table 19. Student Attitudes, Pre- and Post-Test Survey*

Question	Pre-Test Mean *(SD)*	Post-Test Mean *(SD)*	*t* value (DF)
1) Engineers contribute more to making the world a better place than people in most other occupations.	3.83 (1.12)	3.92 (1.04)	.00 (11)
2) Engineers are creative.	4.58 (.52)	4.62 (.51)	.00 (10)
3) The rewards of an engineering degree are worth the effort.	4.64 (.51)	4.46 (.78)	1.15 (10)
4) I enjoy classes in science and math.	4.46 (.66)	4.46 (.88)	.00 (11)
5) Engineering is a respectable career.	4.85 (.38)	4.77 (.44)	.43 (12)
6) I like figuring out how things work.	4.69 (.48)	4.62 (.87)	.43 (12)
7) Technology plays an important role in solving society's problems.	4.46 (.66)	4.62 (.51)	-.69 (12)
8) A teacher or counselor suggested that I should become an engineer.	3.10 (1.45)	2.82 (1.17)	.80 (7)
9) Engineers need good communication and writing skills	4.62 (.51)	4.38 (.51)	1.90 (12)
10) Most of my friends that I hang out with are studying engineering.	2.54 (1.20)	2.55 (1.21)	-.19 (10)
11) I feel confident in my ability to succeed in engineering.	4.08 (.86)	3.83 (.84)	1.00 (11)
12) I recognize the importance of goal setting, and I have clear academic goals.	4.08 (.76)	3.83 (.94)	1.00 (11)
13) I have a good idea of different career options within the field of engineering.	3.92 (.86)	4.00 (.74)	-.69 (10)
14) It is important for engineers to know how to work well with other people.	4.62 (.51)	4.58 (.52)	.00 (11)
15) I want to pursue a degree in engineering.	3.91 (.94)	3.58 (1.00)	1.40 (9)
16) I would consider going to Cal Poly Pomona for college.	4.00 (1.23)	4.00 (1.28)	-.56 (11)
17) Cal Poly Pomona is my first choice for college.	2.69 (1.49)	3.00 (1.48)	-1.40 (11)

Scale: 1 = Strongly Disagree, 5 = Strongly Agree
$*p < .01$

Faculty Seminars Offered by CPP Faculty at Riverside Community College in Year 2

- **February 3, 2010**: Introduction to Engineering Course at RCC's Norco Campus
- **March 6, 2010:** Bronco Engineering Day at Cal Poly Pomona
- **March 10, 2010:** Engineering Principles course at RCC's City Campus
- **March 18, 2010:** Presentation to Veterans at RCC's STEM Center
- **April 21, 2010:** Presentation to Computer Science course at RCC's City

**Note that survey responses were not reported for this presentation. Students in the computer science course were not expected to show interest in engineering majors or careers. Thus, it would not be appropriate to include their data in the overall analyses.*

Student Demographics

A total of 73 students attended the various faculty lecture presentations. The majority of students who attended presentations were male (71%) and more than two-thirds were minority students (e.g., 30% indicated their ethnicity as Hispanic/Latino; see Table 20). A little over two-thirds of students were enrolled at RCC as full-time students.

Student Attitudes

After providing demographic information, students were asked about their attitudes toward the engineering fields. Questions were answered on a 5-point scale, where 1 = strongly disagree and 5 = strongly agree. Results indicated that, on average, students felt a greater interest in pursuing a career in engineering after attending the presentation (see Table 21). They also felt more informed about career options in engineering and more confident that they could succeed in this career. In addition to questions about engineering careers in general, students answered questions about the engineering program and application procedures at CPP. Results indicated that students felt more informed about the engineering program at CPP as well as the admissions process to get into the 4-year university after attending the presentation. Overall, students generally liked the presentation they attended.

Students also indicated why they attended the event. Almost half of the students (47%) attended the presentation to learn more about a specific engineering major at CPP (see Table 22). Other reasons for attending the presentation included wanting to learn more about engineering careers, to network with CPP faculty, and to satisfy a course requirement.

Finally, students indicated their satisfaction with the presentation. All students believed the event met or exceeded their expectations (see Table 23).

Overall, results suggest that students were satisfied with the faculty lecture series presentations and felt more informed about and interested in pursuing a career in engineering. They also felt more knowledgeable about the engineering program at CPP and the admissions process of getting into the school. Additional faculty presentations are scheduled to occur throughout Year 3 of the program and student satisfaction will continue to be assessed.

Key Findings: Component IV Summary

The purpose of Component IV was to prepare students for the Baccalaureate degree by establishing a pre-engineering course at RCC as well as providing

Table 20. Student Attendee Demographics

		Participants	
		N = 73	%
Gender*	Male	52	71
	Female	20	27
Ethnicity	Caucasian	21	29
	Hispanic/Latino	22	30
	Asian/Pacific Islander	10	14
	Other	20	27
Enrollment Status*	Full-time	50	69
	Part-time	19	26

**Note that the numbers provided within each group do not add up to the total number due to missing data.*

Table 21. Student Attitudes, Faculty Seminars*

Question	Mean Score *(SD)*
After attending this presentation, I feel more informed about career options in engineering.	4.47 (.56)
After attending this presentation, I have a greater interest in pursuing a career in engineering.	4.14 (.84)
After attending this presentation, I feel more confident that I can succeed in a career in engineering.	4.26 (.71)
After attending this presentation, I feel more informed about the admissions process at Cal Poly Pomona.	4.38 (.64)
After attending this presentation, I know more about different engineering majors at Cal Poly Pomona.	4.48 (.53)
I have always wanted a career in engineering.	3.67 (1.09)
I generally liked the presentation today.	4.49 (.60)

Scale: 1 = Strongly Disagree, 5 = Strongly Agree

Table 22. Reasons for Attendance, Faculty Seminars*

	Participants	
	n = 73	%
Learn more about engineering careers in general	34	47
Learn more about a specific engineering major at Cal Poly Pomona	33	45
Network with Cal Poly Pomona faculty	15	21
Required for class	20	27

**Note that the numbers provided within each group do not add up to the total number due to missing data.*

Table 23. Student Satisfaction with the Faculty Seminars

	Participants	
	n = 73	%
Did not meet expectations	0	0
Met expectations	43	59
Exceeded expectations	28	38

**Note that the numbers provided within each group do not add up to the total number due to missing data.*

students with an opportunity to participate in a lecture series delivered by CPP faculty and students. Two RCC faculty members were trained during summer 2009 to teach the course. A new Engineering Principles (ENE 5A) course was developed and with 27 enrolled students (13 students completed the course). Results of a pre- and post-test showed that students are highly interested in pursuing a degree in engineering and want to transfer to a 4-year university. There was also a strong impact of the course on student knowledge of STEM careers and engineering programs at CPP.

Five presentations were offered in Year 2 of the program as part of the faculty lecture series and the survey results suggest that students felt more informed about and interested in pursuing a career in engineering after the presentations. They also felt more knowledgeable about the engineering program at CPP and the admissions process of getting into the school.

Key Findings

	Performance Measure	Goal	Year 1	Year 2
Component IV: Extend the Project Lead The Way (PLTW) Course to RCC	**Performance Measure 5.a.** Number of Riverside Community College (RCC) faculty members who are trained to offer PLTW.	Train 2 RCC faculty members in PLTW	Two RCC faculty members were trained during Summer 2009	Two RCC faculty members were trained during Summer 2010
	Performance Measure 5.b. Percentage of Riverside Community College (RCC) STEM students who indicate an increased awareness of STEM career options.	Specific goal not provided	Was not assessed	75% of students who completed the PLTW course indicated that they had a good idea of career options within STEM fields
	Performance Measure 5.c. Number of Riverside Community College (RCC) STEM transfer students who have participated in PLTW.	30 RCC STEM transfer students will participate in PLTW	Course was not created	27 students initially enrolled in the course
	Performance Measure 5.d. Number of seminars with STEM topics offered by CPP faculty at RCC.	Provide five seminars with STEM topics offered by CPP faculty at RCC	One seminar was offered	Five seminars were offered

Component V: Assist Students to Prepare for the Future through Tutoring, Upgraded Equipment, and Research Experiences

Students must be well-prepared during their undergraduate training to be competitive in tomorrow's job market. The *STEM Pipeline Project* aims to assist students in their college preparation through a multi-pronged approach, which includes providing tutoring services outside the classroom, state-of-the-art equipment in the classroom, and an enriched research apprenticeship experience for those students interested in continuing onto graduate school.

