2018 CoNECD - The Collaborative Network for Engineering and Computing
Diversity Conference: Crystal City, Virginia Apr 29

Leveraging a NSF S-STEM grant to initiate "PEEPS" (Program for Engineering Excellence for Partner Schools) for recruiting and retaining students from underrepresented groups while covertly transforming ourselves and our university

Dr. Katherine Chen, Worcester Polytechnic Institute

Dr. Katherine C. Chen is the Executive Director of the STEM Education Center at Worcester Polytechnic Institute (WPI). Her degrees in Materials Science and Engineering are from Michigan State University and MIT. Her research interests include pre-college engineering education and equity in education.

Ms. Jaclyn Duerr, California Polytechnic State University, San Luis Obispo

Jackie Duerr works as a Coordinator for the Multicultural Engineering Program at California Polytechnic State University, San Luis Obispo. Teaching experience includes Engineering Student Success and Multicultural Counseling courses. Research interests encompass advocacy, recruitment, retention, and graduation for under-served students in STEM, with a special interest in first generation and transfer student experiences.

Dr. Lizabeth T Schlemer, California Polytechnic State University, San Luis Obispo

Lizabeth is an Associate Dean in the College of Engineering and a Professor in Industrial and Manufacturing Engineering at Cal Poly, SLO. In her current role she overseas Engineering Students Services and diversity effort in the college. Coming from a 24 year career of practicing innovative pedagogies from Project based learning to flipped classrooms, she now works to transform the institution of high education through structures and practices.

Dr. Jane L. Lehr, California Polytechnic State University, San Luis Obispo

Jane Lehr is Chair of the Women's & Gender Studies Department and a Professor in Ethnic Studies at California Polytechnic State University, San Luis Obispo. She is also the Faculty Director of the Cal Poly Louis Stokes Alliance for Minority and Underrepresented Student Participation in STEM Program. She previously served as elected co-chair of the Science & Technology Taskforce of the National Women's Studies Association, and as a Postdoctoral Research Officer at the Centre for Informal Learning and Schools (CILS) at King's College, University of London. Her graduate training is in Science & Technology Studies and Women's Studies at Virginia Tech.

Ms. Emily E Liptow, California Polytechnic State University, San Luis Obispo

Emily Liptow served as an AmeriCorps VISTA member at California Polytechnic State University in San Luis Obispo for two years where she was involved with a variety of diversity and inclusion efforts in the College of Engineering ranging from student support programs, faculty bias awareness trainings, and inclusive cultural change. She is a recent Industrial and Systems Engineering graduate from Ohio State University, where she was also very involved with social justice initiatives.

Miss monica lauren singer

Monica Singer is an AmeriCorps CSU STEM VISTA supporting diversity and inclusion initiatives within the college of engineering at California Polytechnic State University, San Luis Obispo. There she graduated as a Psychology major, minoring in Child Development and Gender, Race, Culture, Science and Technology. Her research interests include how masculinity and implicit bias function in an academic setting (specifically in the STEM fields).

Ms. Helene Finger P.E., California Polytechnic State University, San Luis Obispo

Helene Finger has been a faculty member in the Civil/Environmental Engineering Department at Cal Poly, San Luis Obispo since 1997, with a break from 2007-2010 to pursue her PhD in Mechanical Engineering focusing on computational science and engineering and thermo-fluid sciences. At Cal Poly, she teaches courses in Water Resources and Water Quality. In 2000, she took on the additional roles of Director of the Women's Engineering Program and advising the Cal Poly section of the Society of Women Engineers.

Leveraging a NSF S-STEM grant to initiate "PEEPS" (Program for Engineering Excellence for Partner Schools) for recruiting and retaining students from underrepresented groups while covertly transforming ourselves and our university

Abstract

PEEPS is a NSF S-STEM scholarship program in which first generation students from underrepresented groups in engineering receive significant financial support (up to $10k for at least 4 years) and a network of classmates, faculty, and staff to assist them throughout their college career at California Polytechnic State University, San Luis Obispo (Cal Poly, SLO). "PEEPS" represents the idea of a "posse," "family" or "my peoples" as a group that supports and cares for one another, and being part of a cohort is central to the program. In addition, PEEPS integrates several interventions (e.g., proactive advising, scheduling of PEEPS students in the same section of courses) and social activities. These components are designed to build community, help strengthen student identities as engineers, provide support structures, and increase self-efficacy.

