Building Equitable Computing Classrooms through Culturally Responsive Professional Development

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Abstract: Computer science education from a young age has been demonstrated to be a predictor of students joining STEM related careers, potentially closing the gap of underrepresented women and minority groups. Systematic changes in classroom environments and instructional practices can attract, maintain, and promote the success of minority students through culturally relevant pedagogy. We developed a professional development model to help teachers build an equitable computing classroom by integrating culturally responsive pedagogy. This paper illustrates the ways teachers came to make sense of culturally relevant pedagogy through interviews and application in lesson plans. Findings suggest that teachers conceptualized culturally relevant pedagogy and planned to create an equitable learning environment for students in different and unique ways.

Keywords: culturally responsive pedagogy, equity, teacher professional development

Introduction

The U.S. Bureau of Labor Statistics (2014) estimates that nearly half of STEM jobs by 2020 will be in computer science (CS) and more than half will require significant CS skills and knowledge. The literature has demonstrated that schools are ill prepared to train students with the appropriate CS skills and knowledge to meet the demands of the future workplace (Sengupta, Kinnebrew, Basu, Biwas & Clark, 2013). Furthermore, there is a clear trend in underrepresented women and minorities in CS and STEM fields (Cuny, 2012). The discrepancies in individual, institutional, and community levels that hinder women and minority students from participating in CS are known as the STEM pipeline leak (Alper, 1993). Generally, unsupportive environments and social macroaggressions factor into the leaky pipeline where students from minority backgrounds are filtered through the leaks (Dowd, Simanek & Aiello, 2009; Hodari, Ong, Ko & Smith, 2016). English as a second language, limited communication skills, low economic status, and the gender gap contribute to further filtering for a homogeneous subgroup of CS students (Han, Capraro & Capraro, 2016; Cuny, 2012).

CS education from a young age has been shown to successfully close the gap in predicted shortage of CS professionals resulting from STEM pipeline leaks (Tsan, Boyer & Lunch, 2016). As well, CS education is an important predictor of students' choice to join the STEM field (Lee, 2015). As a result, systematic changes at the institutional level between schools and teachers in CS practices need to be made to promote the success of all students (K-12 Computer Science Framework, 2016). One way to shift teaching practices to attract, maintain, and promote success in underrepresented and minority groups of students is to prepare teachers to adopt culturally responsive pedagogy (CRP) through professional development (PD). Culturally responsive education engages diverse learners through motivational learning experiences, empowerment and appreciation, and curriculum demands (Scott, Sheridan & Clark, 2014). CRP models aid teachers to produce a rich learning environment and culturally appropriate content as a response to their students, community, and culture (Mejias, Jean-Pierre, Burge & Washington, 2018; Warren, 2017). CRP is best adopted as a combination of motivational learning and a supportive

learning that builds on underrepresented students' experiences, knowledge, and perceptions (Ladson-Billings, 1995a).

A vital premise of CRP is teachers' cultural beliefs. Our approach to culturally responsive CS content and pedagogy aims to engage teachers in self-reflection. Literature has shown that teachers' beliefs of their cultural responsiveness and their teaching behaviors are hardly aligned (Debnam, Pas, Bottiani, Cash & Bradshaw, 2015). Teachers who believed they were culturally responsive in their teaching actually used little culturally relevant material (Debnam et al., 2015). However, culturally responsive teachers displayed strong self-reflective patterns throughout their teaching (Civitillo et al., 2017). Thus, promoting self-reflection of teachers' own biases of intellectual abilities can promote culturally responsive teachers (Gay, 2010; Howard, 2003). In this work, we examine an equity-focused PD program focused on promoting teachers' understanding of CRP in the context of CS teaching, including their ability to self-reflect and make sense of CRP in their own context. Specifically, we focus on the following research questions:

1. How are teachers making sense of CRP and equity as an element of CS education after attending an equity-focused CS PD?
2. How are teachers planning to apply elements of the CRP in their CS curriculum and pedagogy?

Description of PD Model

Driven by a desire to help K-12 teachers incorporate CS principles into their classrooms, our research team initiated a partnership supported by a series of grants from the National Science Foundation since 2012. Our partnership incorporates a three-tiered approach to PD to support teachers as they learn to integrate CS principles across a variety of K-12 curricula: (a) an annual week-long *Summer Institute*, (b) a college field experience course in which undergraduate students with background in CS assist teachers in developing and implementing CS lessons back in their classrooms, and (c) sustainable partnerships with local public and private schools. We first implemented culturally responsive elements into our PD model in 2018 (Figure 1). The scope of this paper is limited to two consecutive iterations of our culturally responsive PD approach (2018 and 2019).

