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Serving the Underserved Amid COVID-19: The Case of a Virtual, Culturally Responsive Summer Engineering Camp

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Abstract

The societal disruptions due to the novel coronavirus (COVID-19) pandemic are well noted, especially in the context of science, technology, engineering, and mathematics (STEM) education. Absent a concerted effort to sustain hands-on learning opportunities in STEM amid the crisis, the consequences of COVID-19 may exacerbate existing inequities and racial disparities among youth of color further stratifying the STEM fields. In the current study, we applied a mixed-method descriptive case study design, using online learning theory and culturally responsive pedagogy as our conceptual framework, to describe how participants experienced this camp, held online due to disruptions of COVID-19, in the southeastern region of the USA. We also share findings from the implementation of a justice bots project, which enabled participants to connect social justice and engineering. Participants included middle school youth, undergraduate engineering students, and in-service math and science teachers. Data sources entailed focus groups, pre-post surveys, observations, and artifacts. Our results indicated that participants experienced gains in their communication skills, positive changes in attitudes toward STEM for middle school youth, established meaningful connections, and enhanced their technical knowledge. Middle school youth reported enjoying the online summer camp environment, though they had experienced more than a year of education online. Undergraduate engineering students asserted that it was challenging to communicate coding and other technical knowledge virtually but having to do so strengthened their capacity to teach others while honing their own competencies. Lastly, in-service math and science teachers reported a better understanding of the connection between engineering and social justice based on their experiences in the camp. We conclude this article with implications for engineering education.

Keywords: culturally responsive pedagogy, pre-college engineering, case study, COVID-19, online learning

In an effort to curb the spread of COVID-19, in the spring of 2020 schools quickly transitioned to online education programs. According to the U.S. Census Bureau's Household Pulse Survey (2020), 52 million adults had children under age 18 enrolled in school in September 2020. Overall, 67% of those adults reported that classes had moved to a distance-learning format using online resources. Similar to traditional learning settings, the global pandemic forced out-of-school programs, including those that focus on engineering, to pivot to fully virtual platforms, requiring a reimagining of how to facilitate learning for participants. However, absent a concerted effort to sustain hands-on learning opportunities in science, technology, engineering, and mathematics (STEM) amid the crisis, the consequences of COVID-19 may exacerbate existing inequities and racial disparities among youth of color, further stratifying the STEM fields. Situating informal learning programs within this context allows for the exploration of opportunities for learning, mentoring, and 21st-century skill development.

Compounded with COVID-19, a racial reckoning also emerged in the USA, brought on by the murder of George Floyd, an unarmed Black man killed by a Minneapolis police officer. His death, among other murders of unarmed Black people, sparked protests across the nation and yet another plea for an end to social inequalities faced by Black men at the hands of police. The impact of this tragedy could not be ignored as conversations about social justice seeped into educational communities and the lives of the children they serve. These events precipitated opportunities to create justice-oriented lessons that use real-word challenges as vehicles for deeper and more meaningful learning of content. However, limited research exists on how aspects of society may contribute to more meaningful engineering-related experiences for middle school students (Tan et al., 2021) and, specifically, how they may be implemented in informal learning and online environments.

In the current study, we use online learning theory (Anderson, 2008) and culturally responsive pedagogy (Gay, 2021) to answer three research questions: (1) According to participants, what were the perceived strengths and challenges of implementing an online, culturally responsive engineering camp during COVID-19? (2) How did participants (i.e., mentees and mentors) describe noncognitive attributes (e.g., leadership skills, teaching approaches) garnered from their involvement in camp? (3) To what extent did participating in the camp influence middle school youth's attitudes toward STEM? While the first research question enabled us to examine the strengths and challenges of the program, the additional questions investigated gains that participants ascribed to their engagement in the program.

Bulls-Engineering Youth Experience (Bulls-EYE), a summer university-based engineering camp, utilized the overlapping circumstances of culturally responsive pedagogy, virtual informal learning spaces, and a social justice context to facilitate opportunities in engineering education for middle school youth of color. The purpose of this paper is to describe how participants experienced this culturally responsive engineering camp in the southeastern region of the USA, held online due to disruptions of COVID-19. We specifically discuss a "justice bots" project implemented during the camp to explicitly connect social justice and engineering.

