Lessons Learned from Implementing an Equity-Focused Peer Mentoring Program for CS Teachers

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Abstract — **There are relatively few ongoing supports for novice computer science (CS) teachers, particularly focused on increasing teachers' use of equitable and inclusive teaching practices. To address this need, we implemented a year-long, equity-focused peer mentoring program with 38 CS teachers across Wisconsin. Through design-based implementation research, we refined structures, streamlined activities, strengthened the focus on developing trust in mentoring partnerships, and created opportunities to build community among mentees. Pilot data suggests both mentees and mentors benefitted from the program, increasing their confidence in teaching and mentoring. In this experience report, we share lessons learned during our first two years of implementation.**

Keywords — *mentoring, K-12 CS teachers, professional development, equity and inclusion, high school, experience report*

I. INTRODUCTION

A. Rationale

The preparation of CS teachers is significantly less than teachers of other subject areas. About 75% do not have a degree in CS or CS education, as compared to only 30% and 18% of novice and veteran high school mathematics teachers, respectively [3]. The majority of professional development (PD) focuses on deepening CS content knowledge and implementing a specific curriculum [7], with little emphasis on developing teachers' pedagogical knowledge or inclusive teaching practices and no coaching or mentoring programs. Few CS teachers report having a chance to develop skill with instructional practices during PD, collaborate with other teachers in their school, and have a mentor or coach to support their ongoing growth [3]. It is common for high schools to only have one CS teacher, thereby leaving the teachers without the typical structures and support of departments [9][10].

B. CS Teachers in Wisconsin

This work is situated in the state of Wisconsin. The number of high schools offering CS courses in Wisconsin has doubled over the last five years [4]. This coincides with the PUMP-CS project, which has focused on providing orientation PD to support Wisconsin teachers in teaching new CS classes. Most CS teachers in Wisconsin are experienced teachers who are new to the discipline: 70% have more than 10 years of teaching experience, but only 15% have more than 10 years of CS teaching experience. Schools serving a larger percentage of marginalized students have less experienced CS teachers. And, most CS teachers are isolated, with 60% having no other school-based CS colleagues [9]. This creates a need for additional professional supports beyond one-time workshops focused on particular curricula.

C. MENTORS in CS

CSTA, WestEd, and the CSTA Wisconsin Dairyland chapter (CSTA WI) formed a research/practitioner partnership to design and continuously improve a high school teacher mentoring process and structures. Our project is titled Matching Experienced and Novice Teachers for Ongoing Rigorous Support in Computer Science, or MENTORS in CS (Figure 1). Across two years of implementation, we have supported 38 CS teachers across the state of Wisconsin.

Figure 1. Description of MENTORS in CS Program

II. DESCRIPTION OF PRACTICE & LESSONS LEARNED

A. Program Overview

We strategically paired novice CS teachers with experienced CS teachers (5+ years of CS teaching experience). Over the course of one school year, pairs met twice per month to work towards mentee goals, aligned to the CSTA Standards for CS Teachers [5]. Mentors also received training and participated in a community of practice focused on effective mentoring. We provided participants with resources to structure their mentoring (e.g., self-reflection, mentoring log) and to maintain a focus on equitable CS teaching (e.g., research on culturally responsive teaching, scenarios around confronting bias in CS).

B. Mentoring Process

Across the year, mentor/mentee pairs complete three 2.5- to 3-month cycles, structured around Zachary's four stages of effective mentoring [11] (Figure. 2). We structure each cycle to move through these four stages and provide resources to help participants talk about and document each stage. Each cycle focuses on one of the five CSTA Standard for CS Teachers [5] (Figure 3). For example, in the third cycle of the year, all mentees set goals aligned to Standard 2. Equity and Inclusion.
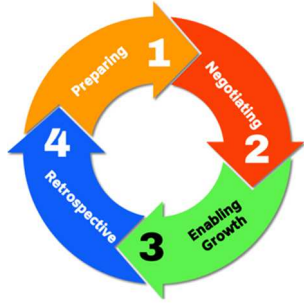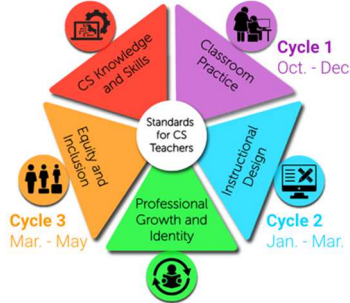
Figure 2. Mentoring Cycle   Figure 3. CS Teacher Standards

