Board 219: C6-LSAMP - Building Bridges to the Baccalaureate

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Abstract

The *California Central Coast Community College Collaborative* (C6-LSAMP, C6) is a National Science Foundation Louis Stokes Alliances for Minority Participation Bridge to the Baccalaureate grant project (NSF/LSAMP/B2B). C6-LSAMP is an innovative, cross-disciplinary, and multi-institutional collaboration developed by STEM leaders from eight California community colleges. The C6-LSAMP alliance leverages existing support structures and best practices across the member institutions to address inequities in STEM outcomes for a population of students comprised of the underserved: Hispanic/Latinx and other underrepresented minorities (URMs) in rural areas. Within the five counties served by the C6-LSAMP colleges, only 13% of Hispanic/Latinx residents 25 years or older hold a bachelor's degree, compared to 47% of the five counties' White, non-Hispanic population. At C6-LSAMP colleges, Hispanic/Latinx students transfer at a rate of 34% vs. 50% for White students. The success rates in key STEM gateway courses in C6 colleges are typically 13% less for Hispanic students than for White students, despite several prior and existing HSI projects at the individual institutions.

The C6-LSAMP project leverages the power of an alliance to support URM STEM students via three pillars: (1) Research Opportunities: Fall Research Symposium and university and LSAMP partnerships, (2) Academic Support: Embedded Tutors in gateway STEM courses, and (3) Professional Development/Career Exploration for students and for faculty: workshops, mentoring, and networking. Reinforcing each pillar is a commitment to creating culturally sensitive, relevant and responsive learning environments.

This work-in-progress poster will summarize some of the project activities, results, challenges and lessons learned during the first two years of the C6-LSAMP project.

1. Introduction

The California Community College (CCC) system is charged with several missions: granting associate's degrees, preparing students to transfer to four-year institutions, providing career technical education, and hosting life-long learning experiences. With nearly 2 million students in 116 colleges, the CCC system is the largest post-secondary educational system in the United States. Over 20% of community college (CC) students in the United States attend a community college in California. Transfers from CCC to the University of California (UC) system make up 48% of UC bachelor's degrees in STEM [1], but Hispanic/Latinx students are still underrepresented in seven of the nine UC campuses [2]. CCC's have always been ready to address the nation's STEM workforce needs in quantity, quality and diversity.

The *California Central Coast Community College Collaborativ*e (C6-LSAMP, C6), a National Science Foundation Louis Stokes Alliances for Minority Participation Bridge to the Baccalaureate grant project (NSF/LSAMP/B2B), strives to support URM STEM students on their journey to transfer and beyond. C6-LSAMP is the first LSAMP/B2B project in California.

Only 13.4% of Hispanics 25 years or older in the five counties served by C6 colleges have a bachelor's degree or higher, a 33.6% gap compared to C6-counties' White, non-Hispanics (47.0%) [3]. The wide gap confirmed the need for action. The eight C6 partners, after sharing and analyzing STEM data across institutions (for the first time ever), made a commitment to work together to close the gap.

2. C6-LSAMP Alliance

The *California Central Coast Community College Collaborative* (C6-LSAMP, C6) is composed of eight partner colleges: Allan Hancock (AHC, lead), Cabrillo, Cuesta, Monterey Peninsula (MPC), Moorpark, Oxnard, Santa Barbara City (SBCC) and Ventura Colleges. All of the institutions are medium-to-small-sized CCC campuses and Hispanic Serving Institutions (HSI), whose resources and personnel are often stretched to provide effective support for STEM students. The many alliance members allow C6-LSAMP to build on a wide range of experiences, talents and expertise. The initial grant period is August 2021–July 2024.

Figure 1: C6 Counties. Distance from Moorpark College to Cabrillo College by car: 304 miles.

The C6 colleges are on California's Central Coast (Figure 1), in five coastal counties stretching across 350 miles of coastline. Although famed for its robust tourist industry, the economic backbone of the Central Coast is primarily agricultural, with a developing light manufacturing industry. Many students at C6 colleges are children of farm workers and those who work in low-paying manufacturing and service-industry jobs. Many of the parents are immigrants to the United States. The Hispanic/Latinx demographic is by far the largest URM group at each C6 college – outnumbering other URM groups at each college by at least 6-to-1 (and typically more), per data from the California Community College Chancellor's Office (Table 1, [4]). Thus, C6 is primarily focused on increasing the success rates and transfer numbers of Hispanic/Latinx students, most of whom are first-generation college-going students.

