Engendering Community to Computer Science Freshmen through an Early Arrival Program

Sophie Engle, Sami Rollins, Gian Bruno, Alark Joshi, Xornam Apedoe, and Matthew Malensek

Abstract

As Computer Science departments nationally see increasing enrollments, first generation college students and students from low-income backgrounds can suffer due to larger class sizes, scarcity of resources (such as fewer opportunities and longer waits to meet one-on-one with the professor or teaching assistant), and lack of community. Computer science as a field continues to struggle with recruiting and retaining diverse students. This leads to students struggling to find a community of like-minded students with whom they can study, take classes, attend departmental events, and so on.

In our S-STEM project (Community Engaged Scholars in Computer Science), we are focused on promoting community engagement by providing students with opportunities to make connections in the department, in the university, and in the technical community. The first major project activity, a one-week Early Arrival program, took place just prior to the start of their first semester at our university. The program introduced students to educational resources on campus as well as preliminary computer science concepts. The Early Arrival program also included social activities with faculty, current students, student leaders from our department's student organizations, and tutors from the peer tutoring center in our department. The program was open to other incoming local freshmen as well. This helped students in our program make connections with other incoming students.

Based on the evaluation of the Early Arrival program, students found the introduction to the major requirements, hands-on sessions on Python and Unix, and a discussion of potential career paths for CS majors as the most useful sessions.

Index Terms

Community-Engaged Learning, Mentoring, Inclusive Excellence, Retention, Alumni Involvement

I. Introduction

With the increasing interest in Computer Science at the K-12 level [1], [2], more students are introduced to computing concepts before they come to college. Unfortunately, there is a vast range of exposure that students may get at their high school depending on their school district's offerings and their course choices. This is coupled with the fact that students from low-income families frequently have fewer opportunities to prepare for a career in Computer Science. When they transition to college [3], their enthusiasm and excitement to pursue Computer Science can fade away as they navigate large classrooms, multiple teaching assistants, aggressive peers, and overwhelmed instructors.

To help first-generation college students and students from low-income backgrounds succeed in their goal of successfully pursuing a career in Computer Science, we at the University of San Francisco started a community engagement-focused program that was funded by the NSF S-STEM program. Our "Community Engaged Scholars in Computer Science [4]" program is focused on promoting community engagement by providing students with a comprehensive suite of structured opportunities to learn from and to contribute back to the community. As a part of this program students will participate in six core activities: (1) an Early Arrival Program, (2) CS 101 - a course specifically designed to introduce them to campus and professional resources necessary for success, (3) cohort enrollment in Computer Science courses [5], (4) CS 301 - a course that will focus on career preparedness and engagement with the local technical community in our city, (5) alumni mentoring and (6) CS service learning [6], [7], [8] where students apply the technical knowledge they have gained in a way that gives back to the community. This paper describes what we learned from our experiences thus far, *specifically* with the Early Arrival Program.

The Early Arrival Program consisted of multiple activities designed to help students get familiarized with the university, the faculty and student groups in our department, and the preliminary fundamentals of Computer Science in Python. The goal was to help the incoming students form community on campus and introduce CS concepts that they could build on in their first semester. We learned a few lessons regarding the organization of the program based on the anonymous survey at the end of the program as well as from the external evaluators of our program who interviewed the students at the end of their first academic semester.

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II. Related Work

Despite a large number of initiatives to recruit and retain students in computing, attrition rates remain high particularly for students from underrepresented groups [9], [10]. Providing sustained support and vital community can be the difference between a student staying in the major or dropping out [11]. Engstrom and Tinto [11] found that students in academic learning communities, as proposed in our program, are far more likely to persist onto the next academic year as compared to their peers. The students in their study mentioned that they felt a "heightened sense of themselves as learners and it increased their confidence in their ability to succeed." The self-identity and self-efficacy benefits of such learning communities are significant.

Frequently, academically talented students from low-income families do not benefit from networking and mentoring [12], [9], resume and interview preparation, and so on, to successfully secure their first employment opportunity. These limitations coupled with any self-efficacy issues they may have can severely affect the internship/job search process as well as the negotiations on securing their first job.

In our S-STEM program, we are focused on creating a cohort [5] of academically talented students with financial need and supporting their success through community connections [3].