Literature Review

The current study builds upon prior work in three key areas: (1) online, pre-college, out-of-school-time (OST) programming, (2) mentoring and impacts of pre-college OST STEM programs, and (3) culturally responsive OST programming for youth of color, as they are the target audience.

Strengths and Challenges of Virtual Pre-college STEM Education during COVID-19

STEM teaching has evolved from the predominant use of face-to-face media to the inclusion of virtual media, such as online learning and gamification (Lucena et al., 2020). The COVID-19 pandemic opened doors to new ideas and technologies that are expected to endure (Lempinen, 2020). Recent studies examining the effects of transitioning to virtual teaching amidst the pandemic have focused primarily on formal K-12 STEM education settings (e.g., Amunga, 2021; Buckley et al., 2021), while to date far fewer (Baucum & Capraro, 2021) focus on OST STEM learning contexts.

The literature identifies numerous challenges associated with the transition to virtual teaching in formal STEM settings. Teachers and students identified key challenges including lack of motivation, issues with time management, and low self-efficacy for virtual STEM teaching and learning (Aykan & Yıldırım, 2021). Some challenges arise from students' beliefs, attitudes, and perceptions of virtual learning (Amunga, 2021), resulting in lower student retention and persistence (Buckley et al., 2021). Further, Hallett and De (2020) found that due to distractions and study habits, students in virtual classrooms spent more time studying in comparison to their face-to-face peers in STEM classrooms. Some students further struggle with technology accessibility and internet connectivity, resulting in access and equity concerns (Diordieva, 2021), which may have posed the biggest challenge with virtual learning during the COVID-19 pandemic. The lack of technology in low-socioeconomic status homes also contributed to the digital divide during the COVID-19 pandemic outbreak (Amunga, 2021). Amunga further noted that students with differential access to technological tools and resources were still expected to complete similar STEM assignments, projects, and assessments, leading to compounding inequities in educational opportunities.

Only one study was found at the time of authoring this paper that focused on OST, pre-college STEM. In their quasi-experimental study, Baucum and Capraro (2021) compared a one-week virtual and a face-to-face STEM summer camp. Both summer camps hosted ninth- through twelfth-grade students from various racial/ethnic backgrounds (in both camps 54% of campers were students of color and 46% were White), utilizing similar activities. Students in both camps focused on standardized test preparation along with designing, coding, and collaborating to build a solution to a problem. Researchers found that students' perceptions of STEM careers and fields in both virtual and face-to-face camps improved positively. Interestingly, in this study, the online camp produced a larger proportion of favorable perceptions of STEM fields amongst the participants, illustrating the potential of this paradigm and the need for further study.

Mentoring and Reported Gains in Pre-college OST STEM Programs

Mentoring plays a critical role in the success of OST STEM programming. It has been shown that mentoring programs that implement evidence-based practices may promote youth of color's sense of belonging to thrive in STEM (Kupersmidt et al., 2018). However, most literature on mentorship in OST STEM programs primarily focused on the mentors' experiences in these programs. For example, in the Summer Engineering Experience for Kids camp, mentors indicated that their "professional opportunities" increased through their participation (Lewis et al., 2018, p. 1). Nelson et al. (2017) studied the Nebraska Science, Technology, Engineering and Math for You after-school program, where undergraduate mentors engaged with K-8 students. Researchers found that the undergraduate mentors self-reported significant gains in the categories of "organization, STEM content knowledge, preparedness to teach, and engagement in the program" (p. 1).

With respect to impacts on mentees, Reid-Griffin (2019) used the vertical mentoring model to examine the mentoring relationship between high school and college mentors of middle-grade students of diverse backgrounds in a summertime program. The model focused on social, cognitive, and identity development, enabling mentees to understand their current and future identity development. Reid-Griffin found that 98% of the middle-grade mentees' comments regarding their learning gains were positive and that interacting with STEM experts throughout the program increased both the mentee students' motivation and the mentors' confidence.