In the *Preparing* stage, partners get to know each other, understand each other's contexts, and build trust. Mentees complete a self-reflection aligned to the CSTA Standards for CS Teachers [5]. Then, in the *Negotiating* stage, partners identify one professional learning goal aligned to their self-reflection, and they also define the terms of their partnership (e.g., when and how to meet, how they will hold each other accountable). Next, *Enabling Growth* is the main, work stage of the cycle, with focused attention towards meeting the learning goal; partners learn together and explore resources, plan lessons, discuss implementation, and reflect on their actions. Finally, in the *Retrospective* stage, partners reflect on successes and whether they met the learning goal and plan next steps.
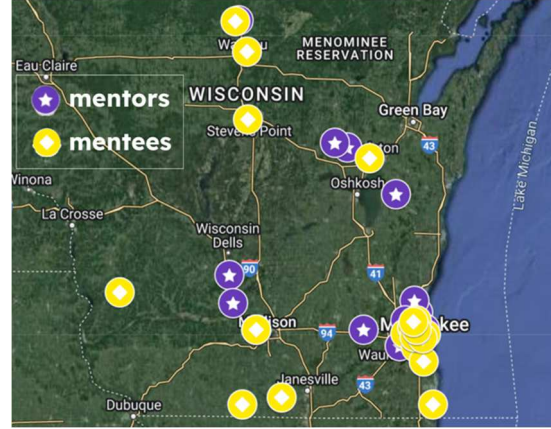
Equity Support: Partners discuss how to promote equity within their classrooms throughout the year, as an intentional part of nearly every mentoring conversation. Mentors learn to facilitate these conversations and practice strategies during the mentor training and community of practice (CoP).

C. Participants

Participants include 38 secondary CS teachers across the state of Wisconsin, including 15 mentors and 23 mentees (Figure 4 shows a map of teacher participants based on their school locations across Wisconsin). See [6] for eligibility and selection criteria. By design, MENTORS in CS broadens participation in computing by targeting CS teachers serving high concentrations of marginalized student populations. Approximately 75% of mentees teach at Title I schools (as defined by the U.S. Dept. of Education, indicating economically disadvantaged communities), and 57% teach at schools with large populations of Black and/or Latinx students (i.e., 150% of the state average of enrollment of Black and/or Latinx students). About 68% of mentees teach in rural or urban communities (27% and 41%, respectively; we determined locale using federal classifications of the school's ZIP code). This reach has been intentional given the prioritized recruitment and selection of participants, which extended beyond existing CSTA WI membership to include many novice CS teachers who were not

yet connected to the CS teacher community. In two years, 5% of teachers (2 mentees) discontinued their program participation.

Figure 4. Map of Teacher Participants

D. Initial Outcomes

Through surveys, interviews, and observations to investigate whether MENTORS in CS influenced mentees' CS teaching knowledge and pedagogical practices, we found promising evidence [1][2]. Mentees reported: 1) increased confidence in CS teaching knowledge and pedagogical practices, plus a reflective stance towards their teaching; and 2) increased use of equitable and inclusive teaching practices, though they may need additional supports to incorporate fully into their practice. Additionally, we saw positive impacts in mentors. Mentors demonstrated: 1) high confidence in CS teaching; and 2) developed greater skills and confidence in their abilities to mentor and support other teachers. We learned that informal exchanges and flexible structures were critical for building a level of trust that allowed for open discussions about the mentees' goals and progress.

E. Recruitment & Matching

Two co-presidents from CSTA WI recruited participants using the community's existing communication channels (e.g., newsletters), CS PD Weeks and other PD, school districts and partners, and targeted outreach. We matched mentors with mentees based on the courses they teach, school and community context (e.g., rural/urban setting, student population), mentees' goals and mentors' strengths, and the teachers' preferences. Virtual mentoring meetings allowed strategic matching of participants outside of the immediate geographic region.

Equity Support: We selectively recruited and prioritized selection of teachers serving rural communities, Title I schools, and high concentrations of Black and Latinx students.

Lessons Learned: We learned the value of personal invitations and nominations as powerful recruitment tools. Additionally, data uncovered several ways our application process hampered our broadening participation goals. We modified participation guidelines from year 1 to year 2, including adjusting the timeline to better accommodate district decisions, refining eligibility requirements to better enable participation from the target teacher population (e.g., specific courses, teaching experience), and defining "novice" more flexibly. We originally assumed that teachers entirely new to

teaching (i.e., not just new to teaching CS) would have more appropriate school- or district-based supports than what we could provide through virtual mentoring. However, we learned that these were commonly not present and teachers new to teaching did benefit from this mentoring program.