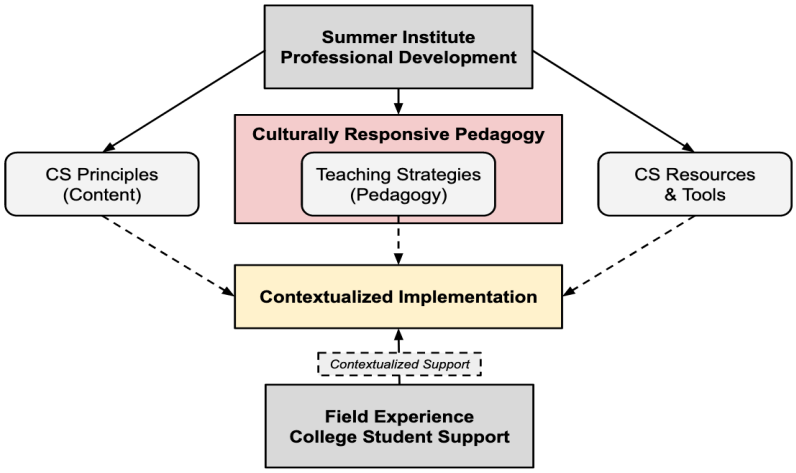

Figure 1. Culturally Responsive PD Model (Codding, Mouza, Pollock & Sheridan, 2019)

Summer Institute

The first tier of our university partnership program begins with participation in our week-long *Summer Institute*, which we have offered annually since 2012. For our 2019 *Summer Institute*, 41 teachers applied, 38 teachers were accepted, and 31 were able to attend the week-long Institute. Of these 31, 11 were male and 20 were female. Participants taught a range of subjects, including core elementary, business, technology, mathematics, library, science and stand-alone CS classes. Teachers hailed from 22 different schools and libraries, four private or

parochial, 17 public or public charter, and one public library. Each year, our program is split into two tracks: *Integration Track* (n=25) and *Course Track* (n=6). These two tracks correspond to the needs of our participating teachers. The *Integration Track* targets elementary and middle school teachers who are interested in integrating CS principles into their existing course materials. The *Course Track* targets high school teachers who teach a stand-alone CS course, specifically the Advanced Placement CS Principles course. Both tracks share the same four goals: (a) to learn CS content and pedagogy, (b) to gain confidence in integrating CS principles, (c) to build a community of practice, and (d) to identify strategies that help broaden participation in computing.

The PD sessions are facilitated by university faculty members, graduate students in CS and education, and local teachers who have previously participated in the partnership and have excelled at implementing CS into their own classes (Table 1). These facilitators model effective teaching strategies and best practices for teaching CS. The Summer Institute is designed to help teachers learn new CS content and strategies for engaging their students in CS and computational thinking (CT). Facilitators also employed CS Unplugged activities, originally developed by Tim Bell, to engage teachers in CT without technology (Bell & Vahrenhold, 2018). Additionally, participants were introduced to a variety of CS tools including Edison Robots, Scratch, Ozobots, Micro:bits, Finchbots, Makey Makey, and Bee-Bots. Teachers were given time to collaborate with fellow teachers and facilitators as they developed lesson plans that integrate the CS principles and CS tools with their respective curricula to facilitate student development of CT. On the final day of the PD, teachers shared these ideas with their cohorts and exchanged ideas on how lesson plans could be adapted for a variety of grade levels and content areas.

Table 1. *Summer Institute* PD Schedule (2019 *Integration Track*)

