I get by with a little help from my PEEPS: Learning from an NSF S-STEM cohort scholarship program

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Abstract

PEEPS (Program for Engineering Excellence for Partner Schools) is an NSF S-STEM funded grant. In our third year of the project, we report some of the formative assessment of the scholarship program. Currently our students are in their 2nd and 3rd years in various engineering programs at a 4-year university. We find some interesting differences between our two cohorts of PEEPS, in terms of their transition from high school to college, their subsequent performance in college, and the interactions among and across the cohorts. While our cohort sizes are quite small, we are able to delve deeper into understanding individual student's experiences and perspectives through surveys, periodic check-ins, social events, and an end-of-the-year focus group facilitated by a project evaluator.

We not only report common institutional indicators, such as grade point averages and degree progress, but we will also integrate quantitative and qualitative findings that help us discern the effectiveness of different program components (e.g., cohort scheduling, study sessions, engineering success courses, mentoring, advising, and social events). The utilization and perceived benefit of available resources by the students is examined. We also describe some of our efforts in developing the metacognitive and self-regulation skills of the PEEPS students. Lastly, we propose next steps that examine institutional impacts.

Background: Creating the PEEPS cohorts and program

The Program for Engineering Excellence for Partner Schools (PEEPS) is a NSF S-STEM scholarship program, and was inspired by the Posse Foundation[1]. At the California Polytechnic ("Cal Poly") State University, we wished to create a program in which underrepresented students in engineering receive significant financial aid (up to $10k for at least 4 years) and a network of classmates, faculty, and staff to support them throughout their college career. Our term and acronym, "PEEPS," captures the idea of a "posse," "family" or "my peoples" as a group that supports and cares for one another.

Our primary goal is to recruit, retain, and graduate academically talented, financially needy students[2] from disadvantaged backgrounds to enter the engineering workforce. PEEPS recruits from our "Partner Schools," which are high schools that have a large percentage of students who qualify for the National School Lunch program, and thus are likely to have low socioeconomic status and be first generation and/or underrepresented minorities (URM). Our recruitment methods and results have been published elsewhere[3], and are summarized in Table 1. To this date, we have two different cohorts and a total of 13 students. In this paper, we wish to report on progress of the program and what we've learned thus far.

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

	Cohort 1	Cohort 2
Criteria	2014 Partner School Financial need Accepted into ME	2015 Partner School EFC* < $12k Accepted into ME, CE, or ENVE First Generation
# selected	6	7
majors	ME, (CE, ENVE)	CE, ENVE, ME
%Female	17%	43%
%URM	50%	86%
%1st Gen	67%	100%

*EFC = Estimated Family Contribution

Through PEEPS, we intend to increase our institutional capacity by identifying effective tools and creating the infrastructure to effectively and efficiently improve the educational opportunities for disadvantaged students. A holistic approach was taken to consider the entire student experience from recruitment to graduation, and a variety of resources already established on campus were bundled together. In addition, PEEPS-specific activities were included, and these program components include:

- Fall welcome back retreat
- block scheduling of gateway engineering support courses with supplemental workshops
- weekly scheduled study room and tutor
- Engineering Success courses
- quarterly advising with PEEPS Coordinator and faculty or engineering advisor
- individualized coaching and mentoring of personal academic and professional goals
- science/engineering outreach activities to local underserved K-6 schools
- peer mentors
- social events

We track the use of resources (e.g., utilization of office hours, supplemental workshops, tutoring, advising, health and counseling services, career services, recreation center, participation in clubs, outreach, research, service learning opportunities) for each PEEPS student to identify the most useful interventions or combinations of interventions. The analysis can then assist future decisions for other student success programs. While we know that it is difficult to generalize our results, we also realize that learning about individual student experiences and qualitative data gathering is useful. Slaton and Pawley[4] discuss the "power of small N" to explore how race and gender (and other categories) interact with engineering education institutions.