Peer Tutoring

Peer tutoring programs have been shown to increase retention and long-term success of underrepresented groups in STEM disciplines (Oestereicher, 1987). CPP has strong record of Hispanic and low-income student enrollment in the science and engineering fields, which accounts for 28% of the College of Engineering population. The success of these numbers is, in part, due to the strong support for these students which includes peer tutoring. The purpose of the *STEM Pipeline Project* is to increase the scope of tutoring programs and extend them to reach a larger population.

The College of Science offers tutoring support via a Math and Science Help (MaSH) program. Tutoring is offered for Biology, Chemistry, Computer Science, Math, and Physics. MaSH's peer tutoring unit, coupled with strong faculty input, allows students to help other students. This peer interaction can lead to success for both tutor and student. In the 2007-2008 academic year (prior to year one of the grant), MaSH provided support for 8,738 students with over 11,422 hours of free tutoring. The *STEM Pipeline Project* sought to expand the MaSH program by offering additional support for upper-division and low-pass rate courses. Support for students in the College of Engineering is offered through the Maximizing Engineering Potential (MEP) program, and grant resources were designed to expand tutoring, workshops and renovation of the study center for engineering students.

The following sections describe specific performance objectives for Component V of the *STEM Pipeline Project* at CPP. Performance measures relate to specifically to RCC STEM transfer students as well as those students in the College of Science and the College of Engineering. For many of these goals, only RCC STEM transfer students in the College of Science and the College of Engineering were targeted as opposed to the entire population of STEM students. There were only 56 RCC STEM transfer students at CPP identified as eligible for program services in Year 1 and 40 in Year 2; however, we also considered RCC STEM transfer students that started at CPP a year before the grant began, given that these students would be the most likely to attend tutoring for upper-division MaSH-supported courses and MEP workshops. Even with expanding the number of eligible RCC transfer students, there are still only a small number of eligible students, and some findings represent a very small proportion of students; therefore, we encourage the reader to interpret the following results related to percent of students served, with caution.

Performance Measure 6.a. Percentage of RCC STEM transfer students using MaSH or MEP services.

The first performance measure examined the percent of RCC STEM transfer students who utilized MaSH or MEP services. When calculating the percentage of students using these services, it is important to note that calculations differ based on which college the student is enrolled within. For example, all students, regardless of their major, were allowed to utilize MaSH services. Thus, the calculations are based on dividing the number of students participating in MaSH by the total number of RCC STEM transfer students (*N* = 56). Unlike MaSH, MEP services are targeted to students in the College of Engineering. Thus, only 43 of the 56 were eligible to utilize these services. Consequently, calculations are based on dividing the number of students participating in MEP by 43, not the total number of RCC STEM transfer students.

Of the 56 students identified as RCC STEM transfer students in Year 1 of the program, ten (18%) used MaSH tutoring services and two students (5%) used MEP services, for a total of 21% of these students using either MaSH or MEP services (see Table 24). This fell below the goal of 25% of RCC STEM transfer students using MaSH tutoring or MEP services.

Table 24. Percentage of RCC STEM Transfer Students Using MaSH and MEP Services

	Year 1 (2008-2009) *N* = 56*	Year 2 (2009-2010) *N* = 119*
RCC STEM transfer students using MaSH services at CPP	10 (18%)	16 (13%)
RCC STEM transfer students using MEP services at CPP	2 (5%)	1 (< 1%)

**Note that in Year 2, the total number of RCC STEM students included those who transferred to CPP between 2007-2010. In contrast, the total number of RCC STEM students in Year 1 included only those who transferred to CPP in the 2008-2009 school year.*

In Year 2, this group of students was targeted more specifically to take advantage of MaSH tutoring services, the MEP program, and other programs offered to support their academic plans. Emails advertising program services were sent specifically to the 40 RCC STEM transfer students entering CPP in Year 2, as well as to the 56 RCC STEM transfer students who entered CPP in Year 1 of the grant, and the 48 students who entered one year prior to the grant. Thus, 144 students were targeted to receive these emails (although only 119 of these students received emails because some graduated or did not enroll in Year 2 of the grant). It was determined that STEM students who had transferred from RCC in previous years would be able to utilize MaSH services throughout their time at CPP. In fact, it would be these older students who would most likely utilize tutoring services for upper-division courses because they would currently be taking those courses (whereas new transfer students might still be taking lower-division courses and therefore not need MaSH tutoring). Thus, it would be appropriate to include them in the following analyses. Data showed that of the 119 STEM students who transferred to CPP between 2007-2010 and were enrolled in CPP during the 2009-2010 school year, 16 (13%) utilized MaSH services. Of these students, only one utilized MEP services. Thus, 14% of RCC STEM transfer students used either MaSH or MEP services in Year 2. Once again, the goal of having 25% of RCC STEM transfer students use either MaSH or MEP services was not reached.

Performance Measure 6.b. Increase in number of new courses beyond the introductory level with trained tutors.

Another goal of the grant was to increase tutoring for advanced courses with trained tutors. Initially, there were 13 courses identified as needing support from MaSH tutoring. As proposed, the MaSH program supported tutoring in upper-division courses in science and engineering. In addition, they extended services to courses that were lower-division but had low pass rates. In Year 1, there were approximately 41 courses supported by MaSH tutoring that were either upper-division science or engineering courses or low-pass rate lower-division courses. Thus, the goal of providing support for 13 new courses beyond the introductory level with trained tutors was surpassed in that year (see Table 25). In Year 2, these same courses were supported by MaSH tutoring with the exception of ten of these courses. Eleven new courses were also added during this year, for a total of 42 courses.

Performance Measure 6.c. Percentage of MaSH tutors tutoring classes beyond the introductory level with CRLA Level 3 certification.

In addition to increasing the number of courses for which tutoring is offered, tutors were trained to attain Level 3 College Reading and Learning Association (CRLA) certification to provide appropriate services to students. Certification involves participating in a training program that focuses on various topics. For example, Level 1 (Certified Tutor) topics include definitions of tutoring and tutor responsibilities, basic tutoring guidelines, tips for active listening, modeling problem solving. Level 2 (Certified Advanced Tutor) topics include those reviewed in the previous training as well as others, including how to use probing questions, cultural awareness, and assessing or changing study behaviors. Level 3 (Certified Master Tutor) topics include discussing issues such as how to deal with target populations, training and supervising other tutors, and group management skills. A student must have

Table 25. New Courses Tutored through MaSH

Department	Course
Biology ($n = 3$)	Bio 211, 303, 310*
Chemistry ($n = 10$)	Chm 201, 221, 304*, 311*, 314, 315, 316, 321, 327, 328
Computer Science ($n = 9$)	CS 210, 240, 241, 256, 264, 301*, 311, 365*, 380*
Math ($n = 15$)	Mat 201, 208, 214, 215, 216, 224, 310, 314, 315, 318, 370, 401*, 417*, 418, 428*
Microbiology ($n = 1$)	Mic 201
Physics ($n = 2$)	Phy 306*, 401*
Statistics ($n = 2$)	Sta 309, 326

**Courses were added in Year 2.*

completed Level 1 and 2 certification requirements before they qualify to participate in Level 3 certification activities. Increasing one certification level typically takes an entire school year.