Table 1. C6-LSAMP Colleges, Full-time Equivalent Students, Percent URM, Percent Hispanic/Latinx, 2019–20 [4].

Community College	City	County	FTES [a]	%URM [a,b]	%Hisp. [a]
Allan Hancock	Santa Maria	Santa Barbara	9,746	69.8	63.2
Cabrillo	Santa Cruz	Santa Cruz	8,929	46.8	44.4
Cuesta	San Luis Obispo	San Luis Obispo	8,169	39.5	35.4
Monterey Peninsula	Monterey	Monterey	5,879	49.1	42.4
Moorpark	Moorpark	Ventura	11,875	40.2	35.4
Oxnard	Oxnard	Ventura	5,398	78.8	73.0
Santa Barbara City	Santa Barbara	Santa Barbara	13,570	37.5	33.6
Ventura	Ventura	Ventura	9,851	66.0	61.3

[a] Full-Time Equivalent Student, Credit and Non-Credit 2019-2020 (Data Mart 2019-20, [4]).
[b] URM: African-American, American Indian/Alaskan Native, Filipino, Hispanic, and Pacific Islander.

The partners have a history of cooperation, within their college district or region, between college administrations, and between individual STEM faculty and support services. Nevertheless, the C6 model is unique, representing collaboration across multiple STEM disciplines at eight colleges, in six community college districts. While each college works on supporting its own students, the leads of the C6 colleges meet via Zoom approximately 12 times per academic year. Neighboring C6 colleges ("pods") also work together on joint experiences. For example, MPC and Cabrillo Colleges both participated in a "Duck Race" design competition in Spring 2022, and Cuesta, AHC and SBCC combined efforts on a joint field trip to a biomedical company in Ventura County in Spring 2023.

By sharing effective practices and resources, C6 has already increased STEM student access to and participation in research and internships; organized industry tours; increased STEM students access to embedded tutoring in gateway courses; and created a forum where STEM leaders share effective practices and data and feel part of a leadership community whose members inspire and support each other. The importance of STEM faculty collaboration across colleges cannot be overstated. Community college STEM faculty – especially those who pursue and manage grant projects – are extremely stretched and often work in isolation. C6 – launched during COVID – has connected the region's STEM leaders into a vibrant network of innovators.

The goals and objectives of C6-LSAMP are as follows:

Goal 1 Narrow the Hispanic success rate gap in STEM gateway courses. By doing so, more students will persist to the next level and eventually transfer.

- **Objective 1.1** Introduce Embedded Tutors in STEM gateway courses at each college, impacting at least 64 sections per year across the alliance.
- **Objective 1.2** Increase the success rate of Hispanic students in STEM gateway courses at each college by 3% each year of the grant.

Goal 2 Increase the number of Hispanic STEM students transferring to universities.

- **Objective 2.1** By the end of the grant period, increase the number of Hispanic STEM transfers each year to CSUs from a baseline of 185 to 217, an increase of 32 (17%) across the alliance.

Goal 3 Hold Fall Research Symposia to celebrate CC student research experiences.

Objective 3.1 Sixteen students will present research/internships/independent studies projects at each symposium.

Objective 3.2 Place 12 students into internship/research opportunities per year across the alliance.

Goal 4 Increase student awareness of their academic path and their sense of belongingness in STEM.

Objective 4.1 Hold six alliance-wide virtual student success workshops per year.

Objective 4.2 Connect at least 80 students per year across the alliance to industry and alumni mentors.

Objective 4.3 Hold three professional development trainings on culturally responsive education per year.

C6-LSAMP focuses on three pillars of support: (1) Research Opportunities, (2) Academic Support, and (3) Professional Development/Career Exploration. Reinforcing each pillar is our shared commitment to create culturally sensitive, relevant and responsive environments.

This work-in-progress paper reports on two C6 activities/interventions: the Fall Research Symposium, and Embedded Tutors.