<table>
<tr><th>Time</th><th>Monday</th><th>Tuesday</th><th>Wednesday</th><th>Thursday</th><th>Friday</th></tr>
<tr><td>9:00-10:15</td><td>Introductions, Program Purpose & CS Unplugged – Icebreaker</td><td>Explore Algorithm Lesson Plans & CS Unplugged – Algorithms</td><td>Assessing Scratch Products for Creativity, Rubrics & Dr. Scratch</td><td>Creating a VR scene using A-Frame</td><td rowspan="2">Finalize Lesson Plans & CS Unplugged – Abstraction</td></tr>
<tr><td>10:15-10:30</td><td colspan="4">Break</td></tr>
<tr><td>10:30-11:45</td><td>Programming with Ozobots using Two Languages (Color Lines & Block-Based)</td><td>Continuation of Algorithms Lesson & Culturally Responsive</td><td>Data Abstraction with CORGIS Visualizer</td><td>Creativity with Micro:bits</td><td>Lesson Sharing & Broadening Participation</td></tr>
<tr><td>11:45-12:30</td><td colspan="4">Lunch</td><td rowspan="6">Adjourn</td></tr>
<tr><td>12:30-1:00</td><td>Broadening Participation in Computing</td><td rowspan="2">CS First with Google Representative</td><td>CS Unplugged – Live Guess Who Game & Explore Lessons on Querying</td><td>CS Unplugged – Internet & Cybersecurity</td></tr>
<tr><td>1:00-2:15</td><td>Continuation of Ozobots – Introduce Creativity and Brainstorm Lessons</td><td>Digital Art in Pixels</td><td>CS Toys: Exploring Computational Curriculum Kits</td></tr>
<tr><td>2:15-2:30</td><td colspan="4">Break</td></tr>
<tr><td>2:30-3:45</td><td>From Standards to Lessons & Culturally Responsive</td><td>Continuation of CS First with Google Representative</td><td>Culturally Responsive Lesson Planning, Lesson Development & Peer Feedback</td><td>Culturally Responsive Lesson Planning, Lesson Development & Peer Feedback</td></tr>
<tr><td>3:45-4:00</td><td colspan="4">Reflection on Learning</td></tr>
<tr><td>4:00-4:30</td><td colspan="4">Adjourn & Individual Consultations</td></tr>
</table>

Culturally Responsive & Equity-Focused Framework

During this first iteration of our culturally responsive PD, we sought to help teachers become culturally responsive by engaging in self-reaction to examine their own biases, particularly biases regarding their perceptions of students' intellectual abilities based on race, gender, and socioeconomic class (Howard, 2003). To this end, we focused on integrating CRP as an element of teacher pedagogy (Figure 1). By focusing on CRP, we sought to offer teachers insight into underrepresentation in CS and noted the importance of self-reflection in becoming a culturally responsive teacher. However, at the end of the Summer Institute teachers reported feeling unsure of how to implement CRP back into their classrooms (Codding, Mouza, Pollock & Sheridan, 2019). Although many of the teachers left our first CRP PD feeling motivated to incorporate CRP and equity-focused practices into their CS classrooms, others left frustrated with how little they understood about this important topic. As one participant put it, CRP prioritizes "recognizing my own biases that I would have internally, which I'm not aware of, so I'm not sure

how I'm going to do that" (Codding, Mouza, Pollock & Sheridan, 2019). It was clear that our communication of CRP lacked the specificity teachers needed to successfully implement pedagogical changes and adapt their CS curriculum, especially teachers who were still learning the CS content themselves.

In response to these findings, we began to develop a new model that would engage CRP in every aspect of our university partnerships (Figure 2). Beginning in the fall of 2018, we implemented CRP training sessions into our field experience course in which undergraduate CS students assist teachers in developing and implementing CS lessons in their own classrooms. Like our Summer Institute, these sessions focused on engaging the undergraduates in self-reflection and culturally responsive teaching strategies. We also encouraged our undergraduates to work with teachers to adapt their lessons to be more culturally relevant for their specific classrooms. Further, we adapted our Summer Institute by contextualizing every element of partnership in a culturally responsive and equity-focused framework (Figure 2). In addition to focusing on self-reflection and promoting specific CRP teaching strategies, we provided teachers with culturally responsive resources and created a digital space where they could collaborate and share their adapted lesson plans. To incorporate CRP into the CS principles, we emphasized creativity as a central principle for creating culturally responsive curriculum and assessments. Our culturally responsive and equity-focused framework has expanded to encompass every element of our PD model (Figure 2).