> **CRLA Certification**
>
> **Level 1 (Certified Tutor)**- Learn tutoring responsibilities and tips for working with students
>
> **Level 2 (Certified Advanced Tutor)**- Learn about asking probing questions and cultural awareness
>
> **Level 3 (Certified Master Tutor)**- Learn how to deal with specific populations and how to train and supervise other tutors

Thirty-eight tutors were recruited to provide academic support to students in Year 1 of the grant. Of these students, 16 tutors (42%) attained the desired level of certification. This fell below the goal of 90% of tutors obtaining this certification.

In Year 2 of the program, state-wide budget cuts did not allow training for CRLA certification training to be funded for the entire academic year. Thus, of the 29 tutors who provided academic support to students, only 11 (38%) reached Level 3 certification in Year 2. Therefore, the original goal of having 90% of tutors achieve Level 3 certification was not achieved. Given that intensive training is provided for all levels of the certification program, it may be beneficial to analyze how many tutors completed any level of training, not just Level 3. Data indicate that all tutors in Years 1 and 2 of the grant gained at least their Level 1 CRLA level. Thus, the goal of having trained tutors was achieved.

Performance Measure 6.d. Increase in GPA of RCC STEM transfer students using MaSH services.

The purpose of expanding tutoring services for Hispanic and low-income students was to increase their Grade Point Average (GPA). In Year 1, for those RCC STEM transfer students receiving MaSH tutoring services (n = 10), GPA was calculated for the Fall 2008, Winter 2009, and Spring 2009 quarters. The change in GPA between quarters indicates a drop in average GPA of .38 over this period, while the comparison group (i.e., non-RCC STEM transfer students receiving tutoring) had a drop of .13. Therefore, the goal of increasing GPA for this group of students was not met.

In Year 2, more students were targeted, and consequently utilized MaSH services (n = 16 in Year 2 as compared to n = 10 in Year 1). Data show that there was a drop in average GPA for students who utilized MaSH services and those that did not. Specifically, there was a .02 average drop in GPA between the Fall 2009, Winter 2010, and Spring 2010 quarters for both groups of people. Once again, the goal of increasing GPA for this group of students was not met. Given the small number of students in the target group that took advantage of MaSH services in both years of the grant, it is apparent that this is a highly selective group that is not performing at a desired level. Given the nature of this self-selected group, we do not feel that these GPA data are a fair representation of impact of tutoring services.

Performance Measure 6.e. Percentage of tutoring encounters that result in a positive attitude towards MaSH services.

Students receiving MaSH tutoring services are expected to derive knowledge from these sessions as well as provide satisfaction with these services. After every tutoring session, students are expected to provide feedback about their experiences, including open-ended responses. These open-ended responses from students were analyzed and coded as positive, negative, or other. Positive comments focused on having access to knowledgeable and patient tutors while negative comments mostly focused on the lack of tutors available during business hours. "Other" comments mostly included words such as "none" or suggestions on adding a printing station.

> **Student Comments Related to MaSH Tutoring**
>
> *"EXCELLENT!!! They've really helped understand not just the problems, but the ideas behind them."*
>
> *"Great job, very clear explanation given by tutor."*
>
> *"Very friendly and helpful. I'm thankful that these services are available to students. Will come back more often! Thank you!!!"*

In Year 1, of the 1487 total comments, 1295 (87%) were determined to indicate positive attitudes toward MaSH services. These results surpass the goal of having 75% of comments indicating positive towards MaSH tutoring services.

In Year 2, there were 2,581 total comments. Of these, 2,284 (88%) were positive, 275 (11%) were negative, and 22 (1%) were categorized as "other." The most frequent negative comments mentioned the hours of the center. Specifically, students expressed a need for having the center open past 6pm. Additionally, many students mentioned having a current tutor schedule posted on the door of the tutoring center. Finally, students mentioned the need for a community printer and more computers to access online homework assignments during tutoring sessions. Despite having some negative comments, participant comments were overwhelmingly positive. Students consistently mentioned how much they liked their tutor and the benefits of their tutoring session.

Performance Measure 6.f. Increase in number of units (per quarter) completed towards degree for RCC STEM transfer students participating in MaSH services compared to non-participants.

In Year 1 of the grant, units completed during the Fall 2008, Winter 2009, and Spring 2009 quarters were compared for RCC STEM transfer students using MaSH tutoring services and those not using MaSH services. The average number of units taken during this period for both groups of students was compared. Data indicated that the ten students using MaSH tutoring services had fewer average units per quarter (10 as compared to 11) by spring 2009 than those not participating in tutoring. Thus, the goal of increase in number of units taken by students using tutoring services versus those not using these services was not met.

In Year 2, average units completed in the Fall 2009, Winter 2010, and Spring 2010 quarters were compared for students who did and did not utilize MaSH services. Data showed that the 16 students who used MaSH services took the same number of units on average per quarter as compared to students who did not use MaSH services. Specifically, both groups of students completed 11 units on average per quarter. Thus, the goal of having students utilizing MaSH services completing more units than those who did not use MaSH services was not reached. Again, we believe this represents a small number of a highly selective group of low-performing students. Thus, comparisons about units completed should be interpreted with caution.

Performance Measure 7.a. Increase in number of workshops beyond the introductory level.

While MaSH tutoring services are provided through the College of Science, additional services are provided via the Maximizing Engineering Program (MEP) in the College of Engineering. MEP has allowed the CPP College of Engineering to become the largest program in California enrolling underrepresented minority engineers. MEP is a retention and academic enhancement program that builds a collaborative learning community among students and establishes a mentor-protégé relationship between students, faculty, and alumni. The *STEM Pipeline Project* sought to expand MEP by recruiting additional student mentors as well as increasing the number of Academic Excellence Workshops (AEWs) that target courses beyond the introductory level to assist transfer students.

During Year 1 of the grant period, four AEWs relating to upper-division courses were offered (see Figure 3). Two workshops took place in winter 2009 (Chem 312 and Mte 208) and two were provided in spring 2009 (Chem 304 and Mte 208). During Year 2, 41 AEWs beyond the introductory level were offered, which included courses in Chemistry, Physics, Math, and Engineering). Thus, the goal of providing more AEWs beyond the introductory level was achieved.

Performance Measure 7.b. Percentage of RCC STEM transfer students participating in workshops.

In Year 1, of the 56 students identified as RCC STEM transfer students, 43 were enrolled in the College of Engineering. Five percent (*n* = 2) of RCC STEM engineering transfer students participated in MEP workshops. In total, 21% of RCC STEM transfer students used either MaSH or MEP services in Year 1. This fell below the goal of 25% of RCC STEM transfer students using MaSH tutoring or MEP services.

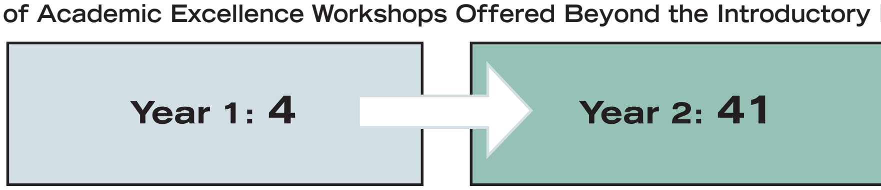
In Year 2, 28 (70%) of 40 RCC STEM transfer students were enrolled in the College of Engineering. Only one (1%) of these students participated in MEP workshops. Overall, 14% of RCC STEM Transfer students used either MaSH or MEP services in Year 2. This fell below the goal of 25% of RCC STEM transfer students using MaSH or MEP services. Once again, it is important to interpret these results with caution given the low number of students participating in program activities.

Performance Measure 7.c. Increase in GPA of RCC STEM transfer students participating in workshops.