3. Fall Research Symposium

The National Academies' 2019 report noted that "exposure to undergraduate research is one of the best predictors of degree completion and success in postgraduate education and careers." Students with research experiences are motivated to spend more time on their studies, which results in higher success and completion rates [5]. Undergraduate researchers gain self-efficacy, self-confidence and knowledge about doing research, and so are more likely to pursue graduate studies. By introducing lower division students to research experiences, a larger, more diverse student population will be developed ([5]–[10]).

The Research Symposium allows students to present work they have performed outside of the classroom environment. The event is a networking and learning opportunity for students, faculty, and staff, and serves to motivate all C6 students as they encounter actual research done by their peers. CCC students and alumni who have participated in research and independent projects during the past year are invited to present posters.

The C6 Fall Research Symposium has for the past two years been co-hosted by – and held at – a leading STEM undergraduate institution, California Polytechnic State University San Luis Obispo (CPSLO). Located nearly in the center of C6's geographic footprint (approximately halfway between Cabrillo to the north, and Moorpark to the south – about 160 miles from each), CPSLO is a highly desirable destination for STEM transfers in California. In addition, we have a great partner in the LSAMP Director at Cal Poly, who is also the director of the Office of Student Research at CPSLO. Dr. Lehr is a long-term collaborator with AHC and Cuesta (she is

PI on CPSLO's NSF S-STEM grant in collaboration with AHC and Cuesta), and a tireless champion of transfer students.

C6-LSAMP and CPSLO's Office of Student Research combined to host a Fall Research Symposium in both Fall 2022 and Fall 2023. In October 2022, over 150 students and faculty from seven C6 colleges converged on CPSLO. C6 students were treated to a transfer admission presentation followed by an option of eight theme-based tours. Following a lunch and networking session, Dr. Mario Banuelos, Assistant Professor of Mathematics at Fresno State, a first-generation college student and son of immigrant farm workers, presented his life experiences and current work in machine learning. The afternoon concluded with a two-hour poster session broken up in two one-hour blocks, during which 16 posters were presented by C6-LSAMP students alongside CPSLO undergraduate researchers. The two-year C6-LSAMP college students took advantage of the networking opportunities with students from the four-year institutions, some of whom had also transferred from a community college.

In October 2023, all eight C6 Colleges brought over 250 students to CPSLO. Students were welcomed by CPSLO and C6 leadership (Figure 2), and then provided the option of several discipline- or interest-group specific campus tours. Lunch was provided and students had an opportunity to network and explore the campus. C6 students could visit tables representing CPSLO colleges and support offices, as well as graduate programs from several universities. The afternoon was capped off by a two-hour poster session broken up in two one-hour blocks.

In 2023, instead of intermingling posters from C6-LSAMP and CPSLO students, the poster presentations were broken up into three large rooms: (1) C6-LSAMP posters; (2) College of Engineering posters, and (3) posters from other Cal Poly colleges (Sciences and Mathematics; Business; Liberal Arts). The 24 C6 posters were afforded the central location in the College of Engineering's space, providing C6 students with a sense of importance they otherwise would not have felt.

A total of 16 C6 posters were presented in 2022, and 24 in 2023; at least 75% of posters each year included a URM scholar, either solo or as part of the team. Monterey Peninsula College students have contributed 17 of the 40 posters. Poster topics have included undergraduate research experiences, work internship projects, and other STEM projects. A sampling of poster topics follows:

- *Designing Circuits for Aerospace Automation* (Allan Hancock, 2022)
- *The role of the Southern Ocean During the Warm Pliocene and the Transition to the Ice Ages* (Cabrillo, 2023)
- *Using an Arduino to Compare Thumb Stick and Flex Sensor Precision for Robotic Applications* (Cuesta, 2023)
- *Need for Speed: Remote Navigation of a Duck* [Duck Race vehicle] [(Monterey Peninsula, 2022)
- *Web Server to Manage Peer Grading* (Monterey Peninsula, 2022)
- *Spectral Profiles of Strawberries under Varied Illumination* (Oxnard, 2023)
- *Electro-Optic Tuning in Aluminum Gallium Arsenide Coupled Micro-Ring Resonators* (SBCC, 2023)

- *Data Analysis with the use of R coding in Field Research* (Ventura, 2023)

Student surveys were conducted after each C6 Research Symposium by the external evaluator. From the 2022 post-symposium survey, some key prompts and responses were as follows:

The most important thing I learned/took away from today's event was:

- *Being able to imagine myself at the college [university] and hopefully present a poster for research in the future*
- *You don't have to be at a 4 year university to get involved in STEM research and that even at an entry level you can help with really impactful things.*
- *I'm not limited to what I think my major is about. There are many opportunities in [an] internship to be able to work in what you think is important.*

If you did NOT present a poster, how did the experience make you think about doing it next year? What support would you need?