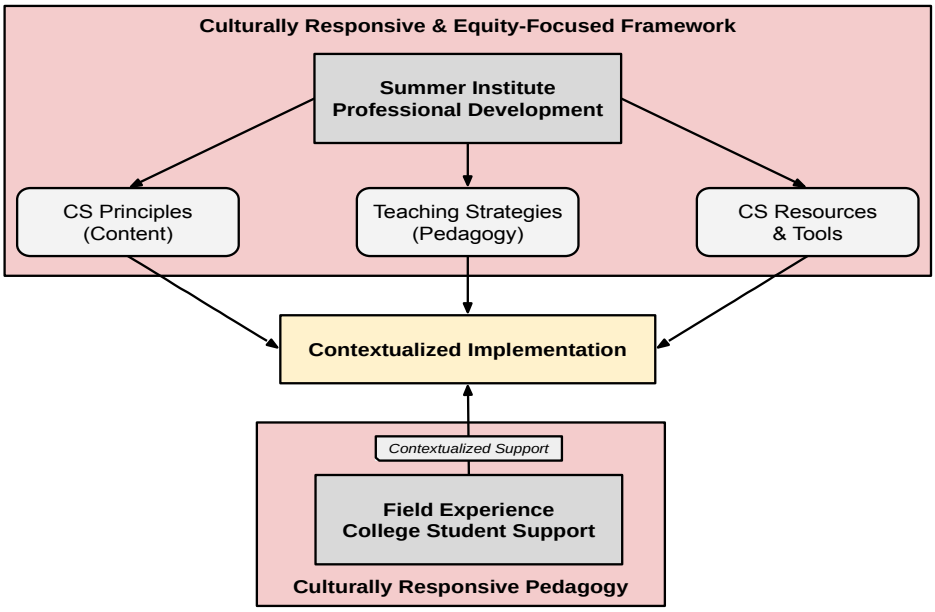

Figure 2. Culturally Responsive and Equity-Focused PD Model

While our implementation of CRP has evolved and improved, we are still seeking to address the underrepresentation of minoritized youth in CS by utilizing culturally responsive frameworks that integrate knowledge relevant to youth identities and communities with computational learning activities (Codding, Mouza, Rolón-Dow & Pollock, 2019; Ladson-Billings, 1995b; Nieto, 2002). During our 2019 *Summer Institute*, we focused on four elements: promoting diversity, self-reflection, centering equity, and implementation (Table 2). Sessions promoting these elements appear on our schedule under two designations: broadening participation in computing and culturally responsive. Each of these sessions lasted approximately 30 minutes and the culturally responsive sessions were paired with lesson planning (Table 1). To promote diversity in CS classrooms, teachers learned to identify promising students and personally invite them to take CS classes ("Identify, Recognize, Invite, Invite Together" activity). Teachers engaged in self-reflection by telling personal stories (Partner Walk activity), writing a short story about their hometown (Five Minute Poem activity), identifying salient parts of their identity (Identity Wheel activity), and practicing how to identify and address microaggressions in their classrooms. To center equity, teachers explored examples of CRP lesson plans, participated in a CRP activity to create a world-changing robot (Designing Robots to Save the World), and learned to allow for more creativity and collectivism in their classrooms. Finally, teachers practiced implementing CRP in their own lesson plans. This paper focuses on how teachers processed and applied CRP and equity following participation in our 2019 *Summer Institute*.

Table 2. Culturally Responsive and Equity-Focused PD Elements

Element	Purpose/Explanation	PD Activities	Literature
Promoting Diversity	Increasing participation in CS through equity-focused and research-based approaches Making CS relevant to solving real-world problems	"Identify, Recognize, Invite, Invite Together"	Alvarado, Dodds, & Libeskind-Hadas, 2012
Self-Reflection	Defining CRP and reflecting on the impact of culture Thinking about ourselves and our students through a cultural lens Dispelling myths and confronting internal biases Identifying and avoiding microaggressions	Partner Walk Five Minute Poems Identity Wheel Identifying & Dispelling Myths Addressing Microaggression	Gay, 2018; Gershenson, Holt, & Papageorge, 2016; Ladson-Billings, 1995b; Nieto, 1999; Tatum, 2007
Centering Equity	Adapting pedagogical approaches Centering culturally responsive interactions	Examples of CRP in CS Designing Robots to Save the World Exploring Shared Interests Assessing Creativity	Pollock, 2008; Scott, Clark, Sheridan, Mruczek, & Hayes, 2010
Implementation	Integrating CRP concepts into CS lesson plans Adapting existing curriculum to be culturally responsive	Peer feedback and support; individual and contextualized support	

Methods

Participants

For this study, we focus on Integration Track participants (N=25). For this track, we aimed to recruit primarily elementary and middle school teachers as research indicates that students determine whether or not they are interested in exploring CS during these formative grades (Bruckman et al., 2009). Integration track teachers taught primarily elementary school students (n=15), but teachers ranged from K-12. Lesson plans were collected from all integration track teachers for this study. We used criterion sampling to recruit interview participants who work in schools that serve a racially and socioeconomically diverse population (n=9). All nine teachers agreed to participate in an individual interview. Participants were primarily white, female, elementary teachers (Table 3). In addition to core elementary teachers, participants taught business, technology, and library classes. Several participants also taught after school CS programming.

