CS for All: An Intersectional Approach to Unpacking Equity in Computer Science Education

AERA 2019 Poster Session Proposal
Division C, Section 1e
(Learning & Instruction, Engineering & Computer Science)

Session Chairs: Jean J. Ryoo & Joanna Goode

Discussant: Karen King

Overall Poster Session Abstract (120 words)
Efforts to broaden participation in computing are addressing how systemic school structures, educator preparation, and curriculum can provide inclusive learning spaces for all students. The emerging multiplicity of scholarship in computer science (CS) education forwards diverse voices, perspectives, and positionalities, and together, provide a rich set of evidence-based narratives that can transform K-12 policies and practices. The eleven posters featured in this session bring together CS projects with varying methodologies focused on equity-oriented pedagogies and learning for all youth across the US, and each poster addresses how: (1) equity is being defined; (2) specific project and research efforts are impacting equity; and (3) efforts to inform teacher practice with attention to multimodality and diverse voices in research methodology and dissemination.

Overall Poster Session Overview (497 words)

Introduction

The Computer Science for All Movement is taking over the nation and world as administrators, educators, parents, students, and researchers recognize the pressing need to democratize access to quality computing education for *all* students. International educational policies around Computer Science (CS) reflect a shift away from designating CS as an enrichment subject in schools, toward ensuring all students experience quality CS learning. This effort to broaden participation in computing is a united response to research revealing that youth of color and females have been systematically denied access to CS courses, especially in low-income schools, resulting in segregated CS education and career pathways (Margolis et al., 2017).

The variety of efforts to broaden participation in computing—with the creation of new curricula, teacher education programs, policy, and assessments—has led to a growing body of research focused on equity in CS education. Yet questions remain about the impacts of CS for All efforts on historically underrepresented students' experiences and engagement with CS, teachers' perceptions of their roles in broadening participation in computing, pedagogical practices for inclusive CS learning, and structures/policies impacting teaching and learning.

Session Overview and Objectives

Responding to AERA 2019's call to challenge the siloes separating our various CS for All efforts, this session seeks to build conversation across diverse stakeholders from the most current CS education research projects focused on issues of equity. Representing a range of

methodologies and contexts across the US that seek to have direct impact on supporting equity-oriented pedagogies and learning experiences for *all* youth, presenters will share how: (1) equity is being defined in their research/program; (2) their CS for All efforts impact equity issues in CS education; and (3) they directly inform the development of professionals and their practice by attending to multimodality and diversity of voice in their methodology and/or approach to dissemination of findings. Together we hope to develop a shared understanding for the multitude of ways we can build narratives across different research efforts that positively impact computing learning for *all*.

Session Structure

This poster session, featuring 12 different projects, will open with a 5-minute introduction to the session, followed by one-minute overviews from each poster presenter. During the next 25 minutes, half the presenters will share key efforts/findings—allowing time for other presenters to visit their colleagues' posters and learn with one another—followed by another 25 minutes featuring the other half of the presenters. We will close with a 20-minute reflection and Q&A led by the discussant.

Scholarly Significance

As computing changes the way we live, study, and work, we must be mindful of who has access and opportunity to innovate and create with these technologies. Broadening participation in computing requires that we build on students' cultural knowledge and effective teacher pedagogy in ways that bring together diverse voices across the CS education landscape. To truly achieve CS for All, scholars and practitioners must inform each other's work through a lens of equity, inclusion, and narratives from communities that have been historically marginalized.

INDIVIDUAL POSTER DESCRIPTIONS

Poster #1 Title: Translanguaging as a frame for more equitable computer science learning

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Poster #1 Summary (494 words):

One of the great challenges in the goals of "CS for All" is conceptualizing what the inclusiveness implied by "All" means. Our project uses the concept of translanguaging (García & Li Wei, 2014) both as an explanatory framework to understand how learners leverage their linguistic resources into new activities such as reading and writing computer code, and as a pedagogical framework to support a diversity of learners' linguistic backgrounds. In this poster, we describe challenges for including learners who are emergent bilinguals in the CS for All

movement, and ways our approach to inclusion addresses these, and might apply to monolingual learners as well.