In addition to the benefits to the scholarship recipients, PEEPS has impacted various programs and practices at Cal Poly, SLO. This paper will describe the institutional, programmatic, and personal impacts. PEEPS has introduced several initiatives such as the Engineering Student Success course (for 1st years), the Engineering Professional Success course (for 3rd years and transfer students), and cohort scheduling of gateway engineering courses for engineering students.

In addition, we also interweave a story about the development and building of multi-year relationships between faculty and staff collaborators before, during, and after the PEEPS grant period. The NSF S-STEM grant has served as an important opportunity to empower multiple people across units to work together to transform our campus to become more thoughtful and supportive of students from underrepresented groups in the College of Engineering.

Setting the Stage – Pre-PEEPS

The PEEPS S-STEM proposal emerged out of conversations generated in a Professional Learning Community (PLC) offered in Winter/Spring 2012 via the [then] Center for Learning (CTL) at Cal Poly. Entitled, "Fostering a Culture of Equity, Diversity, and Inclusivity in STEM Education at Cal Poly," this learning community met for a total of 20 hours face-to-face over two quarters, and many participants completed substantial work between meetings. The goal, as listed in the "Rationale for Topic Selection" from the Fall 2011 PLC proposal to the CTL, was to "combine and integrate attention to demographics (recruitment and retention) with classroom-based practices (e.g., syllabi and assignment construction, team creation, etc.) and the content of STEM disciplines from the perspective of a desire to promote a culture of increased equity, diversity, and inclusivity in STEM disciplines at Cal Poly."

As noted in the "Participant Recruitment and Selection Process," the PLC was also designed to address experiences of isolation and resistance by 1) "strengthen[ing] and deepen[ing] a reflexive, pedagogical community within STEM fields at Cal Poly that will focus on the promotion of a culture of increased equity, diversity, and inclusivity"; and 2) creating "allies within their departments" so that participants were more "supported in proposing, enacting, and examining changes within their pedagogical practices" by purposely selecting pairs of faculty within departments. The goal, as noted in the 2011 proposal, was to "achieve both breadth in disciplines represented (to have the widest impact) and simultaneously the creation of ally relationships with departments (to have the most depth of impact)."

Overall, as co-constructed with participants, the "Fostering a Culture of Equity, Diversity, and Inclusivity in STEM Education at Cal Poly," PLC sought to:

1. identify explanations for patterns of underrepresentation that exist within the research and best practices literature;
2. assess how Cal Poly's student recruitment (admission and yield), retention, and graduation demographics compare to those at other institutions and the nation (with a focus on discipline-by-discipline comparisons);
3. employ the research and best practices literature as a lens to a) initiate analysis of Cal Poly at the course, major, department, college, and university levels and b) identify research questions and areas of uncertainty;
4. build and strengthen new and existing faculty/staff partnerships to a) develop more accurate and richer explanations for patterns of student recruitment, retention, and graduation at Cal Poly; b) enact change to better support student success; and c) evaluate and reflect on efforts to enact change.

This work was strongly informed by a then-active Cal Poly collaboration [2011-14] with the USC Center for Urban Education (CUE), which encouraged the institution, as a whole, to shift from a "focus on students" as the problem to "institutional accountability."

In the 6 months following the PLC (prior to 11/1/2012), participants had submitted three grant proposals to address PLC findings and leverage collaborative relationships that were developed via PLC participation. One of these proposals was revised and resubmitted to the S-STEM Program in 2013 and was funded as PEEPS in 2014.

Description of the PEEPS program

As noted above, the PEEPS (Program for Engineering Excellence for Partner Schools) scholarship program was cultivated from ongoing discussions in a faculty learning community on Diversity in STEM (Science, Technology, Engineering, and Mathematics) at Cal Poly, SLO. Examination of our institution's patterns and possible reasons for the achievement gap of our students from underrepresented groups led us to propose a more holistic approach of bundling several interventions appropriate for our university. Based on our readings and discussions from the learning community, and inspired by the Posse Foundation, we designed a cohort program for students largely from underrepresented groups and brought together different departments on campus (e.g., College of Engineering, Multicultural Engineering Program, Admissions, Financial

Aid) as the support team. We were successful in being awarded a NSF S-STEM grant to implement PEEPS in 2014.