We seek to move beyond a "deficit model"[5] and embrace our student's unique "funds of knowledge"[6] and assist them in viewing their backgrounds and individual strengths as assets as engineers. Not only does this framework guide our scholarship program, but also the Engineering Success courses that have been developed through this grant. Our results are being used to inform other initiatives around campus as we work with other entities (such as another scholarship program and the Multicultural Engineering Program) to impact a greater number of students.

Now in the 3rd year of our 5-year grant, we wish to examine how our underlying paradigm of forming cohorts to support students may or may not be contributing to their academic and personal success in college. Not only is each of the S-STEM scholarship awardees a part of a PEEPS cohort, but they also have the PEEPS Support Team (i.e., Engineering Student Support staff, engineering faculty, AmeriCorps VISTA member, financial aid staff) available for assistance. We have multiple avenues of inquiry to the PEEPS experiences, such as quarterly check-ins (that are also individualized advising sessions), periodic reflections, and a end of the school year focus group.

Therefore, while the PEEPS project enables the cohort members to take certain courses together, study with one another, and socialize together, do they really support each other academically and emotionally to make a difference? How do the PEEPS Support Team and PEEPS activities help students, if any? How can we take what we've been learning through the PEEPS project to impact other programs and infrastructure at our university?

Results

In order to assess our scholarship program, we examine how the PEEPS students are doing in regards to traditional institutional measures, and also investigate their experience of college as part of PEEPS and as part of the university. We seek to go beyond the "deficit" model which views students as being "deficient" and in need of being "fixed" without noting the institutional obstacles or the sometimes-exclusive culture of engineering.[5] To avoid this harmful model, we regularly question our models of "student success" and how we attempt to intervene. We don't claim to know the answers but hope to engage in greater conversations by sharing our experiences.

Institutional quantitative measures: grades, progress towards degree

As part of our formative assessment, we examine the traditional institutional measures of the PEEPS students each quarter. Table 2 displays the average grade point average (GPA), number of times on Academic Probation (AP), and progress towards degree for the two cohorts (with 6 and 7 students per cohort, respectively). Satisfactory academic standing signifies a GPA of at least 2.0, and meeting the expected progress towards degree (based on a 4 year graduation rate). Cohort 2 shows a larger range in average grades and more students falling on AP. However, Cohort 2 students are ahead in expected number of units towards graduation at this point in time.

Table 2: Average grade point average, degree progress and academic probation frequency for each PEEPS cohort.

Institutional measures	Cohort 1 (3rd years)	Cohort 2 (2nd years)
Cumulative average GPA $\pm$ st. dev.	2.84 $\pm$ 0.25	2.54 $\pm$ 0.60
Range of cumulative GPA	2.56 – 3.28	1.73 – 3.51
Total # times on AP across cohort	1	12
# of students on AP at least once	1	5
Ave. # of students on AP per quarter	0.3	2.75
Total Number of D/Fs in a course	12 over 7 qtrs	22 over 4 qtrs
Progress towards degree	55.32%$\pm$0.07%	33.23%$\pm$0.06%
# students below expected degree progress	2 (expected 55%)	1 (expected 28.3%)
# students with Change in Major	2	*2 (considering)

Figure 1 shows that the cohorts in general have different grade patterns. PEEPS in Cohort 1 consistently report that they struggled during their first year. On average, they have been making gains since the initial shock of "doing poorly" their 2nd quarter in college. The dip in quarter 5 can be traced to an individual student in the cohort who experienced health issues, as well as working too many hours on a part-time job. The student then made several changes and did much better the following quarter.