F. MENTORS in CS Resources

We developed several resources through Design-Based Implementation Research (DBIR) to support the mentoring process [6]. Our resources include:

- A **self-reflection** aligned to the CSTA Standards for CS Teachers [5], to enable teachers in identifying specific strengths and areas for growth
- **Relationship building activities** designed to build the trust and context necessary for a successful partnership
- **Partnership agreements** that define the terms and norms of the relationship, including when and how they will meet and how they will communicate
- **Goal setting** templates and example goals aligned to the CSTA Standards for CS Teachers (See Figure 5)
- **Meeting logs** that include planning and reflection templates, a suggested focus for each meeting, and note taking space (See Figure 5)

Figure 5. Example Goal & Partial Mentoring Meeting Log

Equity Support: All mentees set and work to achieve goals aligned to Standard 2. Equity and Inclusion, based on areas for growth identified in their self-reflection. Example goals include: (1) Double the percentage of Black and Latinx students in my CS classes next year through active recruitment, and (2) Increase the diverse representation of Black, Indigenous, and Latinx people in my CS curricula by adding career connections activities once per week (see Figure 5). Additionally, goals aligned to Standards 4. Instructional Design and 5. Classroom Practice are commonly equity-focused. For example, a teacher may choose to evaluate her curriculum for cultural relevance (indicator 4a. Analyze CS curricula). While these goals focus on mentees' growth, in our current project, we commonly see

mentor partners adopting the same goals as their mentees and working to develop alongside one another.

Lessons Learned: We have continuously improved these resources as we gathered participant feedback. We significantly simplified and streamlined structures, reducing the amount of work (e.g., transitioning self-reflection from rubric to simpler checklist), improving the formatting, and enabling more flexible use. This has led to an increased use in the materials. We developed a set of example goals, which helped to improve the clarity and measurability of professional learning goals. We also increased the relevance of the mentoring cycles by resequencing the alignment of teacher standards.

G. Mentor Training and Community of Practice (CoP)

CSTA hosts an initial, intensive training to prepare the mentors. Specifically, facilitators review program expectations, introduce them to the tools and structures, and then train them on: (1) guiding teachers' self-reflection aligned to the Standards for CS Teachers [5]; (2) establishing an equity imperative; (3) establishing strong relationships with their mentees, including the four phases of mentoring [11]; (4) providing guidance on reflection and goal setting; and (5) delivering targeted, effective feedback and support. The CSTA team supports mentors' continued growth in their role through a monthly CoP meeting where mentors share promising practices and troubleshoot challenges; develop and practice equity-focused mentoring skills; and deepen their understanding of equitable and inclusive teaching practice. Trainings and CoP meetings are virtual to enable participation across a large geographic region.

Equity Support: In the initial training, mentors develop an equity imperative and learn how to maintain an equity focus throughout the mentoring program. Mentors deepen their understanding of equitable and inclusive teaching practices and support through CoP activities. In the second year of our current project, mentors discuss *Culturally Responsive Teaching and the Brain* [8] in an ongoing book club; they apply learnings not only to their classroom but also to their mentoring partnership.

Lessons Learned: Teachers need a chance to connect, process, and continue learning while building a sense of community, and the CoP met these needs. Mentors especially benefited from scenario-based learning, developing exemplary goals together, and planning supports for mentees. Many mentors informally adopt similar goals to create a more collaborative experience and flexible mentoring relationships. We learned that mentees required more support to feel connected to and supported by a broader community beyond their mentor. As a result, we now host CoP meetings at the beginning, middle, and end of the year to allow mentees to develop relationships with one another and build a broader community.

H. Multi-tiered System of Equity Supports

All activities are grounded in a multi-tiered system of equity supports, which were explained above and summarized here:

- Deliberate recruitment and prioritized selection of teacher participants ensures we meet our broadening participation in computing targets
- Discussions about equity-focused classroom practice are embedded into ongoing 1-on-1 mentoring conversations

- All mentees set at least one professional learning goals focused explicitly on equity and inclusion
- The ongoing training of mentors develops and strengthens their understanding of equitable and inclusive teaching and support

III. POSITIONALITY STATEMENT

We are a small, researcher/practitioner partnership team, and each member brings unique and valued perspectives and experience to this project. Three authors identify primarily as practitioners. One author joins this project with experience as a former teacher, administrator, CS standards developer, and provider of CS teacher professional development, at both the regional and national levels. Two authors join this project with a deep understanding of the particular community of teachers that the project serves. They are co-presidents of CSTA WI and current and long-time CS teachers. Additionally, they have provided professional development and ongoing support to CS teachers throughout the state through the PUMP_CS PD Weeks, Wisconsin State CS Summits, and other CSTA WI meetings/events. They also participated as mentors in the project, to gain a deeper understanding of the participant experience and provide feedback. All three have experience with participating in and providing equity-focused professional learning for CS teachers. All three identify as white educators who have worked in various urban and suburban communities.