- *I didn't know cc [community college] students were able to present a research poster.*
- *I … really enjoy the presentations. I learned a lot of information I didn't even know or thought to think of from them.*
- *I felt encouraged to do my own research and present. In terms of support, I would need someone else to help me do my research and experiment, a mentor, and overall a supportive community that will push me and make me feel empowered.*
- *I enjoyed looking at the research presented and it exposed me to the way that people can present their research.*

C6 poster-presenters answered the following prompt:

The most important thing I learned from presenting my poster was:

- *I now have the knowledge of how to professionally conduct research and present my findings in an understandable way. I am incredibly grateful to have gotten this opportunity to get this great experience.*
- *I was able to learn about internship opportunities at Cal Poly and what I can do as a community college student to prepare for the opportunities.*
- *I was able to present my work to fellow CC students like myself and see how interested they were.*

As the exit surveys found, the Research Symposium experiences energized and inspired community college students to think about research as something that is possible and doable. C6-LSAMP sees the Research Symposium experience as a first step in addressing a gap that many of our students encounter when they transfer: the sense of being behind from the get-go because their new peers already have research experience. Interviews with transfer students at CPSLO conducted as part of a related NSF S-STEM project between CPSLO, AHC and Cuesta, *Engineering Neighbors: Gaining Access, Growing Engineers* (ENGAGE), found considerable evidence of this sentiment and real challenge [11]:

- *If you do the whole thing [start college] at [CPSLO], you build relationships with professors and get internships in your junior year. When I went to career fairs in my junior year, my resume was not fully developed.*
- *I felt behind because I did not have an internship*

Figure 2. Kick-off Gathering for 2023 Fall Research Symposium. Photo: L. Jewell, Monterey Peninsula College.

Figure 3. Cuesta College faculty (left) and students. Photo: Cuesta College Public Affairs.

Figure 4. Oxnard College students. Photo: Oxnard College.

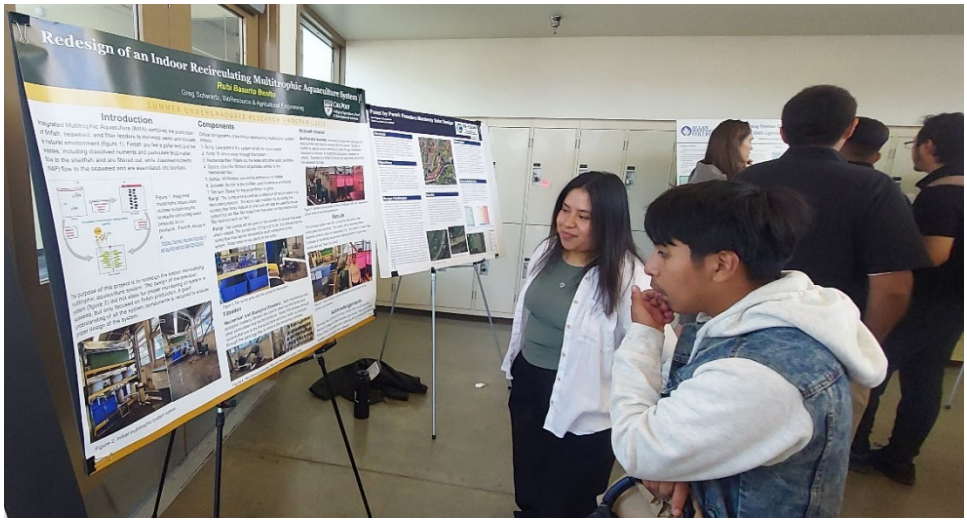

Figure 5. An Allan Hancock College student shares her poster. Photo: D. Dal Bello.