The x-axis on Figure 1 is relative to the cohort's chronological time in college, and not the same quarter for both cohorts. Thus although Cohort 2 started the following year, we plot their average GPA at the start to signify the beginning of their time at college. Cohort 2 experienced the opposite trend during the 1st and 2nd quarters in college, with a rocky start and then doing much better grade-wise the following quarter, before declining again.
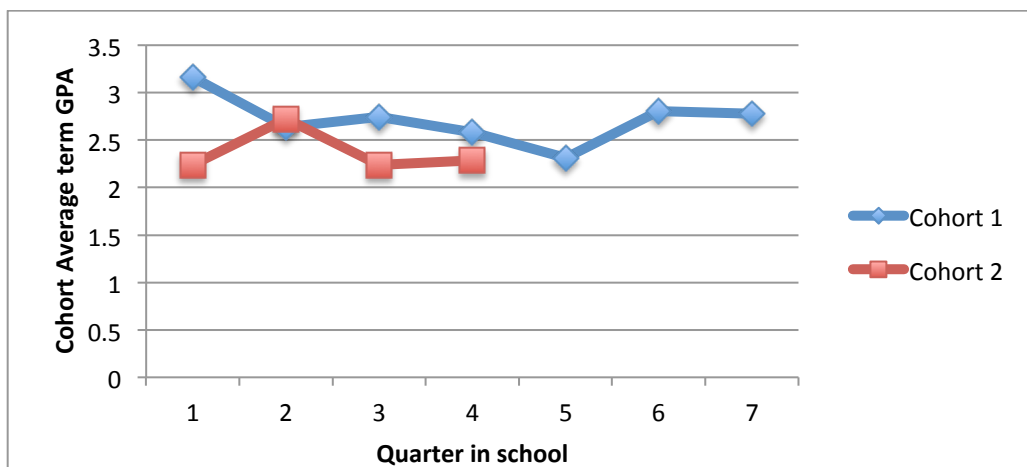

Figure 1. The average GPA for each term per cohort during their time in college.

However, we note that there are large variances in grades within the cohorts and for individual students quarter to quarter. Figure 2 attempts to show this trend by tracking students in each cohort with the minimum and maximum range in term GPAs. The grades of individuals can vary over time in seemingly random patterns.

"Clean data" might show a significant change after a particular intervention, but such a trend cannot be detected in our study. Instead, we see fluctuations in GPA quarter to quarter for individuals, and could easily be affected by one particular course or other life event (as mentioned early). Thus, focusing only on grades for assessment of a program component could be misleading, and we find that quarterly debrief check-ins with students reveal possible causes and give opportunities to offer new strategies.

For the second cohort (currently in their 2nd year of college), we purposefully selected students who needed the maximum allowable scholarship amount ($10k/year with EFC<$12k) and were first generation college students (Table 1). Since our cohort sizes are small, we caution to ascribe the academic performance to any particular demographic, and instead, we try to make sure we can provide the appropriate support.
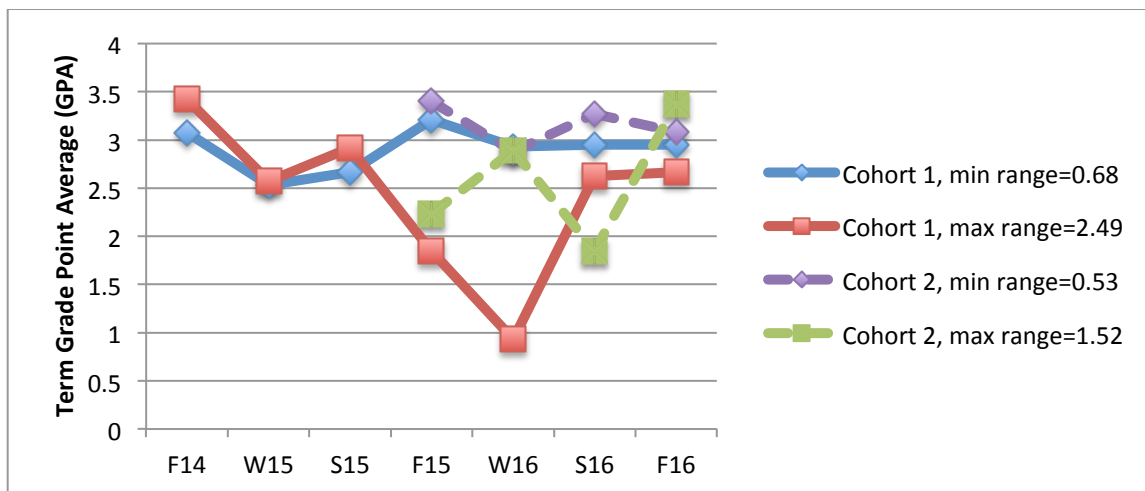

Figure 2. Term GPAs over time for students with the smallest and largest range for each cohort.