Finally, studies show that STEM mentoring programs are successful for youth of color when mentoring and instructions are interconnected with cultural responsiveness (Davis & Allen, 2020; Gilgoff & Ginwright, 2015; Young et al., 2019). For example, Davis and Allen found a significant correlation between girls' confidence and attitude toward STEM subjects and the mentoring relationship quality. Gilgoff and Ginwright suggest mentoring strategies for Black youth and men of color are effective when providing positive and consistent male role models. In online STEM mentoring platforms, in particular, the success of the mentee–mentor relationship depended on the frequency and quality of the interactions between the mentee and the STEM mentor (Kupersmidt et al., 2018).

In summary, STEM OST programs for youth of color that implement evidence-based practices to STEM mentoring, incorporate cultural responsiveness throughout mentoring activities, and include frequent and high-quality interactions between mentors and mentees are beneficial to both mentors and mentees.

Culturally Responsive OST STEM Programs for Youth of Color

Ensuring access to culturally, personally, and socially relevant and responsive OST STEM programs is an important strategy for addressing equity issues and broadening participation in STEM (National Research Council [NRC], 2015). Research has shown a positive correlation between youth of color's participation in culturally responsive OST STEM programs and STEM learning (Djonko-Moore et al., 2018; Garvin-Hudson & Jackson, 2018; Morales-Chicas et al., 2019; NRC, 2015; Sims, 2016; Williams et al., 2017; Young et al., 2019).

Programs that explicitly connect STEM to relevant and authentic situations for youth of color while also engaging their cultural resources and practices allow for the expansion of STEM learning experiences (e.g., Djonko-Moore et al., 2018; Morales-Chicas, 2019; Rahm, 2008). Cultural practices include discourse patterns that can be leveraged to support scientific argumentation (Emdin 2011; National Science Teachers Association, 2008), skills and practices from students' homes that promote participation in STEM (Bevan et al., 2013; Djonko-Moore et al., 2018; Leggon & Gaines, 2017), and belief systems that support observations and analysis of natural phenomena (Bang & Medin, 2010; Stevens et al., 2016). In addition to cultural practices, pedagogical approaches that position youth of color as knowledgeable and capable and leverage their strengths, interests, skills, and networks to secure team success have been shown to aid in developing STEM learning identities (Calabrese Barton et al., 2021; Garvin-Hudson & Jackson, 2018; Williams et al., 2017).

Supporting youth of color's appreciation of how STEM is relevant to important questions and problems in their lives can engage those who are committed to social justice even when they may not have developed STEM identities (NRC, 2015). OST STEM programs that situate learning in relevant settings and contexts are especially supportive of youth of color who may feel "cultural dissonance between current cultural meanings of science, for example, and their personal systems of belief (e.g., religious) or family histories" (p. 21). Situating STEM programs in settings and contexts that are relevant to youth of color's personal, familial, and community experiences allows them to fully participate at an intellectual, social, and emotional level, enabling youth of color to learn STEM content and become members of the STEM community (Leggon & Gaines, 2017; Masucci et al., 2020; Tan & Calabrese Barton, 2018).

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Although research on socially, culturally, and personally responsive OST STEM programming has grown over the past two decades, more detailed accounts of what STEM learning in such programs looks like and leads to are needed (NRC, 2015). This is especially true for responsive OST engineering learning, since the majority of research on OST STEM learning focuses on science or math education, and only a few studies are specific to engineering (and engineering-related) learning (e.g., Lane et al., 2019; Williams et al., 2017).

In addition, more work is needed at the intersection of social justice and OST STEM programs, specifically those that focus on engineering. Despite calls for engineering for justice over the past decade (e.g., Leydens & Lucena, 2017; Lucena, 2013), literature relevant to engineering education for social justice was predominantly concerned with engineering at the college level and beyond (e.g., Baillie & Pawley, 2012; Jiménez et al., 2019; Kabo & Baillie, 2009). Only one research article was found that specifically addressed engineering for social justice at the pre-college level (Calabrese Barton et al., 2021), and this study was in a formal learning context. Therefore, additional research on pre-college engineering education for justice in both formal and informal settings is needed and timely.