III. Approach - The Early Arrival Program

The Early Arrival program was designed to situate incoming scholars at the University of San Francisco (USF) and help them become familiar with the Computer Science major, the department, the university, and the local San Francisco area. We conducted a week-long workshop that consisted of a variety of activities, including the technical aspects of being successful in the CS major, campus life and helpful on-campus resources, and the social aspects related to making friends and finding community with peers and senior students in the department.

A. Computer Science-focused Activities

To prepare students with the fundamentals of Computer Science, we designed many activities based on our experience with incoming freshmen. We included an overview of technical concepts such as Python programming with a hands-on programming component, hands-on practice to gain familiarity with Unix-based operating systems, as well as an introduction to Computer Hardware. We used CS Unplugged activities [13] to familiarize students with Computer Science fundamentals before their first university course.

In additional to the technical aspects, we wanted to ensure student success with respect to major requirements. We provided students with an overview of the Computer Science major and a small group (4-1) advising session to ensure that they were familiar with the major requirements. This is particularly important as some students miss out on taking important courses in their first semester that may affect their eligibility to take courses in subsequent semesters.

B. Campus Resources for Student Success

In addition to the CS major related resources, we wanted the students to be aware of the many resources on campus that support student success. Resources related to studying strategies, time management, applying for an internship/job, and so on.

In collaboration with the Career Services Center at USF, we conducted an overview of potential careers in Computer Science session as well as a session to learn about all the helpful services available to students through the Career Services Center such as resume review, interview preparation, employer meet-ups, and networking events.

On our campus, every student has access to an academic success coach who can help the student learn about resources on campus and help the students develop skills to successfully meet the demands of our curriculum. We had representatives from the Campus Advising Services office present the various resources that students had access to, to help them succeed in their coursework.

The Learning Center on campus provided an informational session on tine management as well as an overview of *active study* tips. Time management for first-year college students is a major problem and leads to poor grades and students dropping out in some cases.

C. Community within the department

To familiarize students with the department and its faculty, staff, and student groups, we organized events such as the Faculty Scavenger Hunt as well as socials with student groups. The goal of the scavenger hunt was to meet faculty in an informal and fun way and to get to know some of them before the semester started.

The Computer Science Department at the USF has many student groups such as the ACM student chapter, the Women in Tech group, and the Diversineers group, that organize networking as well as fun events in the department. The student groups organized social events where they played board games, watched movies, and discussed their experiences with the department and faculty.

Fig. 1. Our Community-Engaged Scholars outside the SF Exploratorium (left) and inside the AutoDesk Gallery (right).

D. Engaging with the outside community

In order to help students who were new to the USF community and the San Francisco area, we organized off-campus events (such as field trips) as well as on-campus events that informed them about ways in which they could be engaged in off-campus community events. Mission Bit is one such local non-profit that trains software engineers to teach in the local schools and provides them with all the resources to teach effectively. The students heard from a representative from Mission Bit. They informed the students how they emphasize project-based, hands-on learning to help create an engaging community for students in local high schools.

We organized a field trip to the Exploratorium that is a "hands-on museum of science, art and human perception" that encourages experimentation and play. Figure 1 shows a photograph from the field trip. The students also enjoyed visiting the AutoDesk Gallery that showcases the creations made using AutoDesk products by designers from all over the world.

IV. Evaluation

In order to build a more robust community, we decided to invite a small number of local incoming freshmen from the Bay Area, to participate in the Early Arrival activities along with the six funded scholars. There were a total of fourteen participants in the Early Arrival program, composed of six scholars (those receiving financial support from the S-STEM grant) and eight local incoming freshmen. All fourteen participants responded to the survey, although one participant did not respond to all the survey questions.

At the end of the program, we conducted a survey to evaluate the efficacy of our activities. Based on the survey results, the sessions the students found most useful were the ones that included an introduction to the major requirements and a discussion of potential career paths for CS majors. Figure 2 shows that the CS Major overview, hands-on sessions (Python and Unix operating system), as well as the overview of computer hardware were found to be extremely/very useful by most students.

