SFSU INCLUDES on SF CALL
(San Francisco Computing for All Levels and Learners)

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Abstract— In Fall 2016, our NSF INCLUDES pilot grant enabled us to develop a partnership and network (SF CALL K–20 ALLIANCE) to design and align a K–20 pathway to CS careers by broadening participation (BP) (1) at the K–12 level; (2) across key transitions between K–12 and college and at the college level; and (3) by coordinating cross–sector stakeholder support for K–20 STEM student success. We are targeting K–20 for BP to provide entry and reentry pathways for careers in computing. SF CALL also supports the development of student leadership groups to create inclusive communities of practice. Further supporting the transition from college to industry, SFSU has partnered with the SF Chamber of Commerce and the South San Francisco city government to develop industry internships for CS students. This is an on-going project that touches a very wide spectrum of inclusive computing education from K-20 to teacher preparation. In this paper, we focus on our efforts to build inclusive partnerships among all stakeholders and create a network to achieve the given goals.

Keywords— Computing, underrepresented, CS pathways

I. INTRODUCTION

Computer Science (CS) is one of the fastest growing areas of employment, a trend predicted to continue in the future [1]. By 2024 the US Bureau of Labor Statistics predicts that 1.1 million CS jobs will exist, but only 450,000 CS graduates will be available to fill them [2]. In addition, the field of CS suffers from a lack of diversity. In 2014, only 18% of bachelor degrees in CS were award to women, only 7% to African Americans, and only 10% to Hispanics/Latinos [3]—these numbers are far lower than one would expect based on these groups' share of the population.

In addition to signaling a substantial problem with educational equity [4], society has increasingly come to realize that this lack of diversity in the CS pipeline makes it difficult to carry out innovative work and avoid unnecessary mistakes [5]. The effects of researchers' pre-existing biases—stemming from factors such as gender and culture—on scientific research has been well established [6]. Personal experience influences the scientific questions that get asked, the way that data are gathered, and the way those data are interpreted [7]. Therefore, the fact that only 2% of Yahoo employees are black and only 4% are Hispanic—and that these numbers are typical in the tech world—is a problem that affects not only underrepresented (UR) groups, but society as a whole [8].

SF CALL K–20 ALLIANCE tries to address the above issues with equitable K–20 computing education by broadening participation (BP) (1) at the K–12 level; (2) across key transitions between K–12 and college and at the college level; and (3) by coordinating cross–sector stakeholder support for K–20 STEM student success. While working on this project, we have identified specific challenges as well as partners to collaborate on such challenges together. We present the background (Chapter 2), challenges (Chapter 3), partners (Chapter 4), our active progress (Chapter 5) and future work (Chapter 6).

II. BACKGROUND

Need for BP in the STEM Workforce.

The need for a robust and diverse workforce in science, technology, engineering and mathematics (STEM) is highlighted in many reports [9-12]. These reports outline strategies to address the persistent disparities in racial, ethnic, and gender representation in STEM by strengthening K–12 education, raising students' interests and motivation in STEM, and increasing the number of students from UR groups entering and completing STEM degrees [13]. BP and equity have become common parlance in STEM, especially in CS, Information Sciences/Technology (IS, IT) and Computer Engineering (CE), where underrepresentation persists [14]. Of serious concern is the underrepresentation of women, African Americans, Hispanics, Native Americans, and persons with disabilities in CS. This disparity is also reflected in the Advanced Placement CS exam (AP CS)[15]. Compared to the 2011/12 data, the 2015 AP CS statistics remain bleak [16, 17]. Of the 2015 test takers, 22% were female and 13% were from UR groups. In three U.S. states, none of female students took the exam; in 9 states, no African-American took the test [18]. In spite of having one of the most rapidly growing technology sectors in the nation, California has among the lowest AP CS participation rates in the U.S. Of Californian students taking the 2013/14 AP CS test just 2% were African American and 9% were Hispanic [19, 20], clearly highlighting the need for BP in the computing fields in California and across the U.S.