Traditionally, learners who are linguistic minorities are marginalized by schooling. Emergent bilinguals make up a significant portion of the school population nationally and especially in New York City where 41% of students speak a language other than English at home (Office of English Language Learners, 2013). Translanguaging pedagogy, an outgrowth of translanguaging theory, is a framework for supporting learners to leverage the breadth of their linguistic resources (García, Johnson, & Seltzer, 2017).

Our project uses translanguaging pedagogy and a technique from computer science, *literate programming* (Knuth, 1984), to support CS Education in bilingual New York City middle schools. In line with the translanguaging pedagogy approach, rather than creating a "Spanish CS" and an "English CS" curriculum, our project works with teachers to co-design units that can draw on and utilize students' diverse linguistic backgrounds. Teachers and researchers create units that use the multilingual Scratch programming language, resources in English, Spanish, and other languages, and other communicative resources to help incorporate computing in their school subjects. We present data from one bilingual Language Arts classroom in which students wrote software simulating interviewing a character in a story; both the characters and the interviewers could use whatever language was appropriate. In several cases, this led to students collaborating and peer teaching using a variety of translanguaging strategies including drawing on multiple named languages, gestures, drawings, and the code itself.

In developing approaches to build on the variety of linguistic resources students bring to their learning, we incorporate the perspective of Gutiérrez and Rogoff (2003) which cautions against seeing diversity as simply demographic, while not respecting the individual histories learners bring. In our setting, emergent bilingual students are not monolithic. They vary in terms of their age, race, genders, schooling histories, and immigration experiences. Some have experience reading and writing the standard named languages of school, others may be more comfortable using oral varieties common to their communities or home countries. By creating opportunities for students learning to code to bring their strengths in language -- *whatever those strengths are* -- we hope to build a more inclusive model for computer science education. Also, we have seen emergent bilinguals translanguage not only using English and Spanish words, but also using other semiotic resources such as code blocks, keywords and gesture to express themselves. This suggests even monolingual students may benefit from our approach.

Poster #2 Title: Toward Using Virtual Identities in Computer Science Learning for Broadening Participation

Poster #2 Authors:
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Poster #2 Summary (499 Words):

This paper presents an overview of key aspects of our computer science education project. It elaborates in-workshop breakout groups not yet reported elsewhere and summarizes key outcomes. Our research seeks to discover best practices for using avatars to enhance performance, engagement, and STEM identity development for diverse public middle and high school computer science students. At sites of our research we run workshops in which students:

- learn computer science in fun, relevant ways, and
- develop self-images as computer scientists.

Our workshops involve eliciting student-generated themes, questions, challenges, and goals. This process includes taking an anti-deficit ideological stance on students and their achievement. We have also developed our own custom platform called [BLINDED], used in the workshops, that allows students to explore their own ideas by creating customized games while learning about human-computer interaction, web design, privacy, coding, debugging, and more (we utilize aspects of the nationally recognized Exploring Computer Science (ECS) curriculum). Students ideas were guided within the context of the following set of topics:

a. how companies make money off your data (Mo' Money, Mo' Problems)
b. how people are represented in computer science (Stereotypes)
c. how people and companies manage privacies and related issues (Surveillance)
d. how we socialize with others online (Social Connections)

Student discussion of these topics was facilitated with students ultimately choosing which topic to focus their own game on. They then were led through a paper prototyping process in which they brainstormed themes, consolidated ideas, conceptualized their own game, then coded it. Subsequently, they went through a round of quality assurance by exchanging their games with other student participants who gave feedback. All students then refined their game based on the feedback and presented their game to the group.

A core component of [BLINDED] is our game for learning programming called [BLINDED] in which play requires learning building blocks of coding. Ultimately, we approach STEM education and access to high quality, relevant learning opportunities as a social justice issue of our time.