Most of the students are making sufficient progress towards their degree. In general, we have found that our students at our university feel pressure to graduate in four years (often for financial reasons), and can sometimes take on high course loads that then lead to poor learning experiences and performance. This is where proactive advising can play a role in relieving stress by creating a plan to graduate in 5 years, and emphasizing the value of learning versus getting a degree quickly.[7] We have noticed that not everyone heeds the advice given for particular courses or course loads, and we wish to delve further to understand this disconnect.

The Engineering Student Success course (ENGR 101), as well as, individual advising sessions assist students in examining their choice of engineering major and guiding them with the change of major process, if appropriate. Furthermore, the quarterly check-ins and individualized advising have normalized the experience for the PEEPS to talk to an academic advisor or support

team member for situations, such as academic probation or the appeal process when being "subject for disqualification" (i.e., not meeting minimum academic progress). Support team members aid students during these stressful times in helping to navigate the process in a supportive manner. As reported in Table 2, several of the students in Cohort 2 face difficulties with course performance, yet they are still persisting and are being "retained."

Year-End Focus Groups: qualitative measures

Our project evaluator ran focus groups with each cohort towards the end of Spring quarter 2016 to reflect upon their experiences over the school year. The evaluator was external to the PEEPS Support Team and was the university's Inclusive Excellence Specialist with expertise in running focus groups. We met with her beforehand to discuss the appropriate formative assessment for this project, and we co-developed the prompts.

The evaluator met with each cohort separately, but asked the same questions. The focus groups each ran for an hour, which allowed time for students to reflect individually (for roughly 10-15 minutes) and then engage in a group discussion. The questions asked were:

1. *What aspects of PEEPS this year have supported your learning?*
2. *What aspects of PEEPS have hindered or created struggles in your learning?*
3. *What suggestions can you offer that would enhance the PEEPS experience?*
4. *How have you participated outside of the required PEEPS meetings? Please include any interaction with the other PEEPS group?*
5. *Please describe any struggles personally, socially, and academically that you faced this quarter/year? In what ways have you engaged in solving problems?*

Throughout the process, the evaluator encouraged sharing and deepening of discussion through slight nudges and probing questions, but also assured that they only needed to talk about what they were comfortable sharing. She prepared a summary, analysis, and a recap of her observations of the group discussion.

The report by the program evaluator summarizes the results from the focus groups:
"The three main aspects of PEEPS that supported student learning were other PEEPS, advisors, and shared spaces. Fellow PEEPS served as each other's support group, providing one another with a sense of comfort in and out of the classroom. Advisors also offered beneficial academic and personal support. Students especially valued getting permission numbers [to enroll] for classes. This aspect greatly reduced their stress levels and kept them on track. Furthermore, goal-setting sessions with advisors helped students to reflect and assess their progress. The study spaces and classes shared by the PEEPS also aided their learning and transition into college.

The vast majority of students stated that PEEPS did not hinder their learning in any way. However, a few PEEPS did experience increased stress trying to fit activities into their busy schedule. Furthermore, some students felt that they underutilized available tutors; as a result, they struggled more in their learning."

The program evaluator noted distinct differences in the interactions among the different student cohorts:

"The year 1 PEEPS [Cohort 2] launched right into discussion. I had expected to have to prompt them a little to get them going, as I have often had to do with student focus groups in the past. However, that was not the case with this group. I wonder if it has to do with their comfort ability in sharing with each other that was fostered during their seminar experience? What was interesting was the clinical and precise way they went about the discussion. A couple of girls took over and began the process of posing the discussion question and then expecting an answer from each person around the circle. There appeared to be an un-written rule that each person had to say something then pass on to the next. It was methodical, but not very organic. I had to really work to get them engaged in a dialog, rather than just submitting a snippet of information. The lack of depth in the dialog was not apparent in their individual reflections. Each PEEP took time and was very careful and detailed in their responses to each question.