Data from previous school years indicated that we would have a sufficient pool of students who would qualify for the scholarship program as "low-income academically talented students with demonstrated financial need." In addition, the group of students at Cal Poly, SLO with the lowest persistence rates were those with Pell grants (vs. 1st generation and URM), most likely due to financial hardships that lead to poor performance or dropping out. We decided for our first year that we would concentrate on only one degree program – mechanical engineering (ME); and for the second year we expanded to include civil engineering (CE) and environmental engineering (ENVE). The process of determining how many students might be eligible with our scholarship criteria (Table 1) opened up an examination of who was being admitted to our institution from our "Partner Schools" (i.e., high percentage of free and reduced lunches). Anti-affirmative action laws in our state prohibit consideration of gender or ethnicity (and other protected classes) in admissions to the state university. Because of this, financial need and 1st generation status is used when recruiting or retaining diverse students. Our partner schools are another way for us to target individuals who traditionally have less access to higher education. The partner schools were first established through the College Preparation Partnership Program initiated by Senator Tom Hayden in 1998, but since then other schools have been added to this list.

Table 1. *Eligibility criteria and demographics for PEEPS scholarship program for 2 cohorts*

	Cohort 1 (Fall 2014)	**Cohort 2** (Fall 2015)
Criteria used	• Partner School • Financial need • Accepted into ME	• Partner School • EFC (Expected Family Contribution) < $12k (high financial need) • Accepted into ME, CE, or ENVE • First Generation
Number of eligible students	42	55
Number who applied to the PEEPS program	15	18
Number selected into PEEPS	6	7
Percent Female	17%	43%
Percent URM	50%	86%
Percent 1st Gen	67%	100%

As we investigated the demographics of admitted students, we found that the students from Partner Schools were an ideal pool for this scholarship. Figure 1 shows the large percentage of first generation and low income (i.e., estimated family contributions < $12k) student participants that had been admitted to the College of Engineering in Fall 2015. Among the admitted (i.e., accepted) engineering students for Fall 2015, 572 (out of 3427) students were from Partner Schools, and 41% of them were first-generation, compared to 8% of the non-Partner School students. Furthermore, out of the first-generation Partner Schools admitted students, 81% of them (or a total of 191) had very high financial need (i.e., estimated family contribution,

EFC< $12k), Figure 1. Such an analysis had not been done before on campus, and thus the statistics and graph was distributed to others in our university, including the Dean of Engineering, Financial Aid, and Admissions. This has changed the direction of many scholarship programs to focus on holistic support as opposed to solely financial gain.

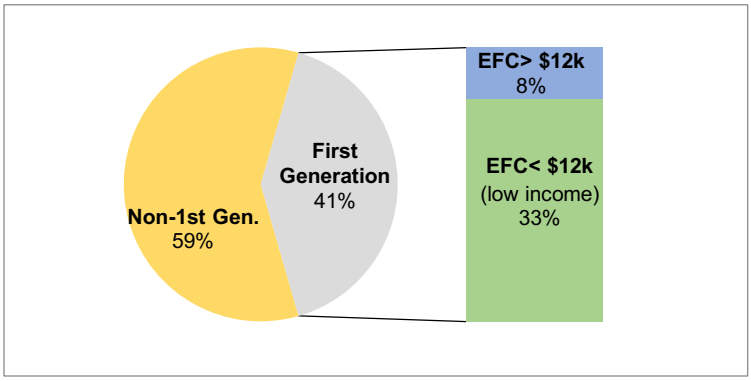

Figure 1. *The Pie Chart shows the make-up of students admitted into Cal Poly's College of Engineering (Fall 2015) from "Partner School." It delineates between first generation and non-first generation and then further shows the percent of first generation students who also have Expected Family Contribution (EFC) less than $12,000 (considered low income).*

We developed a robust recruitment and selection process that included outreach to Partners Schools and coordination with our colleagues in admissions[1]. The eligibility criteria for the scholarship program and demographics of the PEEPS students are summarized in Table 1. Because we chose to give the maximum allowable financial support ($10k/year) to students for 4 (or possibly 5 years) of their college career, we are able to fund only 13 students over 2 different cohorts. The different cohorts are from two different starting years, and we had slightly different criteria and studied some of the differences.