Using qualitative, quantitative, and AI/machine learning analysis techniques, we have already formulated a few best practices and guidelines when it comes to avatar use in education. We have also systematically explored the impacts of different avatar types on users, beginning with distinctions between anthropomorphic vs. non-anthropomorphic avatars, user likeness vs. non-likeness avatars, and other conditions informed by insights from the learning sciences and sociology in crowd-sourced studies (with over 10,000 participants).

Taken together, our studies have revealed that avatars can support, or harm, student performance and engagement. A few notable trends are:

1) 'role model' avatars (in particular scientist avatars) are positively effective,
2) 'likeness' avatars (avatars in a user's likeness) are not always positively effective,
3) simple 'abstract' avatars (such as geometric shapes) are especially positively effective when the player is undergoing failure, e.g., 'debugging,' and
4) 'successful likeness' avatars that look like the user when doing well and appear 'abstract' otherwise are very positively effective.

In summary, our poster elaborates key design features and a summary of project results.

Poster #3 Title: Race(ing) to CS for All: Disrupting Colorblind Discourse in Professional Development

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Poster #3 Summary (456 words):

Efforts to broaden participation in computers science often focuses on developing teacher knowledge in computing so that more students, and more diverse groups of students, have increased access to computer science learning. Yet, without explicitly addressing issues of inequities linked to race and opportunity, school reform initiatives fail to achieve the goals of desegregation and instead perpetuate the racist myth of 'separate and equal' (Cochran-Smith, 1995; Wells, 2014; Bonilla-Silva, 2013). Integrating instruction that focuses on race and computer science in teacher education provides opportunities to disrupt colorblind dialogue that can materialize as evading discourses, individualistic discourses, or deflection discourses (Segall & Garrett, 2013). This poster reports on a study that employed a critical discourse analysis to understand the following question: How and when do teachers dialogue around issues of race and equity in relationship to teaching and learning computer science?

This mixed-methods study took place in a week-long, residential PD workshop designed to prepare teachers from across the United States to instruct an Exploring Computer Science (ECS) course at the high school level. About a third of the teachers returned from a previous summer ECS PD to extend their learning. We collected a pre-PD survey, a post-PD survey, and field notes throughout the week as teachers engaged in their professional learning. This mixed-methods data allowed us to examine how teachers discuss race and equity in the context of teaching computer science, and how teachers' belief systems and discourse might change over time in a professional learning environment that centers equity and inclusion.

Our findings demonstrated a wide range of how teachers engage in conversations about equity and access. Many teachers used colorblind language, such as "they", "them", "those students", even when engaging in research readings and curricular lessons that center race in computer science. Some teachers discussed their discomfort with teaching lessons about cornrows and computing, expressing doubt and uncertainty about the inclusion of this lesson and their own professional ability to teach this lesson to their students. Yet, we also found that the returning teachers, who were often engaging in conversations for the second year around race and computer science education, were more confident, direct, and explicit about race and racism when discussing issues of access and inclusion in computer science.

The results of this study provide insights on how teachers dialogue about race in computer science education and indicates that the integration of scholarly readings and curricular lessons that center on race are essential ingredients for fostering conversations about how to successfully engage students of color in computer science classrooms. Further, the significant differences between how second-year teachers openly engaged in dialogue around race, as compared to first-year teachers, indicates the value of a long-term and multi-cohort model of professional development in computer science.

Poster #4 Title: Study of Access and Outcomes from Advanced Computer Science Coursework in an Urban Setting

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Poster #4 Summary (499 words):

The Chicago Public Schools (CPS) has taken a unique approach to broadening participation of low-income students, students of color, and girls by establishing Computer Science (CS) as a high school graduation requirement. This policy ensures that all CPS high school students will take a CS course, starting with the class of 2020. However, equity is more than just access. We define equity as equivalence in both the quality and outcomes of CS experiences. *Exploring Computer Science* (ECS) is the foundational course that fulfills the CPS requirement. Through ECS professional development, the number of qualified ECS teachers has grown. Two years into policy implementation, three-fourths of the schools offered ECS. Our prior research has shown that ECS participation rates by race, gender, and income closely reflect representation of the corresponding populations in CPS. In addition, student performance on the ECS end-of-course assessment was equivalent by race, gender, and income level. This evidence suggests that the CPS graduation policy is contributing towards equitable access to introductory CS with equitable course outcomes.