Need for Greater Inclusivity in CS Education

The above numbers are in stark contrast to interests in and commitments to computing education [21]. Computing permeates our lives, including the arts, finance, health care, manufacturing, music, security, and science and transcends all sectors of technology [22]. It plays a key role in the U.S. economy. A strong foundation in computing is critical for the U.S. to maintain a competitive and creative workforce, and is fundamental for STEM advances and innovations that drive economic growth [23]. Computing is among the fastest growing areas of the projected job growth. Employment of computer and information scientists is projected to grow by 11% from 2014 to 2024 [24]. By 2018, 49% of all STEM jobs in California are expected to be in computing [25, 26]. Thus, there must be enough graduates to fill the positions in CS, IT, CE, and related fields [27]. This worker-gap is exacerbated by a gender and ethnicity gap [28]. CS is the only STEM field, wherein the number of women earning Bachelor of Science (BS) degrees decreased, even after a modest increase in recent years [29]. The percentage of women studying CS at the BS level remains low (18%). The percentages for African Americans and Hispanics in CS, IT, and CE are even lower and account for only 4.1% and 7.7% of the BS degrees, respectively. Equally disheartening is that at maximum only 2% of graduates from UR groups are employed at major tech firms, such as Google, Facebook and Yahoo [30]. This is a problem that affects not only UR groups, but society as a whole [8] as the personal experience influences the scientific questions that get asked, the way that data are gathered, and the way those data are interpreted [7].

Education Initiatives to Open Pathways for a Diverse Workforce Proficient in Computing

To fill the projected workforce gaps, initiatives are underway nationwide to transform CS education. Excitement is created by multiple initiatives, to name the *K-12 Computer Science Framework [31]* the *Computer Science Teachers Association* (CSTA) K–12 CS Standards [32]; NSF's *Building a Foundation for CS for All [33]* and *STEM+ Computing Partnerships* [34]; Code.org; and the White House initiative *Computer Science for All*. The latter is designed to empower all students in the U.S. from kindergarten through high school (K–12) to learn CS and be equipped with the computational thinking needed to be digital creators, not just consumers, and to become active contributors to a technology-driven world. In 2015, the San Francisco Unified School District (SFUSD) Board of Education unanimously adopted a resolution to expand CS classes across their K–12 schools. The district has several initiatives in place to expand student access to CS courses across the grade bands, especially the students from groups underrepresented in computing fields. This includes increasing numbers of teachers to teach CS courses. As programs continue to grow, the district is attentive to the need to provide teachers of diverse backgrounds with a wide range of professional supports.

SF CALL (San Francisco Computing for All Levels and Learners)

In 2016, the NSF awarded San Francisco State University (SFSU) an NSF INCLUDES grant to create equitable K–20 CS career pathways across the San Francisco Bay Area beginning with strategic partnerships between SFSU and SFUSD. SFSU CS faculty and SFUSD content specialists collaboratively provide professional development workshops for district teachers, and pedagogical support for CS majors who serve as classroom assistants directly in district middle school and high school CS classrooms. SFSU CS faculty also collaborate with district staff to develop the K-12 CS curriculum. At the transition from high school to college, the SFSU Metro Academies provide intensive mentoring for at-risk students in CS related majors at SFSU and City College of San Francisco, the two most common colleges attended by SFUSD students. In college, SFSU has developed innovative supplemental instruction workshops for difficult bottleneck CS courses. These workshops are taught by pairs of near-peers, successful upper-division students. This model has been proven to increase grades and student success. CS faculty are revising the pedagogy of these courses by infusing more problem-solving and design projects into the CS curriculum.

III. Challenges

CS is only taught in a small number of U.S. schools

Despite its critical importance, CS is only taught in a small number of U.S. schools. Of the roughly 42,000 U.S. high schools (HS) only 2,100 were certified to teach the AP CS course in 2011. In California, 56% of all public HS did not offer a CS course in 2013/14 and only 1% of the students in the largest school district are enrolled in CS courses. Of the HS students enrolled in 2015/16 in the SFUSD, only 6% took CS courses. Even worse, nearly 75% of schools with the highest fraction of UR students do not offer CS courses and only 4% of schools with the highest percentage of low-income students offer AP CS courses. Thus, the commitment of the SFUSD to invigorate computing preK–12 and to ensure that the roughly 55,000 students in the district graduate with college– and career–readiness is timely, laudable, and visionary.