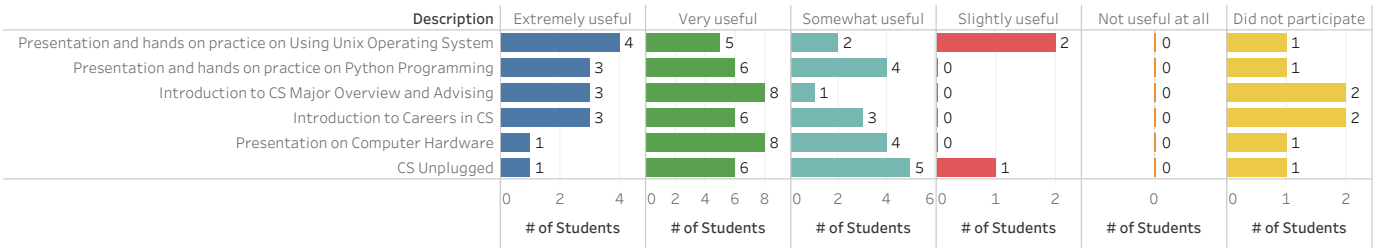

Fig. 2. **All** the Computer Science Activities were perceived as being extremely useful or very useful by the students.

Figure 3 shows student responses for workshops on campus resources. While the Career Services presentation was perceived as being extremely/very useful by most students, students were not as satisfied with workshops focused on general study skills and time management. In the future we plan to rework these sessions to include a clearer connection to the CS major.

A majority of the students were extremely satisfied with the organized social events with student leaders from Women in Tech and the Diversity in Computing (Diversineers) student groups in our department. The Faculty Scavenger Hunt was also rated highly by students. Figure 4 shows student feedback on those events. The field trips and overall faculty interaction were rated highly.

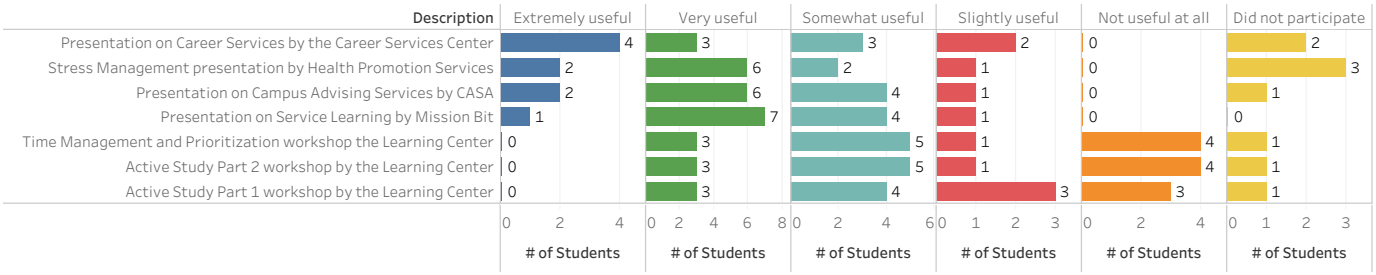

Fig. 3. Of all the campus-related presentations that the students participated in, the students seemed to find the ones by the Career Services Center the most useful. They found the presentations from the Learning Center to be *least* useful.

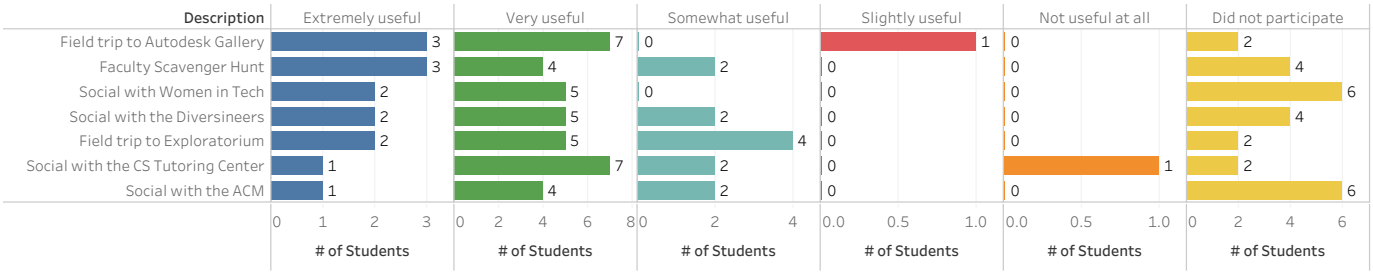

Fig. 4. While most of the social events were found to be useful and engaging, there were many events that students did not participate in. This could be due to the fact that attendance to these events was not mandatory and were usually scheduled at the end of the day during the week of the workshop. Many of the students had not moved into the residence halls and had to commute to our workshop. This may have affected their attendance for the social events with student groups.