Another outcome of interest is the equitable pursuit of advanced CS. Our primary research question for this poster is the extent to which there is equitable representation and outcomes of students who pursue advanced CS coursework in CPS. In particular, we focused on enrollment in the AP Computer Science A (CSA) and AP Computer Science Principles (CSP) courses from the 2014–15 to the 2017–18 school year. The 2014–15 school year was the first year that the CSP course was pilot tested in CPS, and the 2016–17 school year was the first year that the CSP exam was available. For every student enrolled in either AP CS course, the dataset included race, gender, special education status, English language learner status, free and reduced lunch status, overall GPA, AP course grade, and AP exam score. During the target period, enrollment in CSA declined from a high of 220 to a low of 136 students, while CSP enrollment increased from a pilot of 29 students to 693 students. The combined representation of students by race and gender in both courses was not reflective of the district's student demographics. However, student representation by race and gender was closer to the district representation for CSP than for CSA. We conducted a multiple regression of the factors that correlated with the AP exam performance. The students' overall GPA and the grade in the course were significantly correlated with exam scores. Girls scored statistically lower than boys and Latinx students scored statistically lower than Caucasian, Asian, and African-American students. Students who took ECS prior to CSP scored statistically higher on the CSP exam.

These results show promise that using ECS as a foundation course is helpful for students who go on to pursue AP CSP. However, more work needs to be done to capitalize on the success of ECS to encourage CPS schools to offer AP CS courses and to encourage girls and students from underrepresented minority groups to pursue advanced CS coursework.

Poster #5 Title: Using a Research-Practice Partnership to Bolster CS Education: Challenges and Opportunities for Equity

Poster #5 Authors:
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Poster #5 Summary (XX words):
This poster describes a research-practice partnership (RPP) that addresses equity in computer science (CS) education, defined as reducing the disparity in students' access to quality opportunities and ongoing support. The purpose is to show how efforts to broaden participation must work within institutional contexts that have other demands and priorities. While most school districts welcome time-limited classes or events, these tend to attract students that are already interested or have access to CS and are less likely to create CS for All. Reducing inequities requires the integration of CS into existing educational practices and priorities. It also requires critical reflection on implementation, including attention to the preferences as well as the political goals of key stakeholders, including teachers, parents, students, and industry (Vakil, 2018). Our CS for All effort focuses on 3rd-8th grade students in a small, California school district where the student population is 38% Hispanic/Latino and 25% English learners, with 35% eligible for free/reduced lunch. The RPP includes the school district, a non-profit research organization, and a local education foundation.

We use the conceptual framework of absorptive capacity (Farrell & Coburn, 2017) to understand the conditions under which institutional changes can be made. "A district's absorptive capacity is its ability to recognize the value of new information, assimilate it, and apply it in novel ways" (Farrell & Coburn, 2017, p. 141). In this framework, the organizational features that contribute to absorptive capacity include prior knowledge and expertise, communication pathways, and strategic knowledge leadership. The needed qualities of the external partners are to provide guidance that is clear and adds value, to be flexible and adaptive, and to align norms and work practices.

A narrative ethnography analytic approach (Gubrium & Holstein, 2009) is used to describe the organizational features of the school district, as well as the qualities of both the research team and education foundation. Data come from the interactions between researchers, teachers, district administrators, and representatives from the education foundation. Specifically, text from meeting notes, emails, and conversations was analyzed along with notes generated using field-based methods of ethnography. A critical ethnographic approach is used to reflect on the narrative produced and the interpretation aligned with it (Carspecken, 2013), and to examine how different perspectives across the RPP were identified and negotiated.