PEEPS successfully recruited and funded several "academically talented, financially needy" engineering students who otherwise would not have been able to afford Cal Poly. Figure 2 depicts the diversity of the students that are in PEEPS as compared with the college and university as a whole. We have tracked the student's institutional measure of success each year and have done extensive program evaluation through focus groups and institutional data collection. This year we also interviewed students individually in order to capture their experiences so we could learn and inform our next steps. In summary, we have found that the comprehensive support does not guarantee individual students' success. To date, two of the 13 PEEPS students have left the university due to academic difficulty or career shifts. The remaining PEEPS are progressing towards their degree with several graduating this June. In addition to institutional measures, we have used interviews and have submitted a paper to ASEE Annual Conference that tells the individual stories of the PEEPS. The students have been very appreciative of the financial and cohort support often citing both as reasons for deciding on Cal Poly and for their continued retention at the university. Even those who left the University remain in contact with the support team for mentorship and support in their new journeys.

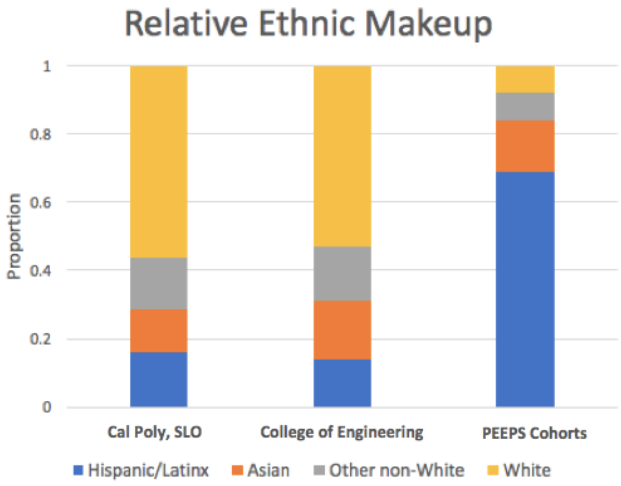

Figure 2. *The chart shows the ethnic make-up of the 13 PEEPS as compared to the College of Engineering and Cal Poly, SLO. The PEEPS are a more diverse group of students even though selections were done without any gender or ethnicity identification.*

Key to the PEEPS scholarship program has been the holistic approach in designing a support structure for the students, as well as program components that come from "cultural wealth"[2] and "funds of knowledge"[3] models (such as being role models and doing outreach in afterschool programs with a high number of low-income and Hispanic children) rather than a "deficient model." We also implemented block scheduling of gateway courses so that PEEPS students could take courses together and strengthen community, where possible.

We evaluate and adjust the program components to match what the PEEPS find most useful. Some of the program components have been developed in response to what the support team felt might help. Frequent interaction of the PEEPS students with certain members of the PEEPS support team naturally provide formative assessment, and the PEEPS students are accustomed to reflecting upon their experiences and offering their perspectives[4]. As an example, weekly scheduled study space for the PEEPS to gather together was only sometimes being utilized. Instead of discontinuing the program component, we hired a tutor (a first-generation graduate student) to attend the study sessions and she took it upon herself to be a mentor and coach for several of the students. Her similar background to many of the PEEPS students and her constant encouragement became a unique and successful support that we had not anticipated.

Institutional impacts beyond PEEPS

PEEPS has not only impacted the lives of the students in the scholarship program, but has impacted the institution and the support team members in their professions. The rest of this paper will concentrate on those impacts that are transforming the university and ourselves.

Impacting another scholarship program

Because PEEPS was designed by a team of representatives from across different university units, the communication lines opened up and the interconnections among the units were better understood and utilized by all involved. Contrary to the "silo" mentality of traditional

universities, many individuals across campus have been eager to help and to learn from our interventions and assessment, while we also learn from them.