Lack of research on best practices in teaching and learning CS, lack of established CS curricula and teaching credentials

Even populous states, such as California, are only very recently developing CS Supplementary Authorizations aligned with a 21st century vision for CS teaching and learning [40, 41]. Compounding this challenge is that many schools, including those with large UR student population, too often only teach rudimentary computing skills but fail to engage students in understanding and applying principles underlying computing.[i] Although a few school boards, like the SFUSD, are fully committed to K–12 computing education, they are all facing same challenges – lack of teachers, lack of established curriculum, and lack of pedagogies that motivate wide student

body. For example, SFUSD faces a severe imbalance in the level of computing education available across all middle schools, which creates corresponding challenges for high school computing courses. CS teachers are required to be proficient not only on content knowledge but also highly flexible differentiating pedagogies/curricula.

Creating Inclusive Learning Community

The first step toward producing a large and diverse pool of individuals with a computing foundation is to educate a large and diverse pool of students. However, the STEM education literature highlights a number of barriers that prevent students from seeking CS education and succeeding in CS. Often a presumption of background knowledge and experience, as well as physical indicators of social belonging, send powerful messages to potential students. This can trigger stereotype threat, the phenomenon in which students who fall outside of the norm unwittingly conform to stereotypes of their group, due to the stress of knowing others' low expectations of them [43-46]. Science students who choose their major in part to avoid the intensive quantitative course work required in a field such as CS may be especially at risk of failing to acquire valuable computational skills [47], and their lack of confidence in their ability to learn CS may lead to imposter syndrome [48], which can reduce their desire to participate in CS courses. In addition, when CS classes are taught without iterative formative assessment and attention to learners' interests, instructors may overestimate students' starting knowledge, leading to assignments that are too difficult and fail to engage students' interest [49,50].

Our conversations with SFSU students confirm that they have experienced these barriers. Most of our students report they felt alienated by computers and mathematics from a young age, as well as feeling unsure which CS class would be a good place to start. Other students report that they experienced disappointment after enrolling in a CS class because

- The classes seemed difficult and abstract, and the students had difficulty seeing how the skills they were learning could be applied to real-life problems; **(content that seems irrelevant)**
- Many other students in the class already had programming experience, and thus beginner classes were not really geared to beginners; **(imposter syndrome)**
- They found themselves the only women or UR student in the room; **(stereotype threat)**

As a result, many students perceive obtaining CS skills as too daunting and elect to study something else. Other students attempt CS courses but find learning is an uphill battle: overwhelming evidence shows that stereotype threat leads to academic underperformance [51-53]. SFUSD teachers also face same barriers while taking the credential courses or even while teaching in classroom **(imposter syndrome)**.

IV. Developing Collaborative Network

We value the development of a collaborative network that can catalyze a collective impact framework. We have actively reached out to partners such as CAHSI (Computing Alliance of Hispanic Serving Institutions) [54] and joined the Northern California CAHSI chapter. We have learned and begun to adopt best practices that CAHSI has identified for computing education that supports UR groups, and are sharing our experiences and planning activities together to continue to create a collective impact framework.

We work synergistically with Promoting Inclusivity in Computing (PINC) [55] to proactively deliver computing education to an established diverse STEM community, such as Biology, by offering a Computing Application minor. In its 2nd year, the SFSU PINC program educates 46 life science students with a specific sequence of CS courses. The PINC students (75% women and 40% URG) will serve as a very diverse set of role models as they enter SFUSD CS classrooms as teaching assistants.

We collaborate with SFSU's Metro College Success Program to include CS (Currently CS is not included in the Metro program). The Metro program provides a personalized education home for students at SFSU during their first 2 semesters, to improve equity and graduation rates. Our focus on creating a collaborative and inclusive environment will attract and retain Metro students, many of whom come from UR groups, once they have completed the Metro program.

We also started the partnership with Tech SF, a local community organization with an aggressive agenda focused on diversity goals in recruitment, enrollment, completion and placement in post-secondary education or employment. Our students will receive job coaching, additional educational opportunities through in-person or online learning, access to employer networks and job/apprenticeship placement services for free.