An additional goal of the grant was to increase the GPA of students participating in MEP workshops. In Year 1, GPAs were calculated for the Fall 2008, Winter 2009, and Spring 2009 quarters for those RCC STEM transfer students participating in MEP workshops. The change in GPA between quarters indicates a drop in average GPA of .37 over this period, while the comparison group dropped an average of .13. Therefore, the goal of increasing GPA for this group of students was not met. Given the small number of students in the target group that took advantage of MEP workshops in Year 1 (*n* = 2), it is apparent that this is a highly selective group that is not performing at a high level.

In Year 2, only one student participated in MEP workshops. Given this small number, it is inappropriate to make comparisons in GPA for students utilizing these services as compared to those who did not. Once again, given the nature of this self-selected group, we do not feel that these GPA data are a fair representation of impact of MEP workshops.

Figure 3. Number of Academic Excellence Workshops Offered Beyond the Introductory Level



Performance Measure 7.d. Increase in number of units completed towards degree for RCC STEM transfer students participating in workshops compared to non-students.

Another purpose of these workshops was to increase the number of units completed towards a degree for target students who participated in workshops versus non-participating students. In Year 1, units completed during the Fall 2008, Winter 2009, and Spring 2009 quarters were compared for RCC STEM transfer students attending MEP workshops and those not attending. The average number of units taken during this period for both groups of students was compared. Data indicated that the two students attending MEP workshops had a greater number of units per quarter on average (1.3 units) by spring 2009 than those not participating in the workshops. However, the goal of a two unit increase was not met.

As indicated, only one student participated in MEP workshops in Year 2. Once again, it is inappropriate to make comparisons between the number of units completed for these students versus those who did not utilize MEP services. It is important to note that MEP workshops are provided for specific courses. Thus, only students enrolled in these courses are able to participate in MEP workshops. Although only one RCC STEM transfer student participated in MEP workshops, it is possible that this is the only student who was enrolled in a course offering a workshop. Thus, it is unfair to expect that all transfer students would be able to participate in these workshops.

Equipment Upgrades

Along with increased tutoring support, Component V sought to provide upgraded technology for students in the College of Science and College of Engineering. This is essential because students can best be prepared for jobs of the future by becoming trained in the latest technology today. Enthusiasm for lab exercises for both students and faculty can increase with equipment and software upgrades, leading to increased engagement within the academic discipline. In turn, increased student involvement can lead to higher retention and, ultimately, to greater career success.

Table 26. Equipment Purchased for College of Engineering

Equipment	Unit Price	Quantity	Total Price	Reason not purchased
Biodiesel Kit	$6,000	1	$6,000	
ProScope	$280	10	$2,800	
Robotic Lego Kits with Laptop	$2,700	20	$54,000	
Surface Area (BET) Measurement Machine	$40,000	1	$40,000	
Ultra-Sonic Cleaners (new budget item)	$1,100	2	$2,200	
Function generators	$30,000	1	$30,000	
Survey Stations	$29,945	6	$29,945	
3D Scanners		**		Purchased by Aerospace Engineering department
CO_2 Sensors		**		Donated by industry
Contact Angle Measurement Machine		**		Will share with Chemistry department
Fiber Optic pH Sensors		**		Will share with Chemistry department
Rapid Prototyping Machine		**		Purchased by Aerospace Engineering department
Spin Coater		**		No longer being purchased
Total			**$164,945**	

***Equipment is no longer being purchased as part of the grant.*

Performance Measure 8.a. Percentage of equipment purchased for EGR 100L (unit is equipment type) by the end of second year of grant.

In an effort to mirror equipment used in industry and research institutions, equipment items were selected to bolster the experience in EGR 100L classes, the First Year Experience sequence. The list was then modified partway through the first year to better accommodate needs of the students. Approximately 40% of equipment was purchased in Year 1 of the grant. The remainder of the equipment (100%) was purchased for the College of Engineering in Year 2 of the grant (see Table 26).

Performance Measure 8.b. Percentage of EGR 100L classes using new equipment.

Due to the timing of equipment purchases and delivery, none of the equipment was used in the EGR 100L sequence in Year 1. However, the equipment was used in senior design projects, where 12 students were able to utilize the Surface Area (BET) Measurement Machine and Ultra-Sonic Cleaners. A survey assessing usage and satisfaction with the equipment was disseminated to faculty in the College of Engineering. Although three surveys were returned, only one faculty member indicated using the equipment during the first grant year. For this faculty member, the new equipment not only improved their ability to teach the material and the students' ability to learn, but also enhanced the enjoyment felt by both students and faculty.

In Year 2, the remainder of the equipment for the College of Engineering was purchased and utilized. Faculty members were once again surveyed about equipment use and satisfaction and three surveys were returned. All three faculty members indicated using equipment. Faculty members were asked to indicate the courses in which they utilized the new equipment and the approximate number of students enrolled in those courses. Data showed that faculty used equipment purchased by the CCRAA grant for 21 courses throughout the second year of the grant. They approximated that 192 students were enrolled in these courses and had access to the equipment.

In fall 2009, two sections of EGR 100L were offered. Survey responses indicated that new equipment was used in both of these sections (therefore the goal of having 100% of EGR 100L classes using new equipment was met). In winter 2010, six sections of EGR 100L were offered. Most of the professors teaching the courses did not complete the survey. One professor who did complete the survey indicated using equipment within her EGR 100L course. Finally, three sections of the course were offered during spring 2010. None of the professors teaching the course completed the survey. Based on completed surveys, data indicate that new equipment was used in 100% of EGR 100L courses and the grant goal was met.

The three faculty members who completed the survey were asked to indicate their agreement with questions about teaching at CPP and experiences with the new equipment (see Table 27). Questions on the survey were answered on a 5-point scale, where 1 = strongly disagree and 5 = strongly agree. Responses to the survey suggested that the new equipment not only improved faculty members ability to teach the material (mean = 5.00), and the students' ability to learn (mean = 5.00), but also enhanced the enjoyment felt by both students (mean = 4.67) and faculty (mean = 4.33). The extremely positive results indicate that faculty members enjoyed using the new equipment, believed it to benefit their own teaching, as well as improve students' learning.

Table 27. Equipment Satisfaction for the College of Engineering (*N* = 3)*

Question	Mean Score *(SD)*
The new equipment purchased with grant funding has improved my ability to teach my course(s).	5.00 (.00)
After using the new equipment/software I enjoy teaching my courses more than I did previously.	4.33 (.58)
The content of what I teach in my courses has changed after using the new equipment.	4.67 (.58)
The manner in which I teach or the structure of my course(s) has changed after using the new equipment/software.	4.00 (1.73)
I enjoy teaching more after using the new equipment/software.	4.33 (.58)
In comparison to previous quarters, my students seem to enjoy the course more after using the new equipment/software.	4.67 (.58)
My students' learning has been enhanced in some way after using the new equipment/software in the course.	5.00 (.00)

Scale: 1 = Strongly Disagree, 5 = Strongly Agree

Performance Measure 8.c. Percentage of equipment (unit is equipment type) purchased for upper-division Science classes by the end of the second year of grant.

In addition to upgrading equipment for the College of Engineering, equipment and software were purchased to enhance the learn-by-doing experience within the College of Science. The purpose of upgrading the College of Science equipment was to improve the quality of upper-division lab courses. For example, microscope cameras for the Biology department would allow students to create their own digital images of what they see in the microscope. Consequently, this would enhance student learning and enjoyment of the course. Upgrades for the Chemistry department would modernize the Analytical Chemistry Sequence (CHM 342, 343, 344), a series of courses which is vital in the preparation and marketability of students as they prepare to enter the analytical chemistry industry. The Geological Sciences equipment would be used in multiple upper-division Geology and Integrated Earth Studies courses (e.g., Natural Disasters, Engineering Geology, etc.) and would augment student learning in these courses. Although approximately 1,200 upper-division students per year use the Mathematics and Statistics computer lab, the current facilities are outdated and technology upgrades were greatly needed to train STEM students in state-of-the art basic and applied mathematics and statistics. The new computer setups would assist in this effort. Finally, the physics software and equipment upgrades would allow students to work with equipment currently used in the industry, and therefore, better prepare them for their careers.