4. Embedded Tutors

Tinto [12] noted that academic and social integration on a college campus is critical to ensure academic engagement, which will lead to greater student success. Thus, it is important to provide opportunities for students to connect with each other in the academic environment. In addition, "Many URM students' learning styles demonstrate preferences for collaboration, group work cooperation and a sense of community" [13]. In-class interventions encouraging student interactions and supplemental tutoring activities have been shown to increase student retention and success ([14]–[19]).

Embedded Tutoring (ET) was identified as an affordable High Impact Practice that could be implemented in gateway STEM courses across C6-LSAMP, and would allow us to study various approaches. ETs are students who have previously succeeded in the course content, share similar backgrounds with the C6 URM student population, and thus are positioned to serve as solid role models. ETs assist faculty sponsors by providing support during in-class activities and labs, as well as host sessions to help students develop problem-solving and study stills. ETs are familiar with course materials, and gain leadership and communication skills.

In preparing the grant proposal, the C6 colleges studied the success rates (ABC grades) by demographic in four key STEM gateway courses: General Chemistry 1 (Chem 1), Precalculus, Calculus 1, and calculus-based Physics (Physics 1) at each of the eight colleges from 2017–2019. We found that White/non-Hispanic students outperformed Latinx/Hispanic students (in all but 1 of the 32 cases). The average gap (simple average) across all campuses and courses was over 13% (Tables 2 and 3).

Table 2. Simple-average Success Rates (%, ABC grades) at each C6 College Across Gateway STEM courses: General Chemistry 1, Precalculus, Calculus 1 and Physics 1, Fall 2017–2019.

College	Hispanic/Latinx (%)	White, Non-Hispanic (%)	Gap (%)
Allan Hancock	55.9	66.8	**–10.9**
Cabrillo	53.1	70.5	**–17.4**
Cuesta	55.5	67.2	**–11.7**
Monterey Peninsula	46.4	68.6	**–22.2**
Moorpark	52.9	63.0	**–10.2**
Oxnard	69.2	74.8	**–5.6**
Santa Barbra	59.2	73.2	**–14.0**
Ventura	50.4	64.0	**–13.6**
Average (of Averages)	**55.3**	**68.5**	**–13.2**

Table 3. Simple-average Success Rates (%) across all C6 Colleges by Gateway STEM Course 2017–2019.

Gateway STEM Course	Hispanic/Latinx (%)	White, Non-Hispanic (%)	Gap (%)
General Chemistry 1	55.7	70.1	**–14.3**
Precalculus	49.5	61.5	**–11.9**
Calculus 1	51.3	60.8	**–9.5**
Physics 1 (calc.)	64.7	81.7	**–17.0**
Average (of Averages)	**55.3**	**68.5**	**–13.2**

With support from C6-LSAMP, our eight colleges were able to fund ETs in over 90 sections in 2022–2023. This is a significant increase over 2021–2022 when C6 funded ETs in only 15 sections. Early results of employing embedded tutors across all C6 colleges in gateway courses in Fall 2022–Summer 2023 are shown in Tables 4 and 5.

Table 4. Overall C6 Success Rates in Gateway Courses, With and Without Embedded Tutors, Fall 2022–Summer 2023 (across all colleges).

Gateway STEM Course	Embedded Tutor?	Enrollment	Retention (%)	Success (%)
General Chemistry 1	No	2,168	84	**60**
	Yes	661	85	**70**
	Total	2,829	84	**62**
Precalculus	No	2,652	70	**47**
	Yes	572	67	**45**
	Total	3,224	69	**47**
Calculus 1	No	3,665	77	**52**
	Yes	286	72	**41**
	Total	3,951	76	**52**
Physics 1 (calc.)	No	756	89	**69**
	Yes	332	82	**62**
	Total	1,088	86	**67**

Table 5. URM C6 Success Rates in Gateway Courses, With and Without Embedded Tutors, Fall 2022–Summer 2023 (across all colleges).