Our results suggest that one of the challenges is the different expectations about pace and the impact of that on equity. School districts are organizations that move slowly as a way to protect themselves from ongoing change (Cohen & Mehta, 2017). Our data suggest that

implementing CS without embedding it in research and district practices, or getting buy-in from teachers and parents, can, in some cases, turn students and teachers off to CS. On the other hand, delays in implementation run the risk of reinforcing the status quo, which are currently inequitable. Our poster will convey how the RPP has grappled with the identification of varying and sometimes conflicting perspectives on pacing, and what those mean for a broader pursuit of equity in CS education.

Poster #6 Title: Centering Youth Perspectives on Agency in CS Education

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Poster #6 Summary (498 words):

The CS for All movement has captured the interest of school districts, nonprofits, industry, and government leaders across the US, in recognition of the role Computer Science (CS) plays in our youth's future academic and career pathways. Yet as CS for All programs—such as Exploring Computer Science or Advanced Placement Computer Science Principles—scale nationwide, we must ensure that the movement does not unwittingly reinscribe current inequities in public education that have resulted in differential access to quality educators, curricula, academic expectations, etc. for our females, youth of color, immigrants, and rural students (Bobb, 2018; Margolis et al., 2008).

In order to keep equity at the center, our project seeks to understand how youth engagement, agency, and identity are being impacted, if at all, by efforts to broaden their participation in CS. Going beyond the "numbers" approach, we define equity as attending to the funds of knowledge and perspectives youth bring to their CS learning experiences, amplifying historically underrepresented youth's visions of what CS education can and should be, that can inform the CS for All movement.

Guided by sociocultural theories, this study understands learning as occurring through social activity influenced by cultural-historical artifacts (e.g., language, tools, etc.) mediating our interactions with each other and the world (Vygotsky, 1978; Wertsch, del Rio, & Alvarez, 1995). As such, in order to make sense of student agency, engagement, and identity in relation to CS, our research methods attend to individual learning in relation to interactions between people, with artifacts, and in the larger historical/cultural contexts of group activity in the classroom (Gutiérrez & Penuel, 2014). We define "agency" in terms of the ways students come to author and enact themselves in relation to their intentions to cause change in their own lives or those of others (Calabrese Barton & Tan, 2010; Basu, 2008). "Identity" is understood in terms of youth's: 1) access to a learning domain and the skills/concepts of that domain; 2) roles and responsibilities taken on in a shared space; and 3) opportunities to express oneself and make contributions to a setting in which one feels valued (Nasir & Hand, 2008, p. 148).

Our methods involve a Research-Practice Partnership (RPP)—a sustained, mutualistic collaboration across researchers and educators producing original analyses toward the improved use of research in decision making and educational outcomes (Coburn, Penuel, & Geil, 2013;

Tseng, 2012)—collecting ethnographic case studies of 15 underrepresented youth's CS learning experiences across three focal classrooms in a large urban school district. Data sources include weekly observation field notes, photos/videos, interviews, and student pre-/post-surveys that have been jointly analyzed with focal classroom educators in the RPP.

Findings describe the various ways that youth see their current and future selves in relation to CS, while exploring the salience of culturally responsive pedagogy in relation to youth identity and agency. The ways our project crosses the boundaries of teaching and research toward increasing our effort's impact and relevance to equity efforts in the CS for All movement are also shared.

Poster #7 Title: Using Online Practice Spaces to Investigate Challenges in Enacting Principles of Equitable Computer Science Teaching

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Poster #7 Summary (500 words):

Significance, Perspectives and Purpose

Computing plays a central role in the future of our communities, workforce, and society (Blikstein 2018), yet critical challenges remain in progressing towards more equitable and inclusive visions of K12 CS education (Margolis et al. 2015). And while many broader structures and policies influence K12 CS education, the "last mile" of CS for All is whether teachers can enact principles of equitable teaching in the classroom.