Two authors identify as CS education researchers. One author identifies as a Black woman who studies the impact of CS PD on secondary teachers' classroom practice and evaluates CS programs for middle and high school students. She brings expertise to the project through her research on CS teaching knowledge and inequities within CS education. One author has worked with supporting K-12 teachers and students for eight years and was a former CS student. She identifies as an East Asian woman and draws from her experiences and the experiences of those around her to inform her work.

IV. LIMITATIONS AND ASSUMPTIONS

Our work has a number of limitations. First, we had a limited ability to reach teachers of underserved students, particularly among our mentors. This was due to a number of reasons, including a small number of total eligible teachers, and changes and uncertainties in school district schedules and assignments. In particular, we had trouble recruiting teachers from larger school districts and rural school districts. Relatedly, our mentor and mentee populations have some significant differences. For example, mentors are significantly more likely to identify as white (93% of mentors, vs. 77% of mentees) and women (87% of mentors, vs. 76% of mentees) and are more likely to teach in suburban communities (47% of mentors, vs. 32% of mentors). This impacts the ability for teachers to understand each other's contexts and provide personalized support. Additionally, this program took place during the course of the pandemic where teachers were dealing with more than usual uncertainties and stressors. This likely affected new teachers even more as they had to learn how to be a new teacher while learning how to navigate working in a pandemic. However, participants also indicated the benefit of having a mentor to support them during these particularly challenging times. Finally, while we are aware of some trends showing inequitable student participation in CS courses as compared to school populations (e.g., [4]), we were limited to using school-wide rather than specific CS course enrollment demographics because of what is available when teachers apply and are selected. Additionally, some information is generally only available at the school- and not course-level (e.g., students qualifying for free and reduced price lunch).

In our work, we had the following assumptions. We aimed to recruit teachers who taught Exploring Computer Science and Advanced Placement CS Principles, assuming that mentoring conversations could be more focused on best practices because they have a shared curriculum. However, even with the same curriculum, given their different contexts and confidence levels with CS teaching, we learned that they needed to work through what they are going to teach before they discuss how they will teach it. Additionally, we recruited participants who have had prior PD with specific courses assuming they would have had exposure to inquiry and equity through those experiences. We also assumed that teachers in programs such as PUMP_CS would be more likely to be willing to engage in equity-focused discussions, since they already had some related experience.

V. IMPLICATIONS AND NEXT STEPS

With continued refinement, we expect that MENTORS in CS will lead to growth in CS teaching knowledge and confidence, increased use of equitable and inclusive teaching practices, and increased commitment to teaching CS. We expect these teacher outcomes will lead to improved and more equitable learning outcomes for their students. This work is critical for local capacity building and continuing to support the many teachers who begin teaching CS each year.

Thus far, our project has built and refined peer mentorship structures using the context of one community, with an explicit strategy from the onset to scale the program across CSTA's growing network of 100+ regional chapters and affinity groups, ultimately reaching thousands of teachers across 50 states and Puerto Rico. By leveraging the existing robust infrastructure of the CSTA chapter network and affinity groups, we hope to eventually create CS teacher mentoring programs throughout the United States, which will bolster ongoing teacher professional learning and ultimately transform the field.

We are currently seeking funding to scale the program to a total of three communities, while learning how to adjust program structures to meet varying sociopolitical contexts. In this proposed project, we will add CSTA's Black Affinity Group and CSTA New Jersey to the existing DBIR partnership to develop and iteratively improve our mentorship program. We intentionally identified communities with teachers who serve Black, Latinx, and economically disadvantaged students at high rates, with teacher populations that have gaps in their representation as compared to their student populations, and with an adequate number of teachers qualified to mentor. We aim to bridge this gap in representation, to support CS teachers in more effectively serving a student population that is far more racially and economically diverse than the CS teaching workforce.

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