As with the engineering equipment, the purchase list for the College of Science was modified partway through the first year to better accommodate the needs of students and faculty. Approximately 46% of the equipment was purchased in Year 1 of the grant. All (100%) of the equipment was purchased by Year 2 of the grant. A summary of the equipment purchases for the College of Science is provided in Table 28.

Table 28. Equipment Purchased for College of Science

Department	Equipment	Unit Price	Quantity	Total Price
Biological Sciences	Digital Microscope Camera	$3,000	12	$36,000
	Inverted Microscope	$3,200	3	$9,600
	Microfuge	$810	4	$3,240
	Centrifuge	$1,667	1	$1,667
	High definition televisions	$849	2	$1,698
Chemistry	Static Mercury Dropping Electrode	$9,900	1	$9,900
	Electrochemical Analyzer	$20,000	1	$20,000
	LS 55 Flurorescence Instrument	$20,200	1	$20,200
Geological Sciences	Seismic Refraction Equipment	$28,500	1	$28,500
	Portable Digital Surveying Equipment	$23,000	1	$23,000
Math and Statistics	iMac Computer	$1,300	5	$6,500
	Matlab License	$450	1	$450
	Dell OptiPlex 755 Computer	$900	25	$22,500
	Dell Precision Workstation T7400		**	
	Maple License		**	
Physics	GPIB Controller for USB-HS Port	$570	8	$4,560
	LabVIEW Core Software	$4,950	1	$4,950
	Model 2000 Precision Digital Multimeter	$1,200	8	$9,600
	Shielded 1-meter Cable	$90	20	$1,800
	MK-2 Component Set		**	
	MK-6 Manual Positioning Set		**	
Total				**$204,165**

***Equipment is no longer being purchased as part of the grant.*

Table 29. Satisfaction with Equipment for the College of Science*

	Year 1 (2008-2009) *N* = 7	Year 1 (2009-2010) *N* = 26
	Mean Score *(SD)*	Mean Score *(SD)*
The new equipment purchased with grant funding has improved my ability to teach my course(s).	4.57 (.53)	4.58 (.65)
After using the new equipment/software I enjoy teaching my courses more than I did previously.	3.86 (1.21)	4.04 (1.15)
The content of what I teach in my courses has changed after using the new equipment.	3.71 (1.38)	3.70 (1.11)
The manner in which I teach or the structure of my course(s) has changed after using the new equipment/software.	3.86 (1.07)	3.74 (.86)
I enjoy teaching more after using the new equipment/software.	4.00 (1.00)	4.09 (1.04)
In comparison to previous quarters, my students seem to enjoy the course more after using the new equipment/software.	4.14 (.90)	4.15 (.81)
My students' learning has been enhanced in some way after using the new equipment/software in the course.	4.29 (.49)	4.50 (.67)

**Scale: 1 = Strongly Disagree; 5 = Strongly Agree*

Faculty members were surveyed at the end of Years 1 and 2 to gain insight into the impact of new equipment on teaching for instructors and on learning for students (see Table 29). Seven faculty members completed the survey in Year 1 and 26 faculty members completed the survey in Year 2.

Questions were answered on a 5-point scale, where 1 = strongly disagree and 5 = strongly agree. Similar to Year 1, results indicated that, on average, instructors agreed that the state-of-the-art equipment improved their ability to teach course material (mean = 4.58) and, consequently, enhanced students' learning (mean = 4.50) in Year 2. Instructors enjoyed teaching more after using the new equipment (mean = 4.09) and also believed their students enjoyed the course more after using this equipment (mean = 4.15).

> *[The new] microscopes replaced the old ones with 30+ years of heavy usage. Prior to the replacement, students often had problems obtaining clear and focused images due the heavy wearing of the lenses and problems with the alignment. Toward the end of each quarter, we would have approximately 6-10 microscopes that were out of work and required repairs by a microscope specialist. With the new microscopes, we have not reported any major problem. The new microscopes are very easy to use and students can easily focus and find the structure. They have made the teaching much more efficient and enjoyable.*
>
> **–Professor of Science**

Performance Measure 8.d. Percentage of RCC STEM transfer students using new equipment in at least one course and Performance Measure 8.e. Percentage of RCC STEM transfer students who use enhanced equipment displaying satisfaction/ improved attitude toward STEM disciplines.

In spring 2010, all RCC STEM transfer students who enrolled at CPP between 2007-2010 (*N* = 144) were asked to complete an online survey about equipment use in their courses. Of the 144 students, only 18 (13%) completed the survey. Of these 18 students, 12 (67%) stated that they took a course that included new equipment. However, only one (8%) of these students indicated using the equipment. Given the low response rate, it is not possible to understand whether students utilized new equipment in their courses and their satisfaction with this equipment. It is important to note, however, that the lack of response does not indicate that students did not use equipment. It is possible that the 12 students who took a course with new equipment took the course before the new equipment was in place, did not know it was new, or did not recognize the equipment. This may help explain why they did not indicate using it. Data from faculty surveys indicate that more than 800 students had access to the new equipment and had the opportunity to use them. It is expected that student responses would have been more positive if faculty handed out surveys to the students in class so that students would have recognized the particular equipment items in question (as opposed to an online survey which could be completed outside of class time). Student surveys about equipment use and satisfaction will be collected once again in Year 3 to answer these performance measures.

Research Apprenticeships

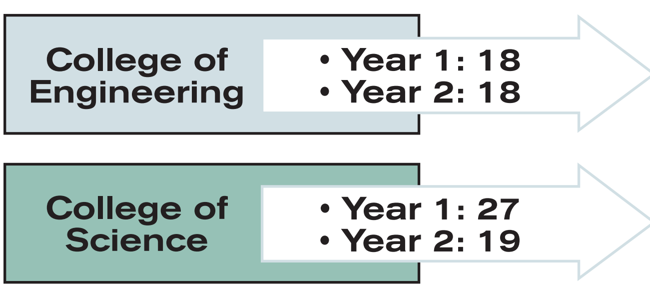
In addition to being engaged in the classroom and excelling academically, students need to actively engage with the scientific process to succeed in STEM careers and pursue advanced degrees. Undergraduate research is perhaps one of the best-known vehicles for exposing students to the scientific process and retaining underrepresented students in the STEM disciplines. The *STEM Pipeline Project* sought to enhance students' quantitative, technological, and communication skills while boosting their confidence in designing experiments. Involving students in the larger research community will hopefully impact future success of Hispanic and low-income students.

Performance Measure 9.a. Number of students participating in research apprenticeships.

The *STEM Pipeline Project* set out to recruit 20 students to participate in the undergraduate research program by providing opportunities in their STEM discipline and other professional development activities. Apprenticeships generally lasted for one year and students received a stipend of $1,350 per quarter for their participation.

In Year 1 of the grant, 45 students participated in the program: 18 students (40%) from the College of Engineering and 27 students (60%) from the College of Science (see Figure 4). This number was twice that of the planned number of apprentices. In Year 2 of the grant, 37 unique students once again participated in the program (seven of these students continued their apprenticeships through the summer): 18 (49%) from the College of Engineering and 19 (51%) from the College of Science. Once again, the goal for this performance measure was met.