Among the many important principles of equitable teaching, our work focuses on positioning students with an asset framing, disrupting preparatory privilege and honoring intersectional identities (Milner 2010; Margolis et al. 2008). Previous work has shown that pedagogies of enactment like clinical simulation and role-playing hold great promise for teacher learning related to equity. Dotger and Ashby (2010) described "conditional inclusive ideologies" where teachers speak and write fluently about equity, yet struggle to enact equity during a simulation with mild social pressure. Self (2016) applied this approach to developing racial awareness, creating moments in simulation where teachers are "pulled up short" before guided reflection and facilitated discussion. Ball (2018) highlighted how focusing on "discretionary moments" can connect tangible teaching decisions with larger issues of equity and bias.

In this poster, we share research done in collaboration with CS teacher preparation programs, seeking to answer: *What kinds of teaching decisions do teachers make when given opportunities to enact principles of equitable teaching within online practice spaces?* and *What kinds of beliefs or biases interfere with teachers enacting principles of equitable teaching?*

Methods, Data and Results

Our approach centers on creating *practice spaces* embedded across a wide range of blended settings for K12 CS teacher learning. *Practice spaces* are learning environments, inspired by games and simulations, that allow teachers to rehearse for and reflect on important decisions in teaching outside of the classroom (Reich et al., 2018). One example of this is Teacher Moments, a mobile web app that immerses educators in short vignettes of classroom

life, and then calls upon participants to react to complex situations with improvisational spoken or typed responses (Thompson et al. 2018). This allows teacher educators to create a shared experience for group reflection and discussion, and creates opportunities for co-creating new practice spaces that focus on the discretionary moments that are most important to particular communities of teacher educators, teachers, and young people themselves.

Our approach creates rich evidence for purposes of both formative assessment and research analysis, including: data recorded within the practice spaces during teacher reflections and responses, observations during small group and whole group discussions, posters and visuals that teachers created during sessions, and written responses to survey questions.

In this poster, we discuss early findings from six fields tests with particular classroom scenarios (n=45 participants). Results describe the ways teachers enact principles of equitable teaching, and how teacher beliefs around colorblindness, meritocracy, and individual accountability may interfere. Finally, we discuss themes around facilitating learning with equity practice spaces, and challenges in creating inclusive learning environments for all CS teachers (Robinson et al. 2018).

Poster #8 Title: Scaling up Equity with E-Textiles: *Stitch the Loop* Unit Results in Exploring Computer Science

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Poster #8 Summary (495 words):

Objectives & Perspectives

Traditional computer science programs in high school typically reflect disproportionate participation across social and economic categories such as student gender, race and socioeconomic status (Margolis et al., 2010). However, leveraging skills and practices that are culturally responsive to learners' existing skills can help students engage with making (e.g., Vosoughi, Hooper & Escudé, 2016) and computer science (Scott, et al., 2015). Using these perspectives as a guide, we developed and implemented a computer science curriculum unit that uses conductive sewing to creatively design and program electronic circuits in textile-based material artifacts (i.e., electronic textiles or e-textiles). The approach leverages interest-driven crafting practices in a way that is atypical of traditional CS courses that privilege gendered artifacts like robots, games, and drones (Kafai, Fields, & Searle, 2014). Instead we support and broaden what counts as computing in order to create opportunities that are diverse in practice and participation.

Context, Methods & Data

Our *Stitch the Loop* curriculum is situated with Exploring Computer Science (ECS) classes that already support equity- and inquiry-based introductory computing (Goode, Chapman, & Margolis, 2012). We created an 8-10 week e-textiles unit where students craft a series of four projects, each increasing in depth of knowledge as well as creative freedom (Kafai & Fields, 2018). Teachers participated in four days of professional development that emphasized learning by designing, promoting aesthetics, celebrating and modeling mistakes (both teachers and students), and promoting peer pedagogy). Both the design of the curriculum and the teaching practices emphasized in professional development supported an equitable environment in CS classrooms at a small scale (see Fields, Kafai, Nakajima, Goode & Margolis, 2018).