Unlike the Year 1 PEEPS, this group [Cohort 1] needed a little prodding to get started on their group discussion. We opened with a "So, how are things going?" question after a little awkward pause. Even though the Year 2's needed a little prompting to get going, they were far more engaged in actual dialogue. Once they got started, they just kept talking. I rarely interjected except to steer their conversation back towards the original questions. They didn't use the questions as prompts; they didn't go around the circle answering, they engaged in a conversation. And, they appeared to really enjoy it! It was a pleasure to observe and facilitate this focus group. All the students had an "ease" about them; they were comfortable with each other and genuinely appeared to enjoy the company and discussion. I wonder if the difference between this group and the Year 1's is totally due to age and experience, or if they were forced to engage more deeply with each other, and in different ways because they had a different first year experience?"

These observations made by the program evaluator were not surprising to the PEEPS Support Team that interacts with the PEEPS students on a regular basis (i.e., individual advising, group activities, and the Engineering Success courses). We don't try to explain the dynamics within the cohorts in attempts for generalization since the individuals are all unique and there are so many confounding factors. Instead, our approach is to make notice, and we attempt to be careful about forcing actions based on preconceived notions of what students want and need to be successful.

Nonetheless, we have tried ways to provide opportunities for Cohort 2 to be able to form a closer community, such as organizing social activities and PEEPS study sessions where they can informally meet to work on homework together. While the students tell us that they would like these PEEPS study sessions, we discovered that if the timing and location of the study session was not ideal (although their schedule would allow it), they wouldn't utilize the opportunity. In addition, we notice that most of the time, only certain students will attend on a regular basis. Attendance is not required, and the PEEPS who are in the same class sections do work together or help others if they've taken the class already during these study sessions. A tutor/mentor (who is an engineering graduate student) is now attending these study sessions, and we hope to assess whether this addition will be beneficial.

Interventions/ Resource Tracking

We periodically collect information on resources used by the PEEPS to gauge the use of resources and to also attempt some assessment on the usefulness of certain interventions. Similar

to the Meyerhoff Scholars Program[8], we wish to increase diversity in Engineering while also transforming our institution.

A survey about the resources used in the 2015-16 school year (administered during the Fall 2016 retreat) revealed that all the students attended instructor office hours. Almost all the PEEPS (12/13) studied with other PEEPS, and roughly half the students used some sort of tutoring service (individual or through the Multicultural Engineering Program). Also about half of the PEEPS utilized Career Services, and Health and Counseling Services. A majority of the students utilized supplemental workshops and/or study sessions (i.e., additional treatment of course material in a group setting). One of the objectives of PEEPS and S-STEM programs is to leverage existing campus programs in order to not duplicate or create new programs. We see that we are successful in promoting these programs to the PEEPS, and we partner with several of these programs.

Similar to the Meyerhoff Scholars Program[8], we assessed the preceived benefit or value of the scholarship program components. We used a Likert scale of 5 with 5=very helpful, 4=helpful, 3=neutral, 2= not helpful, 1= not very helpful, and an option of "N/A, I don't use this resource." All students responded, but not everyone utilized all the resources and the average results found in Table 3 represent the perceived benefits by the students utilizing the program component.

It turns out that one of the original PEEPS no longer qualified for financial aid (in his 3rd year), yet still participates in the program. There were no responses less than 2 (i.e., not helpful), and overall, it appears that all the PEEPS program components are considered beneficial by at least some of the students. None of the components were identified to be discontinued. However, the need/value for different components varies among the students, and thus caution should be used when determining which components are most effective – each student is unique and has different needs. We also realize that we could still improve on supporting our students, and have plans to target specific needs of specific students.