Figure 4. Students Participating in Research Apprentice Program



The research apprentices conducted research in their particular STEM discipline with their research advisor. They also attended group meetings, workshops, and presented their research at an on-campus or regional conference. Several faculty members presented research-oriented presentations to the research apprentices, including those from Chemistry, Physics, Biology, Applied Math, and Engineering. Students and faculty who attended these presentations completed an online survey about their experience. Fourteen students and seven faculty members responded to the survey. Most respondents (43%) attended between 6-9 seminars. When asked to indicate their reasons for attending, the majority (71%) stated the main reason they attended was because "the talks seemed interesting." For the 12 students who gave an "elevator talk," most found it very useful (50%) or somewhat useful (42%). One student explained that "the elevator talk was a great way to prepare a short, generalized speech to a non-professional. The brevity forced us to focus on the most important aspects of our research and cut out any unnecessary fluff." Finally, participants were asked to indicate what type of presentations they wanted more of in the future. Results indicated that the majority of participants wanted to hear more from professors talking about what they do in their research groups (56%) as well as more elevator talks by students (50%). They believed there were the right number of longer talks by students, professors talking about their general field of research, and professors talking about research skills. One student stated that "I liked professors talking about their general fields of research because it helped me gain a better idea of the research going on at Cal Poly and it made me feel more connected to the Cal Poly research community as a whole." These results indicate that students and faculty who attended these seminars found them useful and interesting.

Performance Measure 9.b. Percentage of students who indicate an intention to pursue an advanced degree in a STEM discipline.

In Year 2, a pre-test and post-test was administered to all research apprentices (these surveys were not administered in Year 1 of the program). Although there were 37 unique apprentices, some students continued their apprenticeship through the summer. Thus, 44 surveys could be completed. Overall, 38 surveys were completed (86%). In addition, a focus group with seven apprentices was conducted in spring 2010. The majority of students (78%) who participated in the Research Apprentice Program were seniors in college. Most of the participants were Asian (34%), Hispanic (24%), or Caucasian (24%). Apprentices were nearly equally distributed in the College of Science (58%) and College of Engineering (42%). See Table 30 for more information about student demographics.

Upon completion of their research, students were asked to share their opinions and experiences in the Research Apprentice Program. Survey questions were answered on a 5-point scale, where 1 = strongly disagree and 5 = strongly agree. Upon completing the program, students indicated increased confidence in their ability to design experiments. They also believed the program helped them develop stronger quantitative research skills, technical skills, and communication skills (see Table 31).

Increased communication and presentation skills were also a topic discussed during the focus group. For example,

Table 30. Research Apprentice Demographics (*N* = 38)

		n	%
Class Level	Junior	8	21.1
	Senior	30	78.9
	Asian	13	34.2
	Caucasian	9	23.7
	Hispanic	9	23.7
	Multiple Ethnicities	4	10.5
	Other	3	7.9
Major*	Mathematics	3	7.9
	Physics	4	10.5
	Engineering	17	44.7
	Biotechnology	6	15.8
	Biology	4	10.5
	Other	6	15.8
College	College of Science	22	57.9
	College of Engineering	16	42.1

** Note that participants were allowed to mark multiple responses. Thus, the total number of responses is greater than the number of participants.*

one student stated that he *"learned how to share [research with] people in different levels - lay people and scientists."* Additionally, many focus group participants reported gaining experience dealing with commonly cited issues in professional research, including budget constraints, lack of appropriate materials or equipment, and time management. However, this was considered positive because *"navigating through some of the roadblocks that I encountered gave me some valuable experience."* Students explained that learning how to solve issues would eventually be beneficial as they continued conducting research.

In addition to gaining confidence and learning specific skills, the Research Apprentice Program had a positive impact on the participants' attitude towards their academic experience. On average, research apprentices had an increased understanding of various STEM disciplines (*M* = 3.55, *SD* = 1.41) and made them feel like a member of the research community (*M* = 4.32, *SD* = 1.04). Students prior to Summer 2010 answered questions about their agreement with statements regarding if they believed their courses prepared and taught them concepts necessary for their research apprentice experience, and in turn, the experience increased their understanding of those concepts (see Table 32).

Similar to the positive experiences indicated in the survey, focus group participants also explained that they had a positive experience through the Research Apprentice Program. For example, several students described positive experiences interacting with the research community through attending conferences and seminars by researchers in their respective fields. These professional networking opportunities were often stated as the most valuable aspect of the apprentice position. One student stated that *"hanging around with people in the seminars, the people in my labs and the conference, and seeing people that had gone that route was really inspiring. I want to be like them and I wouldn't have met all these people if it wasn't for this program."* These interactions also provided research apprentices with professional contacts for future research experiences and professional positions. For example, one student explained that *"You have the contact information, so once you graduate you have someone to go and ask for a job or an internship."*

Table 31. Student Survey Results*

Question	Mean Score *(SD)*
The Research Apprentice Program has increased my confidence in my ability to design experiments.	4.21 (1.07)
The Research Apprentice Program has allowed me to develop stronger quantitative research skills.	4.24 (1.29)
The Research Apprentice Program has allowed me to develop stronger technical skills.	4.24 (1.30)
The Research Apprentice Program has allowed me to develop stronger communication skills.	4.29 (1.18)

Scale: 1 = Strongly Disagree, 5 = Strongly Agree

Table 32. Research Apprentice Experience Survey Results

Question	Mean Score *(SD)*
The Research Apprentice Program has given me a better understanding of similarities and differences between the various STEM disciplines.	3.85 (.88)
The Research Apprentice Program has made me feel like a member of a larger research community.	4.50 (.80)
The Research Apprentice Program has helped me better understand concepts presented in courses I've taken.*	4.55 (.69)
My courses have prepared me for my research apprentice experience.*	4.18 (.80)
I was able to apply concepts I learned in my classes to the research apprentice experience.*	4.4 (.80)
I would probably do a research internship even without funding from the CCRAA Research Apprentice Program.**	3.73 (1.44)

Scale: 1 = Strongly Disagree; 5 = Strongly Agree

** = This question was only asked of students prior to Summer 2010*
*** = This question was only asked of students in Summer 2010*

Research apprentices believed that their experience at CPP was strengthened through the program and strongly agree that they have a better idea of their career goals (see Table 33). Students also believed that they would have participated in research without help of the Research Apprentice Program. However, the program offered them both a level of credibility when approaching potential research opportunities and the financial means necessary to devote time to research as opposed to other employment. This was evident when one student explained that *"with the program and the main advisor, it was easy to get a lot more credibility to [approach] research advisors and companies. I would have had no support before."*

Research apprentices also reported strong positive experiences with their research advisors. Focus group participants found that their advisors became research mentors, as well as provided guidance in other areas of their education and personal lives. One student stated that *"I am still learning a lot from my professor but the bigger thing is that I got to demonstrate that I am capable of doing all these things to someone who can point me in the right direction and provide references."* Another student remarked that *"It was a great experience for me because he is more than just an advisor to me, he is a mentor. He took me in and kept me under his wing for the longest time. It is definitely a strong bond."*

When asked how often they met with their research advisor, the majority of students ($n = 20$; 87%) reported that they met weekly, one met daily, one met monthly, and only one student stated that he met with his advisor one time. Many students also indicated that they were authors on papers that were either in press ($n = 2$; 9%) or that were in preparation ($n = 12$; 52%).

After completing the Research Apprentice Program, participants were asked to indicate how likely they were to attend graduate school or medical school, as well as whether they planned to conduct research outside of academia or perform work unrelated to research. Results indicated that most students ($n = 33$, 80%)[1] thought it likely or highly likely that they would attend graduate school after graduation. In contrast, only ($n = 6$, 15%) thought it was likely or highly likely that they would attend medical school. After participating in the Research Apprentice Program, 33 (80%) believed that they would conduct research outside of academia upon graduation and 26 (63%) thought they would perform work unrelated to research when they graduated. Thus, the goal of having 35% of apprentices intend to pursue an advanced degree in a STEM discipline was met.