Perhaps one of the largest institutional impacts was the influence on an almost parallel scholarship program that was started shortly before PEEPS was established. In fact, some of the brainstorming for the design of PEEPS came from the staff who shared the challenges and identified the shortcomings of the new university "CP Scholars" program, which also targeted the Partner Schools. In turn, we viewed PEEPS being able to pilot interventions as a test bed for the larger CP Scholars program; and indeed, the teams associated with the two different scholarship programs worked with one another.

The CP Scholars program improved immensely once a Director was hired to build in programming and support to augment the scholarships. Mirroring the PEEPS model of collaboration, the Director worked across campus departments to support the retention component of the scholarship program; Admissions, Housing, College Advisors, and Student Affairs meet regularly to discuss the success of this cohort. Due to the success of the PEEPS cohort scheduling, the CP Scholars program launched variations of the idea with special sections of a General Education course and a Statics course for their students.

Impacting degree programs with cohort scheduling

Cohort scheduling is a strategy that creates student-learning communities through students taking the same course sections together. There has been significant research on learning communities and their impact on student success[5,6]. Students in learning communities develop supportive relationship with their peers and spend more time outside of the classroom in study groups. Students are also more likely to draw connections between classes, which deepens their understanding of important concepts. For engineering students, cohort learning communities support student engagement and success, and can increase retention, particularly among students from underrepresented groups[7]. Furthermore, students develop their engineering identity and sense of community among their peers.

The cohort scheduling model was further extended to three different engineering programs for their incoming freshmen students in Fall 2017. Because all incoming freshmen at Cal Poly are given schedules with courses needed for their degree, the Registrar's office was willing to try out "degree program cohort scheduling" for a limited number of students as an experiment. The math, physics, and chemistry departments were all on-board as well. Five cohorts of about 10 students each (48 in total) were created randomly to take the same sections of math, chemistry, and their major's intro engineering course (Figure 3) together for the three quarters of their first year. The students were notified of their placement in the cohort and encouraged to study together, but there was no enforcement or expectation to do so. Surveys are planned to gauge markers like GPA, change of major, sense of belonging, how much they connected with or collaborated with their cohort. It is hoped that since this cohort requires minimal intervention or staff support, this might be a low-cost retention tool. Figure 3 shows the design of courses these students are taking together.