V. Active Progress

A. Summer Professional Development

In BP of K-12 computing education, high quality teachers are in the core by cultivating interests of all students. Beginning in January 2017, we started to prepare for a one-week summer PD for prospective and current SFUSD CS teachers. We reached out for collaborators such as Prof. Jamal Cooks, an expert in culturally relevant pedagogy (CRP), to infuse CRP in our PD curriculum. We established a diverse instructional team and put focused efforts to integrate multiple pedagogical strategies (Collaboration, Culturally Relevant Pedagogy, Differentiation, Supporting English Language Learners, and Assessment) into CS content courses and workshops [56].

In summer 2017, SFUSD teachers at all levels (elementary, middle, and high school) attended a one-week SF CALL summer institute that focused on fostering teacher self-efficacy, improving CS content knowledge, developing culturally relevant, student centered pedagogy, and equity based recruitment and support strategies. Teachers could elect to participate in all five days of the program and a list of each day's topics was made available to teachers who had the

option of choosing individual days. Curricula for each level are listed below:

Elementary (K-2 Creative Computing): Scratch Jr.

Elementary (3-5 Creative computing): Scratch

Middle school 1: MyCS. MyCS is an introductory CS curriculum designed to help all students understand the relevance and significance of CS. It was originally created by CS faculty at Harvey Mudd College. Students learn about algorithms, data, robotics, and impacts of computing, as well as how to program in Scratch. The CS team recently rewrote the curriculum based on teacher feedback. The revised curriculum will enable students to create animations, games, mazes, art, music, and robotics while learning fundamental CS concepts and skills.

Middle school 2: App Inventor. App Inventor is a second-level CS curriculum designed for students who have already taken MyCS. Students learn to design and develop real, downloadable apps for Android devices using a tool created by Google and MIT. These apps include a soundboard, drawing app, quiz, slideshow, and various games. In their final projects, students will apply design thinking to collaboratively develop an app that will be used to address a community need or challenge for positive social impact.

Middle school 3: CS Discoveries. CS Discoveries is designed for students who have already taken MyCS and App Inventor, and is currently being adapted from a new curriculum created by Code.org. Students will build upon their foundation in CS and learn text-based programming to create interactive animations and games in JavaScript. In addition, students will learn about the relationship between hardware and software while building interactive projects with Arduinos.

High school teachers expressed a need for additional CS content and the following three topics were offered based on teacher requests:

Internet Applications: Teachers followed the path of an application from back-end to user. The day was spent delving into client-server architecture, HTTP protocol, server side applications (PHP), and client side.

Internet of Things: Teachers learned the basics of the Internet of Things through in-depth use of Arduinos. The two days included:

- *Electronics 101:* Introduction to the basics of electronic components such as resistors and LEDs. Teachers had hands-on instruction connecting components via a solderless prototyping board.
- *Introduction to the Arduino:* Following up on Electronics 101, teachers were introduced to embedded C programming, using the Arduino IDE to upload sketches, and ended building an electronic random dice application.

Cyber Security: Teachers were introduced to the core concepts associated with cybersecurity through hands-on exercises. The topics covered are:

- *Day 1 (Cryptography):* Motivation, Cryptosystem, Encryption and Decryption, and Data Integrity
- *Day 2 (Network Security):* Computer Networks and Internet, DNS Name Resolution, Cache Poisoning Attack, and DNSSEC.

For some parts of the days, teachers were grouped together across grade levels while in other parts of the day elementary, middle, and high school teachers were separated and focused on activities that could be used in classrooms at each level. A sample of daily schedule is shown in Figure 1. There were pre- and post- workshop surveys, as well as daily surveys, to measure the effectiveness of the summer institute.