In Spring 2018 the unit was implemented across 17 classrooms with a total of 280 high school students taught by 15 different teachers (in as many schools) in a large urban school district. We used likert-based survey instruments before and after the unit to ask students about their social and economic demographics as well as information about their perspectives on computer science and its importance in their future.

Results

After validating our survey constructs using a Cronbach alpha measure of consistency and performing a statistical analysis of variance (ANOVA), we show that after completing the *Stitch the Loop* e-textiles unit, there were significant ($p<0.001$) increases in student self reports of: (1) being competent in computer science, (2) being able to be creative in computer science, (3) being fascinated with computer science-based problem solving, and (4) valuing computer science in future endeavors. Furthermore, our results suggests that these outcomes emerged independent of self-reported gender, race, primary home language, or family educational attainment.

Significance

Collectively, these results suggest that the electronic textiles unit widely and consistently supported positive and equitable learning outcomes across social and economic categories that are traditionally underrepresented and/or marginalized in computer science educations. In our discussion, we consider potential factors that may be mediating these effects in order to inform computer science professional development programs designed to support increased diversity in computer science learning.

Poster #9 Title: Better Data, Better Progress: Methods for Measuring Inequities in Access to CS Education

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Poster #9 Summary (470 words):

This study enhances research on CS education for underrepresented populations by collecting and publishing more accurate and comprehensive state-level data than what has

previously been available in the field. Equity here refers to both access to and successful completion of high school CS courses by traditionally underrepresented populations such as students of color, females, and students from low income families. Research on equitable access to CS education has been hindered by the fact that available data have tended to be lacking in either precision or scope. For example, College Board (2018) measures of student enrollment in CS by different demographics only address two Advanced Placement CS courses. The Google Inc. & Gallup Inc. (2016) report provides estimates of the percentage of schools that offer any CS course, but the estimates come from self-reported data that inherently lack precision and come with other limitations, including concerns of construct validity. For example, across all sampled schools in the U.S., 78% of high school principals reported that their school offers at least one CS course. Numbers like these are likely to be inflated as educational leaders often conflate computing (e.g., programming) with computer literacy courses (e.g., keyboarding). Indeed, our research using objective counts shows that only 39% of high schools in Texas offer at least one CS course.

Ensuring equitable participation in CS education requires reliable and systematic methods for tracking key outcome measures longitudinally. The limitations of the extant research and available data underscore the need for data on CS course offerings and enrollment that come from systematic and objective measurement methods. Such methods are possible at the state level, as many states already have a mandatory data reporting system in place for public schools. This study took advantage of one such data reporting system in Texas by using actual counts from every school in the state to analyze demographic enrollment trends and determine the exact nature of the gap in access to CS education for underrepresented students. Results include student-level data that illustrate how enrollment gaps in terms of gender, income, and race differ across 16 distinct CS courses and how these gaps are exacerbated for students who live in rural communities. Results from school-level data demonstrate how the number of CS courses that schools offer differs according to its location and the demographic makeup of its student body. In conjunction with the school-level data, we present the CS Equity Quotient (CSEQ), a new method for quantifying the degree to which a campus or district's CS course enrollment reflects the gender, income and ethnic diversity of the school. It is our intention that the CSEQ serve as a consistent, simple metric to assess CS equity and a model for other researchers nationally to accurately measure and track broadening participation in CS efforts even as overall student demographics may change over time.