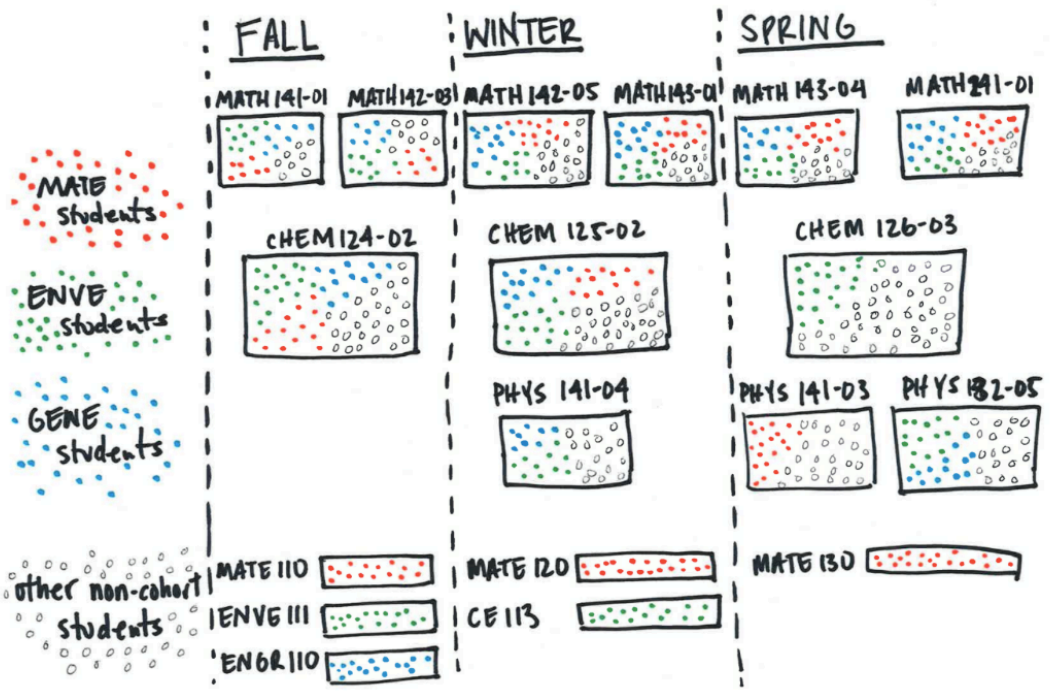

Figure 3. *A schematic of the degree program cohort scheduling pilot for 3 different majors for first year engineering students.*

Impacting other engineering students with Engineering Success Courses

By virtue of the NSF grant, we were able to create and implement two credit-baring (but usually not degree applicable) "success courses" with students from underrepresented groups, first-generation students, and low socio-economic students in mind (although the course was open to everyone). The ENGR 101 – Engineering Student Success course was a mechanism to create a sense of community among first-time freshmen who might feel isolated on our campus, while also creating an environment of support by the university and developing the engineering student identity[8]. While the PEEPS students were required to take the course, other students were encouraged to enroll. However, we ran into an unexpected challenge in reaching students that could benefit from the course in the Educational Opportunity and TRIO programs because those students were required to take a different seminar series. So as to not duplicate efforts across the university, the course has since been re-envisioned to assist those who are undecided about their engineering major. While still targeting low-income, first generation students within the Multicultural Engineering Program and with a focus continued in building a network of friends and campus resources, the course content also allows time for identity and career exploration. 79 students have taken the course over the 4 times it has been offered.

The follow-on course is ENGR 301 – Engineering Professional Success, and is designed to support juniors and seniors (especially first-generation and transfer students) in their pursuit for internships, jobs, graduate school and other opportunities after graduation. A panel of industry representatives also serve as "just in time" mentors before the career fair and help the students practice their elevator pitches about themselves. In the class, students develop their professional

identity and have opportunities to explore ways to get involved in their communities as an engineer. Again, the course was designed for students beyond PEEPS and has run twice with total enrollment of 69. The engineering success courses have received positive feedback, and we expect the courses to continue beyond the life of the grant. As part of the grant activities, these courses have not only enabled the university to extend support to other underrepresented groups and transfer students, but have also created a supportive environment for students to succeed in school and in their profession.

Impacts on the PEEPS Support Team members

A couple years into the grant, we realized that PEEPS was also transforming ourselves – the PEEPS support team. We reflected jointly about the impacts and have included some of the quotations here. This is not intended to be an exhaustive research project, only an illustration that when we endeavor to change the institution, we also change in the process.

Comprehending the experiences of students from underrepresented groups and/or first-generation status

Being connected to PEEPS meant that we were also in tune with individual's struggles and successes as a student from an underrepresented group and/or first-generation status. As Slaton and Pawley[9] contend, the "power of small N" can garner valuable data about individual student experiences in contrast to studies that strive to generalize results with large number of participants. These students have impacted us greatly.

As one of the PEEPS support team members from the Multicultural Engineering Program relates:

"Holistic advising and the importance of time spent outside the office: in our office, despite whatever coordinator "hats" some of us may wear, we are always advisors first. That way, it really emphasizes a model in which we put student first. However, we typically engage with students in limited capacities and reoccurring environments (discussing flowcharts/curriculum within an office setting). PEEPS provides a holistic approach to support a student. We engage not only within our office, but in the classroom, around the dinner table, at a picnic, in groups, one-on-one. This ability to get to know this student, from their upbringing to their roommates to how they engage with other members of their support network, creates deeper connection and understanding regarding their experiences and situations. Through holistic advising, not only can I further support their journey within their curriculum by developing a deeper understanding for who they are, but I can support them through other conflicts which may arise throughout their college experience."