Table 3. Participant Demographics

Pseudonym	Race	Gender	Experience (years)	Grade Level
Cindy	Asian*	F	12	Elementary
Deborah	Black*	F	7	Middle School
Tara	Black	F	11	Elementary
Emma	White	F	6	Elementary
Sandy	White	F	8	Elementary
Beth	White	F	9	Elementary
Mary	White*	F	22	Middle School
Kathy	White*	F	23	Middle School
Lane	White	F	26	Elementary

Note. Asterisk indicates teachers who participated in previous study (Codding, Mouza, Pollock & Sheridan, 2019).

Data Collection & Analysis

Qualitative data were collected through semi-structured, individual interviews with teachers. The interview protocol included nine questions that focused on teachers' experiences in the Summer Institute, the effectiveness of culturally responsive sessions, and their need for follow-up support. The four culturally responsive questions asked

teachers to: (1) define CRP, (2) identify the connection between CRP and CS, (3) give an example of how students can use technology to solve real-world problems in their community, and (4) explain how they will apply what they learned about CRP to adapt their curriculum back in their schools. Four teachers participated in a previous study (Codding, Mouza, Pollock & Sheridan, 2019), as indicated in Table 3. These four teachers answered three additional questions: (1) reason for attending multiple years, (2) reflect on applications of culturally responsive PD in their classroom following the previous PD, and (3) whether a second year of the PD improved their knowledge of CRP. Professionals from an education research center conducted the interviews on the last day of the PD, allowing participants to voice their ideas without PD organizers present. Interviews were conducted in private rooms and lasted approximately 15-20 minutes depending on each participant's responses. All interviews were recorded and transcribed for analysis.

Final lesson plans (n=10) from all Integration Track participants were analyzed to examine how teachers applied elements of CRP into their planning. Teachers worked independently (n=4) or in small groups of 2-4 throughout the week-long Summer Institute to design a CS lesson plan that could be used in their own classrooms. In addition to a detailed lesson plan, teachers were asked to indicate the target audience (grade level and subject area), lesson goals, CSTA standards, required technologies, and learning assessment. Teachers were also asked to detail how they used CRP in their lesson plan and how they would incorporate students' personal and cultural identities. Teachers designed lesson plans for grades K-12 that could be used for multiple content areas in addition to CS classes, including ELA, math, business, and library. Digital copies of each lesson plan and accompanying materials were collected via Google Drive. Additionally, teachers created posters depicting key elements of their lesson plans, which were presented on the final day.

Interview data were analyzed to identify common and unique themes using an analytical approach inspired by grounded theory (Glaser & Strauss, 1967). Data were coded based on emergent themes and categories, which were applied during two rounds of coding. Themes were categorized for analysis based on our first research question, which examines how teachers are making sense of equity, yielding four themes: (1) cultural awareness, (2) student-centered pedagogies, (3) inclusion and belonging, and (4) equal access. To address our second research question, which examines how teachers are applying CRP, lesson plan data were analyzed using a framework we developed based on Kea and Campbell-Whatley's (2004) CRP guidelines to analyze five key elements of CRP in the lesson plans: (1) individual learning differences, (2) foundational elements of a well-planned lesson, (3) inclusive learning environment, (4) instructional practices, and (5) unbiased assessments.

Findings

The week-long *Summer Institute* successfully articulated the need for CRP within teaching and learning environments. Findings revealed that teachers demonstrated an understanding of culturally responsive elements for application towards an equitable computing classroom. However, teachers differed in their understanding and application of CRP depending on the context of their teaching, learning experiences, and world-view.

CRP and Equity as an Element of CS Education

A review of the interview transcripts revealed four overarching themes in teachers' responses; teachers made sense of CRP through cultural awareness, student-centered pedagogies, inclusion and belonging, and ensuring equal access.