	Monday, 8/7				Tuesday, 8/8			
	K-5	MyCS	AppInv	HS	K-5	MyCS	AppInv	HS
8:30-8:50	Breakfast & Networking				Breakfast & Networking			
8:50-10:00	Welcome + Collaboration				Culturally Relevant Pedagogy			
10:00-12:00	Unplugged CS	Intro + Unit 0	Intro + Unit 0 *(Events)*	Internet Appli-cations	Bee Bots	Unit 2: Animation *(Loops)*	Unit 2: Paint Pot *(Vari-ables)*	Internet of Things
12:00-12:45	Lunch				Lunch			
12:45-1:30	Conditionals (Selection)			Internet Appli-cation *Project*	Loops (Iteration)			Internet of Things
1:30-2:30	Scratch Jr.	Unit 1: Motion *(Events, Initial-ization)* + Inter-sessions	Unit 1: Sound-board App *(Cond-itionals)*		Scratch Jr	Unit 3: Games *(Cond-itionals)*	Unit 2: Paint Pot *(Vari-ables)*	
2:30-3:00								
3:00-4:00					Creative Project: Design			
4:00-4:30	Close-Out				Close-Out			
Key:	General / Reflection *(room 39)*				CS Pedagogy *(room 39)*			
	Design Project *(room 39)*				Networking & Eating! *(food in room 44)*			
Big Goals:	1) Build community.				2) Deepen knowledge and skills in computer science (CS).			

Figure 1. A sample schedule of summer PD. Full version is available at *https://gcoe.sfsu.edu/2017-san-francisco-computer-science-summer-institute*

SFUSD leadership surveyed teacher participants each day. We have begun the analysis of 106 teacher responses to the surveys which included Likert scale prompts concerning the usefulness of different components of the days' sessions as well as open ended prompts about what parts were most useful and how the sessions could be improved. Pre- and post-survey questions at the beginning and the end of the week also asked what teachers hoped to learn from the institute and asked for Likert scale ratings on how prepared teachers felt about different aspects of the professional development (Figure 2 & 3). Overall, teachers gave high usefulness ratings to individual sessions and reported increased confidence (between pre- and post-survey) in all grade bands with respect to both knowledge and skills in CS and preparedness for helping students learn fundamental CS concepts and skills. Most open-ended survey prompts for the professional development survey contained positive feedback concerning the usefulness of the professional development. One clear

pattern from the comments highlighting room for improvement was that teachers would like greater differentiation within the offered professional development program. This was particularly the case for those teachers who had already experienced CS professional development. Feedback from teachers in the summer professional development suggests that the experience was valuable for advancing their knowledge of the content and pedagogy of CS teaching.

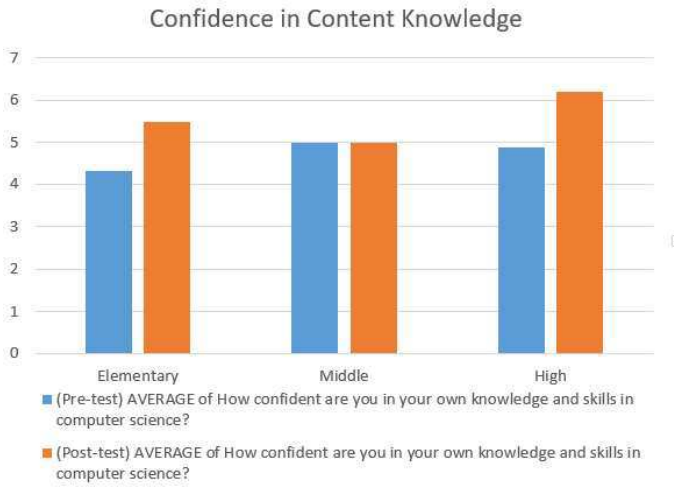

Figure 2. Pre-Post survey on confidence in CS content. Value ranges between 2-7 (2: not confident, 7: highly confident)