Our AmeriCorps VISTA member[10] worked closely with the PEEPS students and support team:

"Working with the PEEPS students and learning about their backgrounds and experiences prompted me to reflect a lot more on my own engineering experience and personal identities. I felt that I was able to be an encouraging and helpful mentor overall. However, I also recognized that I wasn't going to be the best mentor for each student, regardless of how much I tried and cared for them. As a white, middle class woman from Ohio, I didn't share the same struggles during my engineering undergraduate experience. It was important for me to recognize and

accept this, and then support them in finding other people and organizations that they could connect with. Being a part of PEEPS certainly encourages me to continue advocating for diversity in engineering. And it also motivates me to address the culture of engineering and the attitudes of majority (white, male) students and faculty in the field."

A deeper and richer understanding of the individual PEEPS students by the support team members influences their disposition and interactions with other students, and shows up in their work, including the faculty members who teach many students each year. Information about PEEPS and the things learned from our students has been documented in update reports and presented in Advisory Board meetings for the Women in Engineering and the Multicultural Engineering programs at Cal Poly. Thus, the narratives of the PEEPS student experience have reached beyond the support team and Cal Poly and into the industry who will hire and recruit.

One of the original grant co-PI's (and now current PI) has been recently promoted to Associate Dean and in her role, can influence programs and practices across the college:
"Hearing the stories from the PEEPS students has profoundly impacted my desire to increase equity and access across the college. As I hold aspirations for the individuals who work towards students' success I am mindful about the private struggles of students from a less privileged background. PEEPS has allowed me to see something I was blind to."

The original PI of the grant moved to a different institution and a new role that was heavily influenced by PEEPS:
"After experiencing how positive transformations can occur within an institution with a dedicated and passionate team that takes a systems view, I now approach most projects the same way. I hope to transfer the strategies and methodologies of PEEPS to a new institution to create a supportive culture and structure for underrepresented students."

Building even greater institutional capacity with AmeriCorps VISTA

With the start of our grant, we were fortunate enough to also be awarded an AmeriCorps VISTA[11] to help get PEEPS off the ground and to continue its development while working on institutionalizing effective programs for lasting transformation of the university. The VISTA fostered many relationships and collaborations across the PEEPS Support Team and beyond; as such, the VISTA member gradually started to be involved with other diversity and inclusivity initiatives across campus.

One of the most successful programs organized and developed by the VISTA member was an Unconscious Bias Training[12] that was attended by College of Engineering faculty search committees, department chairs, and the Dean's office. This VISTA member received a grant from the University of Washington's ADVANCE Center for Institutional Change[13] to fund this training. Many people and departments across our university were brought together to plan and implement the training including the director of the Women in Engineering program, the Office of University Diversity and Inclusion, Human Resources, and the College of Engineering. Over 50 faculty, staff, and administrators attended the training which was well received overall. This successful training helped get the College of Engineering focused on diversity and inclusion and set a framework for future professional development for faculty.

The current VISTA member also supports Advancing Cultural Change (ACC)[14], an action-oriented ethnographic research initiative of a faculty member not associated with PEEPS that seeks to disrupt exclusionary behaviors often found in engineering culture. Through ACC, case studies are developed to illustrate the experience of bias that many students, particularly students of color and women, deal with regularly. These case studies are then used in the classroom to engage students in dialogue surrounding biases and engineering culture, and to provide skills to disrupt bias as it happens to them or their peers. The VISTA members helped to expand ACC's reach to our university's chapter of the Society of Women Engineers, specific engineering departments, and the ENGR 301 class. With the VISTA member's support, ACC reached over 500 students, faculty, and staff at our university, and this work was shared with the American Society for Engineering Education at their annual conference[15].

Transforming a university with relationships from a Professional Learning Community

As noted in the introduction, we have come to think of PEEPS as an important opportunity to empower multiple people across units to work together to transform our campus to become more thoughtful and supportive of students from underrepresented groups in the College of Engineering. Another way to state this is that PEEPS has allowed us to continue our praxis and strengthen relationships that, for many of us, began in the 2012 Professional Learning Community or a similar space.