A sense of cultural awareness encompassed three underlying elements. The first element was teachers' willingness to center their classroom or lessons around cultural differences. Teachers made statements that recognized students' various cultural needs and the importance of accommodating their needs because "when it comes to teaching, . . . breaking through those barriers [and] knowing your students is what makes everything better." The second element was regarding ways teachers can adapt classroom culture to be more inclusive. For example, a teacher recognized that "some times during the day . . . something might happen with our kids and that might not be the time for us to discuss it, but them knowing . . . that I can come to my teacher and we can talk. A lot of times that's not in. . . classroom culture." The final element of cultural awareness identified in the interviews was

introspection and reflection where teachers acknowledged privilege, and challenges regarding race, culture and gender. Speaking about real issues in educational settings during the PD helped teachers recognize the importance of understanding different points of privilege and taking a step back to say, “oh, wait a minute. This isn't the starting point for most of our students.”

Teachers discussed the importance of centering students by examining student needs and implementing a student-centered pedagogy. CS education is no longer about “students just fitting in one mold” and “we’re completely neglecting an entire population of people because we're not looking at their needs.” Teachers recognized that the different and unique learning needs, educational backgrounds, and interests of students in their classroom are valuable. One teacher believed “a lot of students really do love computers and if we encourage those students to be more involved with computer science, maybe were going to bring out a strength that we didn't know they had” because “this is the way teaching should be. Kids need to touch and build and make.”

Inclusion and belonging revolved around membership and student identity in classrooms. Teachers discussed CRP as a way of uniting and bringing together students in CS. Rather than labeling students based on language abilities or behavior needs, “computer science is a way to unify everybody and say hey, we’re all learning something new. Nobody knows how to do this.” One teacher explained that her classroom was arranged in groups identified by pictures of CEO’s, including several women and people of color, because she wants her students to see themselves represented beyond the stereotypical “white male” CEOs. CRP was also a way for students to come into their identities and personalities. Being culturally aware is “about being open to every possibility that could exist and not be closed off” and not limiting students to a group “because people identify in different ways and they change.” As one teacher put it, “it's a mindset for the educator to be adaptable and to be open.”

The final overarching theme was ensuring equal access. Teachers equated CRP as a “model of inclusion.” The ideal inclusive classroom is characterized as “including all belief systems, all ways of thinking” where teachers “don't exclude but don't only include you.” Recognizing the need for CS, teachers discussed their efforts to recruit minority populations into the clubs at schools to give them access and exposure to different CS activities. One teacher wondered if minorities aren't included because people have biases or “is it because they've never had access to it?” The essence of CRP in CS is “everyone . . . should have access to what we're doing somehow at some level.”

Application of CRP PD in CS Curriculum and Pedagogy

A review of the lesson plans revealed how teachers plan to address five elements of CRP: individual learning differences, foundational elements of a well-planned lesson, inclusive learning environment, instructional practices, and unbiased assessments. All lesson plans included elements of an inclusive learning environment and positive social interactions. The characteristic most frequently presented in the lesson plans was strategies for preparing students to work together. Teachers implemented pair programming with observer and navigator roles, allowed students to take turns contributing as a class, assigned group work to complete tasks and assess one another, and initiated collaboration with students on assignments online. Teachers also frequently tried to recognize or celebrate students’ differences by “encouraging students to create a [self-portrait] that reflects who they are” using Scratch (block coding platform) programming and encouraging “student creativity [that] allows for personal/cultural identities” through poetry on Flipgrid (video sharing platform). On one occasion teachers mentioned making accommodations for individuals with learning needs by “adjusting language to meet the needs of students” in the lessons. One lesson mentioned online safety and digital citizenship as part of the lesson goals and one teacher embraced family and home life in classroom assignments by asking students to gather information about their culture from their parents to share in class.

Nine out of ten lesson plans included elements of individual learning differences as a form of CRP. The characteristic of individual learning differences teachers most frequently recognized in their lesson plans was students’ academic and social abilities. For example, students were asked to collect information about various cultures to present through CoSpaces Edu (a block coding platform). Among the resources teachers provided were books from local libraries and from parents. Recognizing that students have different reading levels, teachers included videos, podcasts, and assistive technology as a response in their lesson plan. Teachers also recognized potential limitations students may have with technology in three of the lesson plans. The challenges teachers anticipated in their lesson plans using Scratch programming and Micro:bits (tiny programmable computers) were

students' lack of familiarity and potential struggles with the tools. Teachers mentioned incorporating students' linguistic, cultural, or gender differences in two different lesson plans by "allowing students to work together to assist with language issues" and taking the time to explain a game that students may not know how to play. Only one lesson plan accommodated for interpersonal challenges students may face in the classroom such as "students not being able to express themselves." Additionally, one lesson plan took into consideration students' interests when creating a lesson plan around Scratch and game design because "middle schoolers really like games and competition."