Attending graduate school was a theme that was reiterated in the focus group where the majority of students reported planning to further their education. For example, one student stated that *"We have the potential to certainly learn a lot of things that you wouldn't have the opportunity to do if you did not pursue graduate school. This program kind of solidified that for me."* Interactions with current graduate students through seminars and conference participations provided apprentices with a better understanding of both the personal and professional lives of students who pursue further education. These experiences helped them determine whether

Table 33. Research Apprentice Satisfaction Survey Results*

Question	Mean Score *(SD)*
I was able to apply concepts I learned in my classes to the research apprentice experience.	4.35 (.78)
This research apprentice experience strengthened my overall learning experience at Cal Poly Pomona.	4.73 (.55)
Completing the research apprentice experience has provided me with a better idea of my career goals.	4.73 (.63)
Overall, I am satisfied with my research apprentice experience.	4.82 (.50)

Scale: 1 = Strongly Disagree; 5 = Strongly Agree

** = These questions were only asked of participants prior to Summer 2010* graduate school would be their next step. For example, one student explained that *"In the seminars we had the chance to get really personal with the PhD students and even ask them about their personal lives… you have that role model to look toward."*

Performance Measure 9.c. Percentage of students who give on-campus or regional presentations of their research projects.

As part of the research apprentice program, students were required to present their research projects at either a local on-campus conference or regional conference. In Year 1 of the grant, 38 of 45 (84%) presented their research at an on-campus student research conference or a regional research conference. This included 12 of 18 (67%) apprentices from the College of Engineering and 26 of 27 (96%) apprentices from the College of Science.

Student Success

Students participating in The CCRAA Research Apprenticeship Program along with students working on their 2009-2010 senior project and a research volunteer tied for third place in a student design competition at the 8th International System-on-Chip (SoC) Conference held in Irvine, CA for their work on a the development of a *High Speed, Low Power Readout Integrated Circuit Operating in Burst Mode for Infrared Imaging*.

2 research apprentices published research papers with their advisors during Year 2. 12 additional students are currently working on submitting a paper for publication with their advisor.

In Year 2, 33 (89%) of the 37 students presented their research at an on-campus student research conference or a regional research conference (see Table 34). It is important to note, however, that some research apprentices will continue on through Year 3 and will have additional opportunities to present their research projects at conferences at that time. Thus, the goal of having 95% of apprentices present their research projects was not reached.

When asked about whether the program met their expectations, students strongly agreed that they had positive experiences with the Research Apprentice Program. The opportunity to interact with members of the research community provided insight and experience with the world of academic research, and increased confidence and ability to pursue research as a career. Results from the survey and focus group indicate that, overall, students were very satisfied with their experience with the Research Apprentice Program.

Key Findings: Component V Summary

There were three major areas in Component V. The first was providing tutoring for students via the MaSH program and MEP workshops. Only a few RCC STEM transfer students utilized MaSH or MEP services. However, those that utilized these services reported positive experiences with these services. Given the small number of students who participated, it was inappropriate to make comparisons about GPA or unit changes for students using these services versus students who did not use these services.

The second major component to Component V was to provide upgraded equipment and technology for the Colleges of Engineering and Science. One-hundred percent of the equipment was purchased for the Colleges of Engineering and Science. Based on completed faculty surveys, it can be inferred that 100% of new equipment was used in EGR 100L courses and the grant goal was met. Faculty surveys indicate positive attitudes towards teaching and student learning after using the new equipment. It is unclear at this time whether students used and were satisfied with equipment due to low survey response rates.

The last component of Component V was to provide opportunities for students to participate in research apprenticeships with faculty members. There were 37 unique students who held research positions, thereby greatly surpassing the goal of 20 students participating in this program. Many of these students indicated an intention to purse an advanced degree in a STEM discipline during a post-test. Finally, it was hoped that 95% of these students would present their research at a local on-campus or regional conference. Overall, 89% of students who participated in the research apprentice program during the fall-summer quarters presented their research at a conference.

Table 34. Research Presentations*

	n	%
On-campus student research event	14	61%
Off-campus professional regional meeting	15	65%
Off-campus professional national meeting	8	35%
Other	6	26%

** Note that participants were allowed to mark multiple responses. Thus, the total number of responses is greater than the number of participants.*

[1]A subsample of research apprentices who began their work in summer 2010 also completed a pre-test survey. We compared pre-test and post-test responses to determine if their attitudes would shift during their apprenticeship. Although it appears that there may be a slight change in their likelihood to attend graduate school (92% at pre-test in comparison to 87% at post-test), this change is not significantly different. Therefore, only post-test data are reported.

Key Findings

	Performance Measure	Goal	Year 1	Year 2
Component V.1: Expand MaSH Tutoring Services	**Performance Measure 6.a.** Percentage of RCC STEM transfer students using MaSH or MEP services.	25% of RCC STEM transfer students will use MaSH or MEP services	21% of RCC STEM transfer students used MaSH or MEP services	14% of RCC STEM transfer students used MaSH or MEP services
	Performance Measure 6.b. Increase in number of new courses beyond the introductory level with trained tutors.	Provide tutoring for 13 new courses beyond introductory level with trained tutors	Tutoring was provided for 41 new courses	Tutoring was provided for total of 42 courses
	Performance Measure 6.c. Percentage of MaSH tutors tutoring classes beyond the introductory level with CRLA Level 3 certification.	90% of MaSH tutors will have CRLA Level 3 certification	42% of tutors had Level 3 certification	38% of tutors had Level 3 certification
	Performance Measure 6.d. Increase in GPA of RCC STEM transfer students using MaSH services.	10% increase in GPA of RCC STEM transfer students using MaSH services	There was a .38 average drop in GPA for those 10 students who utilized MaSH services	There was a .02 average drop in GPA for those 16 students who utilized MaSH services
	Performance Measure 6.e. Percentage of tutoring encounters that result in a positive attitude towards MaSH services.	75% of tutoring encounters will result in a positive attitude towards MaSH services	87% of comments indicated positive attitudes towards MaSH services	88% of comments indicated positive attitudes towards MaSH services
	Performance Measure 6.f. Increase in number of units (per quarter) completed towards degree for RCC STEM transfer students participating in MaSH services compared to non-participants.	Increase in two units (per quarter) completed towards degree for RCC STEM transfer students participating in MaSH services compared to non-participants	Students using MaSH services had one less unit completed per quarter on average than those not using these services	Students using MaSH services completed the same amount of units per quarter on average as those not using these services

	Performance Measure	Goal	Year 1	Year 2
Component V.2: Expand MEP Academic Excellence Workshops	**Performance Measure 7.a.** Increase in number of workshops beyond the introductory level.	Specific goal not provided	4 MEP workshops provided	41 MEP workshops provided
	Performance Measure 7.b. Percentage of RCC STEM transfer students participating in workshops.	25% of RCC STEM transfer students will participate in workshops	5% of RCC STEM transfer students used MEP services	1% of RCC STEM transfer students used MEP services
	Performance Measure 7.c. Increase in GPA of RCC STEM transfer students participating in workshops.	10% increase in GPA of RCC STEM transfer students participating in workshops	There was a .37 average drop in GPA for those 2 students who attended MEP workshops	Did not calculate GPA for the one student who attended MEP workshops
	Performance Measure 7.d. Increase in number of units completed towards degree for RCC STEM transfer students participating in workshops compared to non-students.	Increase in two units completed towards degree for RCC STEM transfer students participating in workshops compared to non-participants	The two students who attended workshops completed 1.3 units more per quarter on average than those not attending workshops	Did not make unit comparisons for the one student who attended MEP workshops