Table 3. Perceived benefits of the PEEPS components averaged over both cohorts

PEEPS Program Component	Average (out of 5)	# Responded using resource
Financial Scholarship	4.9	12
Block scheduling of courses (i.e., ability to take courses with other PEEPS)	4.4	13
My PEEPS (i.e., cohorts) for academic support	4.4	13
My PEEPS for emotional support	4.2	13
Check-ins and academic advising with Support team	4.2	13
Socials	4.1	12
Engineering Success Courses (ENGR 101, 301)	4.0	13
Outreach opportunities	3.9	11
PEEPS Study Sessions	3.8	12

Reflections on reflections

The PEEPS project attempts to bring about the development of students as whole human beings, and not the sole purpose of graduating engineers. Thus, reflection is a frequent component that occurs formally and informally in PEEPS. The Engineering Success courses[9] have several reflections as assignments and we do reflections during the quarterly check-ins. The Support Team members often prompt students to reflect on previous behaviors in order to set future goals. As part of the fall retreat for the 2016-17 school year, the PEEPS were asked to complete a "Goals and Action Plan for Success" as part of their scholarship agreement. We asked the students to state their 1) academic goals, 2) professional goals, and 3) contribution to PEEPS cohorts, and we reviewed their plans with them during their individual check-ins.

For almost all of the PEEPS, they set their academic goal of getting better grades – sometimes a specific target grade for a class or for a specific quarter or the cumulative grade average at the end of the year; and sometimes it was just improving grades in general. The focus on grades is not surprising, especially when several have faced AP where grades can be the deciding factor with continuation of college. Unfortunately the large attention placed on grades (i.e., an external motivator) is not only stressful, it can also preclude the desire to learn for learning sake. This tension between wanting to learn versus wanting good grades is apparent in conversations with the PEEPS, as well as other students[10]. In terms of professional goals, almost everyone talked about updating their resume, attending the career fair, or getting a summer internship. And some had goals of participating or taking leadership roles in clubs. This mindset towards gaining professional experiences with the first generation students is seen as a positive and evidence of PEEPS assisting with navigational capital.[11]

Almost all the PEEPS expressed that they wanted to help and support their fellow PEEPS more, study together more, and attend more PEEPS social events. Their responses on their Success Plans corroborate with the focus group report that indicated that mentoring across the two cohorts did not really materialize as envisioned and that Cohort 2 did not quite have the same level of bonding as Cohort 1. In addition, the level of participation of the PEEPS social events the previous year was not consistent across the students. However, we also realize that with small groups, the needs might be very different across the students.

The Support Team wanted to empower the students to take the initiative for organizing a social event for the PEEPS on their own, and one of the older PEEPS took on the challenge. However, while many people seemed excited for the event (a pumpkin carving get-together), the social ended up being canceled due to the PEEPS backing out due to the need to study or other last minute reasons. As a final attempt to get everyone together, several end-to-the-quarter social events were planned by the Support Team to be flexible enough for students to attend when they could (Figure 2). Only one person showed up for two of the events, none for another, and then two students for the last event. Here we experience a disconnect between what is requested of our program and what gets utilized. Feedback revealed that the end of the quarter is too stressful and busy to give up any time to socialize. We have gone back to holding an occasional Sunday dinner but would still like to have the students self-organize events.

Figure 2. PEEPS social events are not mandatory and are designed to be fun and flexible for student schedules.

As a follow-up to the Goals and Success plans done in at the beginning of Fall quarter, the PEEPS were given a "reflections assignment" at the beginning of Winter quarter. Basically, the assignment was to reflect upon their previously stated goals and plans, and to identify what things helped and hindered their ability to reach their goals. In addition, they were invited to revise or make new goals as further opportunity to develop their meta-cognition skills.[7] Attitudinal and behavioral changes brought on by metacognitive practice and mentoring have been reported by others.[12] These written, structured reflections are used during check-ins and will help provide records for student development. We have found that the students appear to value and enjoy these reflections.