Poster #10 Title: Implementing a Hybrid Instruction Model to Democratize Computing: Online Content with a Classroom Facilitator

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Poster #10 Summary (500 words):

The mission of the Constellations Center for Equity in Computing is to democratize computing. The Center views equity as a structural matter and aims to build a structural solution to the deployment of computer science education, specifically in schools where resources are not allocated to prioritizing access to high level of computing courses. These

schools are often dominated by enrollment of students of color and low socioeconomic communities and face all of the challenges associated with the intersection of race and class and education. In computing education that manifests itself in their having no access to capable teachers of computer science or schools that engender the composite set of skills upon which a solid computing education can be built. There are not enough computer science teachers and there is no mechanism to create enough of them in a reasonable time frame. Our firm belief is that the only structural solution to this challenge is to build a hybrid instructional model. In this model, the teacher of record is an expert facilitator, but not expected to be the sole subject matter expert.

Building on the successful deployment and infrastructure of Georgia Tech's Online Masters in Computer Science (OMSCS), the Center will develop online courses and teacher resources. These materials will support the implementation of a sequence of credible, college readiness computing courses to include Advanced Placement Computer Science Principles (AP CSP), Georgia Tech's Introduction to Computing Using Python, and AP CS A. The development of online resources will be informed directly by the contributions of Constellations Fellows who will be instructional coaches working in schools and by an assessment of the most effective online tools for teaching computing courses.

Starting in the fall of 2018, the Center will deploy a team of three Fellows to teach AP CSP in six of the ten public high schools in the Atlanta Public Schools (APS) system. APS is representative of a school system that has not been able to prioritize quality computing education, at least at the secondary level. In 2017 there were 11,887 students enrolled in grades 9-12 in APS (1% Asian, 79% Black, 7% Hispanic, 12% White) and of the ten public high schools in this school system there was only one high school with a physical teacher teaching an AP CSP course. The Constellations Fellows are tasked with initiating the sequence of high level computing courses in addition to conducting classroom-based professional development to increase capacity in facilitating the courses with teachers who are new or novices to computing. The end goal is to establish equity in access to a steady and sustainable implementation of hybrid instruction in secondary computing courses that lead to opportunities in post-secondary STEM and computing studies, especially in schools where resources are not available to offer students a rigorous academic experience in computing education. Since scalability is always a programmatic objective, this hybrid model will require careful considerations of effect integration of teacher capacity building and student motivation to continue into post-secondary STEM and computing studies.

Poster #11 Title: Identifying Barriers and Practices for Broadening Computing Participation among Underrepresented High School Students in California

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Poster #11 Summary (376 words):

This poster will describe an examination of computer science education implementation efforts within California, utilizing current and retrospective data on equity in access and participation. This project is analyzing high school computing education pathways across the state, including the availability of courses, participation in courses by demographic groups, and trends in participation over the past three years. The project also examines the efficacy of initiatives to reduce inequity in three large focal districts which have demonstrated leadership in the implementation of district-wide computer science education initiatives—San Francisco Unified School District, Oakland Unified School District, and Los Angeles Unified School District. Thus, using statewide student and course data, district-level, and student-level data, this poster will share results of this longitudinal examination at the state and district levels of access, participation, success, and persistence in K-12 computer science education among underrepresented students to determine whether race and gender equity gaps have decreased over the past three years.

Further, this poster will document the obstacles and barriers to participation existing despite access to courses, to directly inform the design and implementation of the next generation of computing education initiatives. This project examines two key questions: (1) Have the implementation of computer science initiatives increased access, equity, participation, success, and persistence of underrepresented groups in computing in California? (2) What demographic, academic, and curricular factors are predictive of student enrollment, success, and persistence in computer science? Utilizing this research-based approach to drive equity, this poster will reveal the efficacy of computing education pathways within California, and will examine focal district-level data to determine the efficacy of current practices and policies to broaden participation in computing.

These findings, along with evidence of variables predicting successful outcomes, will contribute to ongoing district and state-level implementation plans, such that continuous improvement can be made to increase the number of women and underrepresented students with access to computer science courses, enrolled in computer science courses, demonstrating successful completion and persisting in computing sequences. This research will additionally help to refine and test models for broadening participation in K-12 computing education that can be utilized across local districts, states, and at the national level. Thus, this poster will inform larger strategies and initiatives for broadening participation in computing among underrepresented students across the nation.

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