As noted by a Co-PI and campus LSAMP director:
"In returning 6 years later to the list of participants from the 2012 PLC entitled, "Fostering a Culture of Equity, Diversity, and Inclusivity in STEM Education at Cal Poly," I see that some of my most valued, most productive, most generative, and most cherished collaborations and collaborators participated in this workshop series. Indeed, it is not too strong a statement to say that it is those collaborations and collaborators that retained me, not just our students. The funded PEEPS proposal was both an opportunity to stay connected with each other; invite new faculty and staff into the conversation and community; and, explore, envision, implement, and evaluate programs to increase the recruitment and retention of students from historically underrepresented and underserved groups. In addition to the long-term impacts of PEEPS in shaping specifically scholarship and program practices as described above, part of the sustainability of PEEPS is our continuing relationships with each other."

Conclusions

Frustration, although quite painful at times, is a very positive and essential part of success.
- Bo Bennett

A consistent theme within this program implementation was getting creative and developing innovative solution despite frustrations with a system or situation. The PEEPS support team bonded over shared philosophies and goals to create the PEEPS scholarship program, in part to show the university what could be done to recruit and retain students from underrepresented groups. Through the NSF S-STEM grant, we've been able to pilot, implement, and institutionalize different interventions that will have broader reach. Furthermore, the PEEPS students and support team members have been impacted in unexpected ways that will further fuel our collective aspirations for equity in science and engineering.

Acknowledgements

This work was supported by the National Science Foundation, S-STEM grant #1356753. All opinions expressed are those of the authors and not necessarily those of the National Science Foundation.

References

[1] Chen, K. C., & Schlemer, L. T., & Lehr, J. L., & Liptow, E. E., & Duerr, J., & Finger, H., & Cabanez, J. B. (2016, June), *PEEPS: Cultivating a Cohort of Supportive Engineering Students and Building a Support Team for Institutional Change,* Paper presented at 2016 ASEE Annual Conference & Exposition, New Orleans, Louisiana.

[2] Yosso, T.J., "Whose Culture Has Capital? A Critical Race Theory Discussion of Community Cultural Wealth," *Race Ethnicity and Education*, 8(1): 69-91, 2005.

[3] Smith, J.M. and Lucena, J.C., *Making the Funds of Knowledge of Low Income, First Generation (LIFG) Students Visible and Relevant to Engineering Education*, ASEE Annual Conference & Exposition, June 2015.

[4] Chen, K., & Schlemer, L. T., & Liptow, E. E., & Duerr, J., & Finger, H., & Lehr, J. L. (2017, June), *I get by with a little help from my PEEPS: Learning from an NSF S-STEM cohort scholarship program,* Paper presented at 2017 ASEE Annual Conference & Exposition, Columbus, Ohio.

[5] Tinto, V. (2003) Learning Better Together: The Impact of Learning Communities on Student Success. *Higher Education Monograph Series*, Syracuse University

[6] Gabelnick, F., J. MacGregor, R. S. Matthews, and B. L. Smith. (1990) *Learning communities: Creating connections among students, faculty, and disciplines*. San Francisco: Jossey-Bass

[7] Jones, S.A. and Were, M. (2008). Impact of the POSSE Program on the Academic Integration of Minority Engineering Students. *ASEE/IEEE Frontiers in Education Conference*.

[8] Liptow, E. E., & Chen, K., & Parent, R., & Duerr, J., & Henson, D. (2016, June), *A Sense of Belonging: Creating a Community for First-generation, Underrepresented groups and Minorities through an Engineering Student Success Course,* Paper presented at 2016 ASEE Annual Conference & Exposition, New Orleans, Louisiana.

[9] A. E. Slaton and A. L. Pawley, "The Power and Politics of STEM Research Design: Saving the "Small N," ASEE Annual Conference & Exposition, June 2015.

[10] www.calstate.edu/cce/vista/

[11] www.calstate.edu/cce/vista/

[12] advance.washington.edu/liy/index

[13] advance.washington.edu

[14] socialsciences.calpoly.edu/advancing-cultural-change

[15] Liptow, E. E., & Bardini, M. H., & Krigel, N. R., & Singer, M. L., & Carrigan, C. (2017, June), *Engaging Engineers in Inclusive Cultural Change Through a New Method, Articulating a Succinct Description* Paper presented at 2017 ASEE Annual Conference & Exposition, Columbus, Ohio.