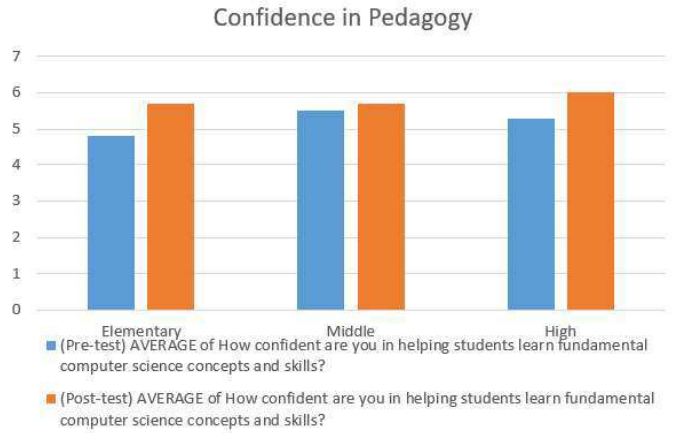

Figure 3. Pre & Pot survey on confidence in CS Pedagogy

B. *Learning by Teaching Course*

We also support the development of CS student leaders to help create support communities. In spring 2017, 12 SFSU CS majors were selected and trained to serve as teaching assistants (TAs) in SFUSD middle and high schools. The CS TAs not only served to support teachers and students in the classroom, but also brought back their observations to the lead faulty and their peers to work on continual improvement of Computing Education practices. This input was also used to further support the SFUSD teachers in the summer professional development. The course was so well received and successful by SFSU students and SFUSD teachers that it continued through the fall and had an overwhelming number of applications for the spring semester of 2018.

Course Design

This three-unit elective course is designed to offer unique learning experience to CS undergraduate junior or senior students. The CS students will assist SFUSD middle or high school teachers and students in their classrooms. Selected students were especially excited by the opportunity to contribute to the development of CS education for middle and high school students, recognizing that the development of CS pedagogical content knowledge is in its infancy.

Learning Objectives of the Course:

- **Soft Skills** needed to succeed in IT careers (Communication, collaboration, presentation skills, networking, positive attitude, etc.)
- **Best Practices for "active learning,"** that you can 1) apply to your students and 2) reflect on your own learning
- **Collaborative learning techniques** (Think-pair-share, small group discussion, group presentation, pair programming etc.)
- **How to teach** important programming building blocks using interactive and engaging applications

Concretize Computational Thinking Practices by reviewing

- Analysis of the Effects of Computation
- Usages of Abstractions and Models
- Analysis of Problems and Artifacts
- Communicating Processes and Results

Students will practice and solidify CS principles as you

- **Teach and communicate** with teachers and young students in grades 6-12
- **Learn techniques** for supporting teachers and teaching students
- **Review and revise** current high school and middle school curriculum and programming projects

Communicate Seven Big Ideas of CS with teachers and 6-12 students.

Grading

2 Lesson Plans	40 points (20 points each)
FINAL Report	20 points
Participation Activities	20 points
Feedback from SFUSD teachers	20 points

Teacher Feedback

Students were expected to serve at SFUSD middle or high schools for 4-5 hours per week. SFUSD teachers' response to having a knowledgeable TA in the CS classroom was overwhelmingly positive. 74% of the teachers evaluated the TAs as "Very Helpful," and 95% indicated "Helpful" or "Very Helpful." Some of the ways the teachers noted as helpful include: discussing best practices, answering technical questions for both the students and teachers, helping to explain

concepts to the students and providing one-on-one support. When assessing the TAs, teachers used the words "awesome," "great asset," "valuable addition," "great help," and "invaluable." One teacher commented, "I can't say enough about him and the work he did in my classroom." Specifically, teachers were appreciative of having the help and support for content knowledge including ". . . helping with code I didn't know." Another teacher commented, "As a new teacher to CS, it was great to bounce lesson ideas off him and ask him technical questions." "...Alex is very knowledgeable and I learned about version control in GitHub from him. He is patient with my students and works well with all of them. He seems to really enjoy interacting with students." "...Joey went above and beyond in helping me with Raspberry Pis in the classroom. He created an excellent presentation for the students on how to build circuits and write programs that use the circuits. I would really have struggled through that week without Joey's help" "...He was especially helpful with one Spanish speaking student, assisting him in his native language."

SFUSD teachers also reported that middle and high school students feel a lot more connected with the TAs and enjoy learning and talking with them. TAs who have a student centered approach to learning CS content provided a valuable presence and became role models for the younger students. SFSU CS faculty have worked to identify undergraduate TAs who reflect the diversity of the San Francisco communities in which they serve. For example, the SFSU faculty member who is responsible for recruitment was able to meet a teacher request for a TA with Chinese language fluency assigned to help in a classroom with many native speakers.