Beyond PEEPS, Institutional Impacts

We have been attempting to take what we've learned to be successful through PEEPS to a broader audience, such as the CP Scholars program (which also serves students from Partner Schools and has 150+ engineering students). We piloted the concept of "cohort scheduling" for a particular engineering support course (known to have a high failure rate) with the CP Scholars to support collaborative learning, and 87% of the participants passed with a C or better[13]. There is interest in some engineering departments to have "cohort scheduling" available for their students to form academic learning communities to help with student success and retention.

We've also discovered that an abundance of resources might overwhelm students, and that individualized advising for specific academic plans are needed. In addition, different entities on campus have similar goals for first generation, low-income, and URM students, yet many times they work independently without knowledge or coordination of each other. We even witness how the PEEPS students must make decisions about which activity (social or extra-curricular) to attend if deciding not to study.

Furthermore, despite the efforts placed in recruiting and retaining URMs in Engineering, there continues to be disparities in achievement and experiences. Rather than focusing on students or programs, perhaps what would be more impactful is an examination of the institutional barriers that maintain the status quo and the culture of STEM that advantages dominant groups.[14]

Next Steps

We plan to conduct interviews by an external evaluator team with individual PEEPS students as case studies to understand their unique experiences with the PEEPS scholarship program, their peers, instructors in classes, and with the University. In addition, we'd like to explore how their experiences at the university interfaces with their families back at home. Figure 3 sketches out the multiple points of interactions that a student may have with different entities, and provides a framework for us to inquire about those experiences through their narratives. For instance, we wish to understand how the PEEPS interact with the advisors (PEEPS Support Team), within their cohorts, with other students. Furthermore, we seek to understand how the institution and their family/home help or hurt the PEEPS with their academic and personal goals.

Through the interviews, we hope to better understand the student decision-making process about signing up for a workshop or getting a tutor, taking advice on course selection, working while on a scholarship, feeling a part of the PEEPS cohort and the university, navigating through the university system, identifying as an engineer, shifting relationships with family and friends, etc. These qualitative measurements may give us a more holistic view of the experiences of our students.
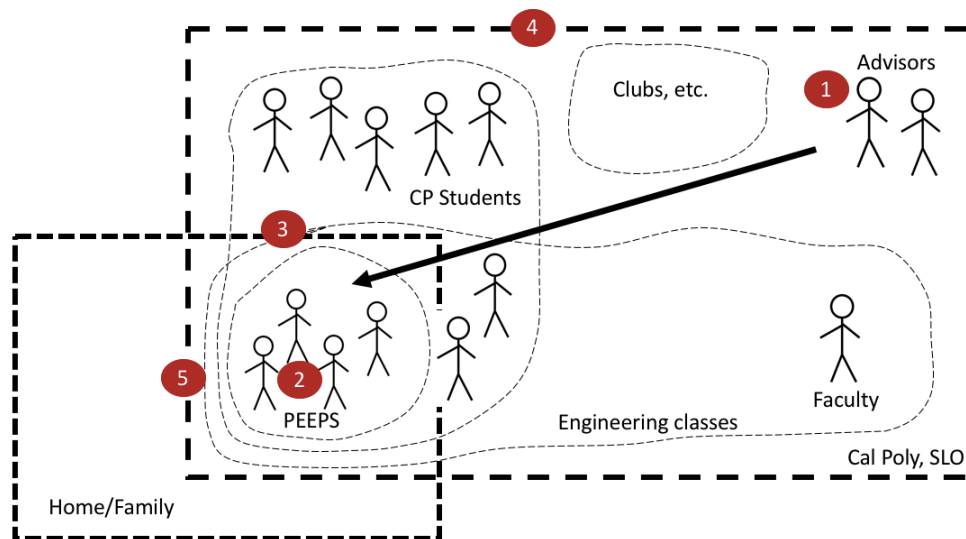

Figure 3. A schematic of the interactions that the PEEPS students encounter with different entities, which might interact with one another in producing the experiences and outcomes of the individual.

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