	Performance Measure	Goal	Year 1	Year 2
Component V.3: Increase Equipment for Student Use at Cal Poly Pomona	**Performance Measure 8.a.** Percentage of equipment purchased for EGR 100L (unit is equipment type) by the end of second year of grant.	100% of equipment will be purchased for EGR 100L (unit is equipment type)	40% of equipment was purchased by the end of the year	100% of equipment purchased by the end of the year
	Performance Measure 8.b. Percentage of EGR 100L classes using new equipment.	100% of EGR 100L classes will use new equipment	Was not assessed	100% of EGR 100L classes used new equipment
	Performance Measure 8.c. Percentage of equipment (unit is equipment type) purchased for upper-division Science classes by the end of the second year of grant.	100% of equipment will be purchased for upper division Science classes by the end of second year of grant	46% of equipment was purchased by the end of the year	100% of equipment was purchased by the end of the year
	Performance Measure 8.d. Percentage of RCC STEM transfer students using new equipment in at least one course.	80% of RCC STEM transfer students will use new equipment in at least one course	Was not assessed	8% of RCC STEM transfer students used new equipment in at least one course
	Performance Measure 8.e. Percentage of RCC STEM transfer students who use enhanced equipment displaying satisfaction/improved attitude toward STEM disciplines.	75% of RCC STEM transfer students who use enhanced equipment will indicate satisfaction/ improved attitude toward STEM disciplines	Was not assessed	No RCC STEM transfer students indicated satisfaction/ improved attitude toward STEM disciplines

	Performance Measure	Goal	Year 1	Year 2
Component V.4: Increase the number of undergraduate students participating in STEM Research	**Performance Measure 9.a.** Number of students participating in research apprenticeships.	20 students will serve as research apprenticeships	45 students participated as research apprentices	37 students participated as research apprentices
	Performance Measure 9.b. Percentage of students who indicate an intention to pursue an advanced degree in a STEM discipline.	35% of students will indicate an intention to pursue an advanced degree in a STEM discipline	Was not assessed	89% of students indicated an intention to pursue an advanced degree in a STEM discipline
	Performance Measure 9.c. Percentage of students who give on-campus or regional presentations of their research projects.	95% of students will give on-campus or regional presentations of their research projects	84% of apprentices presented their research at an on-campus or regional conference	89% of apprentices presented their research at an on-campus or regional conference

Conclusions

The primary purpose of the *STEM Pipeline Project* was to provide access to important services that will strengthen the pipeline from high school through graduation from CPP in order to increase retention and graduation of Hispanic and other low-income students in STEM disciplines. It is anticipated that these goals will be accomplished through five distinct, but integrated, components. Transfer students from Riverside Community College (RCC) were specifically targeted for these efforts. It is important to note that although there were few RCC STEM transfer students to service within each component ($n = 56$ in Year 1 and $n = 40$ in Year 2), many program activities provided services to additional STEM students. The following sections describe program activities that were on schedule during Year 2, those that were delayed, and those that need improvement. Overall, many of the goals set for the second grant year were accomplished or were on schedule. Some goals were delayed or need improvement. These areas are currently being reviewed and will be addressed during Year 3 of the grant.

Program Activities on Schedule: All components have made progress in reaching some, if not all, goals set for Year 2 of the grant. For example, Component I held the Summer Professional Development Institute with local high school teachers and students, CPP faculty, and local industry partners. In addition, the STEM Learning Conference was offered twice during the year. Counselors were hired to work with RCC students in preparing them for transfer into a 4-year university (Component II). CPP faculty created all transfer curriculum sheets as well as some online modules (Component III). Faculty from RCC were trained to teach a PLTW Engineering Principles course during summer 2010 for Component IV. The course was offered at RCC in winter 2010. Finally, tutoring for hard-to-pass courses continued to be offered through MaSH and the MEP program, all of the equipment designated for purchase was acquired and installed, and more students than expected participated in a research apprenticeship program for Component V. Thus, much progress was made during Year 2 of the grant.

Delayed Program Activities: Although many of the goals set for Year 2 were accomplished, there were some activities that were delayed due to various reasons. First, the *UDirect* system used to help students develop personal roadmaps for their college career (Component II) was not available for use during the year. Difficulties in the purchase procedure delayed the acquisition and installation of the program. It is expected, however, that the program will be available for students to utilize during Year 3, although it appears doubtful that CPP students will be able to fully use this system for course planning until the end of the third year of the grant. In addition, online modules (Component III) were not fully developed during Year 2. Math and Physics were the only departments that created online modules that were available for student use. They plan to finish developing these modules during Year 3. It is expected that other departments in the Colleges of Science and Engineering will also begin creation of modules and find additional ways to address curricula gaps.

Areas in Need of Improvement: Finally, there were some areas of the program in Year 1 identified as needing improvement. The areas concerned the following:

- **Target RCC STEM Transfer Students:** In Year 1, it was suggested that program components should more specifically target RCC STEM transfer students for program activities. This has been addressed in Year 2 via increased marketing of services to RCC STEM transfer students.
- **Strategic Work between Various Program Components:** In the previous year, it was suggested that communication between different component elements should be improved so activities and program services can be more efficient and effective. Due to fewer meetings between component directors, this area is still in need of further improvement.
- **Completion of Planned Evaluation Activities:** Program evaluation activities were slow to start during the first program year and hence some data were not collected. In the second year, data were collected to be able to address all program questions.

Given the complexity and diversity of the overall program design, the *STEM Pipeline Project* continues to make strides to meet or exceed many of their stated goals. Moving forward, the evaluators will continue to track program implementation in comparison to stated goals, in addition to noting any potential side effects from program participation. Measurement instruments will continue to be designed and revised for the program evaluation. Marketing efforts will also continue in order to ensure all program eligible students are aware of additional resources in terms of tutoring assistance and research opportunities.

Project Next Steps: Aims Year 3

During Year 2, the *STEM Pipeline Project* has continually strived to meet the five program goals and all of the performance objectives reviewed in this report. The grant has been extended to continue for a third year, although not all program components will be offered in their entirety. A summary of the next steps for the *Project* follows.

- **Component 1:** The Summer Professional Development Institute and STEM Learning Conference will not be offered individually. Instead, a hybrid seminar incorporating activities from both conferences will be created. This one-week conference will include presentations and networking opportunities seen in the Learning Conference and Institute, but will not include the internships or lesson plans which were a part of the original Summer Professional Development Institute. Finally, students who participated in the institute will be asked to complete an online survey six months after participation (February 2011). Changes in attitudes and goals relating to the STEM fields will be assessed at that time.
- **Component 2:** As next steps for the *Project*, counseling services will continue to be provided at RCC during Year 3. Data about GPA and units completed for RCC STEM students will be tracked. A Transfer Day specifically for STEM majors will also be offered (as opposed to a general Transfer Day). Finally, the *UDirect* software program will be installed and student implementation will be tracked.
- **Component 3:** Transfer curriculum sheets will be finalized during Year 3. In addition, online course modules will continue to be developed and student usage will be tracked.
- **Component 4:** The Project Lead the Way Engineering Principles course will be offered again at RCC in fall 2010. In addition, a second part of the course series (ENE 5b) will also be offered. Student satisfaction and knowledge derived from this course will be tracked. Satisfaction and awareness of STEM fields will be also be assessed. In addition, seminars by CPP faculty will continue to be provided at RCC. Engineering and Science faculty will be recruited to provide these seminars.
- **Component 5:** Tutoring services through the MaSH program and Academic Excellence Workshops presented through the MEP program will continue to be offered. However, RCC STEM transfer students will be targeted more specifically to participate in these programs during Year 3. Academic data about these students will also be tracked at this time. Student and faculty satisfaction with new equipment will continue to be assessed. Finally, students will continue to be provided an opportunity to participate in the research apprentice program. It is expected that research apprentices will be given a slightly larger stipend in Year 3, but also be allowed to work more hours per week. The increased stipend allows students to decrease work commitments outside of school to more specifically prepare for career-initiating positions and/or graduate programs. Research apprentices' attitudes about STEM disciplines and the research process will be assessed with a pre- and post-test.

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