During the spring and fall semesters of 2017, upwards of 800 students and 17 teachers benefited from having the TAs in the classrooms. Using "near peers" also proved effective as the TAs were able to form relationships with students over the course of the semester. The biggest evidence of success for the teachers is that 100% of them indicated they would like to continue having a TA in the classrooms.

TA Students Feedback

Similarly, many of the TAs themselves reported that they learned from their experience participating in the project. While the numbers are small with responses collected in only a single semester, TAs reported a wide range of reasons for participating in the program in surveys including interest in gaining teaching experience (4), learning more CS (2), and developing communication skills (2). In addition to the SF CALL stipend, TA's reported the following benefits to participating in the program. When asked, most said they would recommend it to a friend. Students went on to describe the value of experience explaining complex computing concepts to young people.

- Several TAs noted that practice communicating about complex computing ideas in the simplest language possible has helped several TAs sharpen their own understanding of the ideas.
- Several TAs believe that experience communicating clearly about computing will be helpful in future careers. Examples include the future need to communicate with clients or onboarding new staff.

This was also exhibited in the development of TA confidence and communication skills while they learned both the material and student behavior. They also reported that their understanding of CS was enhanced as they explained the concepts and developed lessons.

Beyond CS, the TAs learned about the public school system and teaching in general. At least one of the TAs indicated that teaching might be a near-term professional choice, while others indicated that teaching might be one of their long-term goals. Another expressed interests in developing an after-school "Hacker club" in the following semester. While several brought new ideas into the classroom, one introduced the teacher and the class to GitHub for classroom use, including developing lesson plans and teaching the class.

TA Students Observations

Within the same school district, there are huge gaps between classes. The main focus of the equity-oriented discussion was on differences across schools. Some common themes concerning CS instruction in SFUSD and the support that TAs can provide included the following:

- CS programming environments vary a great deal across the classes that students are supporting and this occasions reflections on advantages and disadvantages of each in instructional settings
- Some of the TAs report working in schools with enough technology to meet instructional needs (one student said her teacher has "a wealth of materials") while others reported working in schools with resource needs.
- Through their experiences in the schools and opportunities to talk with one another, TAs gained insight into inequality in schools- TA's notice that the level of rigor and expectations about student capacity varies across schools

These are quotes from students' observations. "*Teacher added some great small details to the curriculum which I think were an excellent addition. First, immediately when the students walk in, they're given a "do now" activity to complete. The "Do now" activity composed of blocks of code, small problems, or a question for the students related to the lecture. Students may either speak with their classmates or seek help from myself and the professor. I think this addition is extremely valuable, because it gives a small warm up period for the students to acclimate their thinking towards programming before the bulk of the session starts, furthermore it promotes more in class dialogue with the lecturer.*" "*Teacher was incredibly skilled in his field and was a great teacher to show me the ropes. His lesson plans were very understandable and were right to the point with*

interaction between students being a key attribute" "*The students got 2 or 3 assignments to do on code.org. I think code.org is a great learning tool. However doing it individually everyday grew boring for many of the students which is why many of them refused to work. Having no full class instruction and little student-teacher interaction is one of the reasons why the students disliked the class so much.*" "*... I've seen their report cards. With a few exceptions, most of the kids had low grades in this CS Discoveries class, but significantly higher grades in all their other classes. It was obvious that there was a problem in the classroom that wasn't the fault of the students. I think with a more engaging classroom environment these students would be a lot more eager to learn and succeed in the class.*"

VI. Future Work

CS Education is still in its infancy and it suffers the lack of diversity greatly. Our NSF INCLUDES pilot grant enabled us to address this issue with a partnership and collaborative network. During its first year, we focused on developing this collaboration, identifying challenges, designing and developing solutions. During the next year, we will revise the summer institute to address more integrated pedagogy and CS contents and teachers can take this professional development as a part of their credential program. SFSU is developing supplementary authorization courses as well as a General Education Quantitative Reasoning course to attract women and UR into computing area. "Learning by Teaching" course will be more thoroughly assessed, so we can measure the impact on students and teachers more closely. We also look forward to synergistic results of collaborative network and partnerships.

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