Gateway STEM Course	Embedded Tutor?	Enrollment	Retention (%)	Success (%)
General Chemistry 1	No	1,147	81	**55**
	Yes	435	83	**66**
	Total	1,582	82	**58**
Precalculus	No	1,634	68	**41**
	Yes	319	61	**38**
	Total	1,953	67	**40**
Calculus 1	No	2,061	76	**49**
	Yes	155	68	**41**
	Total	2,216	76	**49**
Physics 1 (calc.)	No	341	89	**67**
	Yes	234	84	**62**
	Total	575	87	**65**

At first glance, the impact of embedded tutors seems to be negative, except in General Chemistry 1. The implementation of ETs in chemistry, especially within the laboratory, appears to significantly improve outcomes. The lab allows the ETs and students to interact in an unstructured environment, building stronger ET-student connections. Chemistry is typically the first college lab experience students have, so in-lab assistance can be extremely helpful.

In fact, one Chemistry faculty member found that employing an ET has increased the success rate in their General Chemistry 1 classes as follows: 49% in Spring 2022 (first semester implementing ET) to 63% in Fall 2022 and to 66% in Fall 2023. The ET is actively involved in the lecture and lab experiences and holds regular tutoring/help hours outside of the normal lecture and lab times.

The apparent negative impact of ETs is a phenomenon observed by C6 colleges' Institutional Effectiveness and Institutional Research Offices. Several factors may contribute to this. Faculty may not utilize ETs effectively to support students within and outside of the class. Faculty may not sufficiently encourage their class to visit the ET if they hold tutoring hours. Students may roll back their own studying, believing they have a safety net in the ET, but then do not sufficiently utilize the ET (or wait until it is too late to do so). Faculty and students may both become complacent … without effort from faculty and students, ET support may be taken for granted and thus the intended improvement not realized.

We do note from Tables 3 and 5 that the 2022–23 Success Rates (Hispanic/Latinx) in Precalculus has dropped by about 9-percentage points compared to the 2017–19 baseline data (all URM), while those for Chemistry, Calculus and Physics did not see such a decrease. The reduced success may be partly a result of the impacts of COVID, but we have not looked deeply into this data.

In discussing these findings, the alliance members found significant variations in implementing the ETs. We are in effect comparing apples to oranges (and variations in between). C6-LSAMP is thus considering what may be a more effective approach to quantitatively assessing the impact of ETs. Instead of being discouraged, the data catalyzed a new conversation about what makes ETs effective and where ET funding can most strategically be invested. Proposed future work includes continuing to share best practices among faculty, as well as implementing alliance-wide faculty and ET workshops and a community of practice.

Embedded Tutor Survey

The alliance gained additional insights on the effect of Embedded Tutoring by conducting a survey and interviews with experts – the ETs themselves.

Our external evaluator surveyed 38 ETs from all 8 colleges and interviewed 6 of them. As expected, the survey uncovered significant variations in implementation from ET training models, to the way ETs work with their assigned instructor, to what the ETs do in the classrooms and labs, to how and when the ETs meet with students. The survey also asked the ETs what kind of students they spend most time supporting. Most ETs reported that the students who are most likely to come see them are those destined for As and Bs (the least in need of help), although a few ETs reported serving students likely to get a C or not even pass. When asked how to encourage more students to "use them," the ETs agreed the most powerful approach is for instructors to offer credit to students who go see their ET. They also suggested that ETs are more likely to be successful if they are placed in classes with labs because that offers more opportunities for them to get to know students. In a related suggestion, the ETs also encouraged faculty to create opportunities for ETs to meet and get to know students. A surprising number of

students tend to not know they can get help from the ETs; faculty need to help "promote" the ETs and keep reminding students that they should go see them.

The ETs also commented on the benefits of being an ET which they all agreed on as being substantial. They learn the material better and they have the satisfaction of helping others while – in most cases – also feeling part of a community with other ETs.

5. Concluding Remarks

C6-LSAMP has successfully implemented the Fall Research Symposium bringing 16 posters and over 150 students to Cal Poly in Fall 2022, and 24 posters and over 250 students in Fall 2023. Embedded Tutors have been implemented at all C6 colleges. The ET program is a work-in-progress that we are continuously developing and improving through alliance meetings and other collaborations. Colleges are encouraged by the qualitative, if not quantitative results, of the ET program, and some are institutionalizing ETs based on C6-LSAMP's work and the work of other campus programs that sponsor ETs. C6-LSAMP members look forward to continue working together to support URM student success. There is great value to faculty having a community of STEM innovators with whom they can share and get new ideas, allowing the alliance members to think not only about improving URM student outcomes at their own college, but across the region.

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