Foundational elements of a well-planned lesson were found in nine out of ten lesson plans. These elements included communicating accurate and relevant objectives, addressing limitations with technology, and selecting content and teaching strategies that were developmentally appropriate, respond to student interests, and acknowledge linguistic, cultural, or gender differences. Teachers mentioned developing or selecting content, resources, and strategies that respond to students' academic and social abilities in seven of the nine lessons. Teachers mentioned "instructional opportunities for students that finish [tasks] quickly and students that need more time" such as extending on a Scratch project by "challenging students to create a narrative behind their raceway." The second most common characteristic found in five of the nine lesson plans was developing and selecting content, resources, and strategies that respond to students linguistic, cultural, or gender differences. For example, teachers included shapes and colors labeled in Spanish for ELL students to experience Bee-Bot (bee shaped robot) programming with the rest of their class. Content, resources, and strategies that respond to student interests were found in four lessons. Unlike merely recognizing or stating students' interests, teachers took action. For example, students were introduced to coding on paper using a Code & Go Robot Mouse (mouse shaped robot) and encouraged to "draw and design their own maze with personal touches." In three lessons teachers mentioned defining and communicating the lesson goals and objectives with students. Finally, only two lessons developed and selected content, resources, or strategies to address limitations with technology such as using CS unplugged activities.

Teachers demonstrated elements of CRP related to instructional practices in eight of the ten lesson plans. The most common characteristic found in seven of the lessons was a statement dedicated to explaining the instructions of the lesson to students. It is important to note that many of the teachers jumped right into the activity without clarifying how students will understand what to do. For example, pair programming was a popular strategy in lessons. Unlike teachers who simply stated students will work in pair programming, these teachers stated they will "explain what paired programming looks like," including an explanation of the role of each pair for the activities. Teachers used communication strategies to facilitate understanding for students with cultural and linguistic differences in two of the lessons. For example, one lesson depended on the game "Guess Who" so the teacher provided a video for students who do not know how to play and one round was played together as a class. Furthermore, teachers mentioned modeling tasks for students in two lesson plans. For example, in a lesson using Bee-Bots, teachers modeled what arrows represent on the devices on a maze mat. Only one lesson discussed communication strategies to facilitate understanding for students with learning needs by "restating and chunking tasks" and one teacher mentioned limiting their involvement with students, allowing them to take the lead.

The least common element of CRP found in lesson plans was any form of unbiased assessment practices. Teachers mentioned implementing unbiased formal and informal assessment practices in four lessons through follow up or discussion questions for the class, exit tickets, and simply asking students for examples to display their understanding of procedures or algorithms. Three lesson plans required students to submit their work online through a program/website hosted by the school for grading. Similarly, three teachers asked students to share their progress or completed assignments with class members through Google Drive or a class gallery. Finally, the least frequently mentioned assessment practice was providing students with a rubric or checklist prior to submitting their work for grading.

Conclusion

This paper presented the outcomes of our week-long *Summer Institute* for teaching CS through the application of CRP and equity-focused elements. Findings of this study were supplied by a series of interviews from teachers after completing the Summer Institute and lesson plans teachers constructed during that time. Statements

teachers made in interviews and examples of CRP in lesson plans indicate that teachers developed a strong foundational understanding of what it means to be culturally responsive and equity focused. By offering teachers resources, training, and skill development during their participation in PD, we were able to effectively influence the way teachers will construct or use culturally appropriate content, pedagogy, and CS tools. Previous models at the *Summer Institute* left teachers with a basic understanding of CRP and thirst for contextualized support. Thus, although sessions were short yet intensive, the current PD model was able to successfully establish the importance of CRP and articulate the need for equity-based learning environments for diversity in CS. Future research needs to follow teachers in their classrooms to understand and observe the application of CRP. Additional PD opportunities and CRP resources should be constructed around contextualized support for communication strategies, assessment practices, challenges with student expression.

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