A. Student Preparation

One of the key goals of the Early Arrival program is to build student confidence and a support structure that will encourage students to leverage available resources during their remaining years of study. All but one of the participants indicated that the early arrival program left them *very prepared* or *extremely prepared* to take advantage of the resources available in the college.

In addition to the survey conducted at the end of the week, our external evaluators conducted interviews with the scholars in our program. Here are a few student comments from the survey and the interviews related to the early arrival program:

- "Getting to know the community was amazing, and the information was **valuable** to receive."
- "I thought it was a **thoughtful**, helpful program that made me better overall as a CS student."
- "I think **one of the most important parts** was the early arrival program. [...]that one week was filled with so much that it was, we were told that it's going to be overwhelming and it was, but I think it mentally prepared us for what's coming. So that was really helpful. I think there was a lot of information but it was nothing that we didn't need."
- "In the early arrival week, we coded Python and [...] it helped me just get an understanding of what coding is. It definitely made my semester a lot easier because we did a whole month. I was a **whole month ahead** just off that week basically."
- "The early arrival program was **extremely helpful** because in a week or just a few days really, the panel covered most of what I will learn in this semester, and that supplemental information helped me understand the CS110 class better over time, because I kind of already learned it and then we got to learn it more in depth in the class itself."
- "In the early arrival program I developed a strong foundation of Python skills and they kind of also told us that it's less about the being specifically skilled at language and more just a general foundation of knowledge, which helped me focus more on the concepts in the class."
- "The early arrival program was really helpful because we learned things like knowing our way around GitHub and all about pulling and pushing. And then we learned how to use the computer monitors like logging into terminal using terminal commands and even things like connecting to the Slack channel, because my sister is also a CS major and she's a third year. She was like, "I didn't find out about the Slack channel until I was almost halfway through my second year.""

One student also expressed how the early arrival program had impacted their self-identity through the field trips - "being able to mentally prepare yourself for that type of workforce to go into, like when you're prepping for interviews or what we were talking about networking with different people, we know the environment they're in, so we know how to approach them."

We are encouraged by these survey results and student comments. We will continue to build on this early arrival experience as an important part of the larger project to prepare low-income, academically talented students for the technology workforce by offering a comprehensive suite of structured opportunities to learn from and contribute back to the departmental, technical, and broader local community.

V. Lessons Learned

A. Challenges with Cohorts

Creating a larger 'cohort' of students (six scholars from our program and eight local incoming freshmen) presented both opportunities and challenges. A major challenge when trying to maintain a cohort that can take courses together is their different levels of prior exposure to computer science. Due to the fact that students come to USF from a variety of backgrounds and preparation, some students had significant coding experience whereas some students did not have any. Consequently, not all the students were able to enroll in the same courses due to the fact that some of the incoming students had taken AP courses, scored at different levels in the Math Placement test, and some had even taken CS courses in high school. However, we found that our plan of mixing our funded scholars with local incoming freshmen worked well for building community, as our scholars were able to make connections within this larger cohort of incoming freshmen, ensuring that they were enrolled in the same courses with someone they already knew. We are considering modifying the early arrival program for next year to take into account the variance in preparation in the incoming cohort.

To foster a living learning community for all our incoming scholars, we want them to stay on the same floor in the residence halls. We worked closely with the *Housing Office* to make that happen. Our housing office was extremely helpful in making it happen and were flexible when there were certain last-minute changes. This may be a challenge at other universities. We did not anticipate the interest the other students participating in the early arrival program would have in moving in to campus early—despite being local commuting to campus every day was a challenge for a few students. We were able to accommodate some, but not all, of these last minute requests.

B. Improving the Early Arrival Program

Based on our evaluation at the end of the Early Arrival week, we found that other than the welcome reception event with students and their families, we did not have any general social event with faculty and other incoming students. We plan to organize a few more *social events with meals* to allow students and faculty to get to know each other better.

As per the student feedback shown in Figure 3, students were not as satisfied with workshops focused on general study skills and time management. In the future we plan to rework these sessions to include a more clear connection to the CS major. The Early Arrival program is just one part of our larger S-STEM project, and we look forward to offering additional community-building experiences that allow students to learn from and contribute back to the departmental, technical, and broader local community.

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