Conceptual Framework

Our conceptual framework consists of online learning theory (OLT) and culturally responsive pedagogy (CRP). We begin by describing OLT, drawing from Anderson's (2008) conceptualization, which states that effective online learning is learner, knowledge, and community focused and entails developing strong interactions between the learner, teacher, and the online environment. Virtual learning, similar to traditional face-to-face experiences, should provide opportunities to experience the discourse of their disciplines, collaborative learning, and frequent chances for students to reflect on their learning (Anderson, 2008). Applying Vygotsky's (1978) concepts of social cognition, Anderson suggests that teachers and learners should focus on collaborative co-construction of knowledge in online spaces. These interactions enhance communication and learning and situate online learning spaces as communities of practice and inquiry that provide interdependent learning opportunities, a shared sense of belonging, trust, and commitment to participate and contribute to the community (Anderson, 2008; DiPietro, 2010).

An asset-based framework, CRP acknowledges that the "cultural heritages, experiences, perspectives, and contributions of different ethnic groups of color" should be integrated into intellectually rigorous and purposeful teaching and learning opportunities (Gay, 2021, p. 212). As such, educators should assume that students have valuable prior knowledge that can be leveraged to enhance their learning experiences. This requires that educators get to know their students on a personal level. According to Sleeter (2012), CRP is a "political endeavor" (p. 577). Thus, educators should not decontextualize learning from its sociopolitical context. Moreover, Gay argues that CRP is more than the infusion of curriculum content, but an approach of multidimensionality that considers the interrelatedness of the context, learner, and content. Similar to tenets of online learning theory, these entities are inextricable and cannot be considered in isolation if educators are to promote the achievement and well-being of youth of color, especially in online settings. Other features of CRP include "[caring], cultural affirmation, socio-emotional well-being, interpersonal relations, and political efficacy" of individuals and systems (Gay, 2021, p. 212). When CRP is applied appropriately, students may be more engaged in the learning process (Sleeter, 2012).

Based on the literature, we applied a conceptual framework combining OLT and CRP as an analytical lens to interpret the emergent data from the study. The conceptual framework tenets and program components of the online summer camp are summarized in Table 1.

Methods

The current study is part of a larger, longitudinal, mixed-methods study investigating a summer engineering camp for middle school youth that exposes them to hands-on, project-based learning experiences using culturally responsive pedagogy and mentoring. Given our interest in this specific camp, we chose to examine this topic with a case study methodological framework. Our use of a case study is appropriate due to the unique methodological advantages that case studies offer to address complexity within the inquiry process (Creswell, 2018; Plano Clark et al., 2018) while also allowing us to utilize multiple forms of data to explore overlapping patterns and interactions of findings, ultimately producing an in-depth understanding of our case (Simons, 2009; Yin, 2014).

While there are various types of case studies, we use a descriptive case study to examine the effects of COVID-19, online learning, and a social justice-oriented virtual engineering camp for youth. Descriptive case studies describe a phenomenon as it occurs within a real-world context when we are interested in a specific case of interest (Yin, 2014). We bound our case study by population (program participants—mentees and mentors), time (summer 2021), and virtual location (an online summer camp hosted via Zoom). In the next sections, we describe the program background, program participants, data sources, collection, and analysis, and finally the data quality determinants that we chose to ensure rigor and reliability.

Table 1
Conceptual framework of OLT and CRP.

	Tenets of OLT	Tenets of CRP	Camp components
Learner	Learner-centered context	Asset-based; multidimensionality considers interrelatedness of the context, learner, and content	
Community	Presence of a learning community or community of practice	Acknowledgment of the cultural heritages, experiences, perspectives, and contributions of different racial/ethnic groups in the learning process	Learning community includes middle school youth, undergraduate engineering mentors, and math and science teacher mentors
Nature of knowledge	Considers forms of knowledge dissemination	Intellectually rigorous	Knowledge dissemination of information geared toward building technical and life skills (e.g., justice-orientation of engineering; how to build autonomous vehicles)
Learning opportunities	Activities to promote learner understanding and opportunities for reflection	Purposeful teaching and learning opportunities	Culturally responsive program content focused on developing life and technical skills
Nature of collaboration	Collaborative, interdependent learning		Participants are placed in design teams
Affective aspects of learning	Shared sense of belonging	Promotes socioemotional well-being	Humility and closeness are embedded in mentee and mentor tenets
Nature of relationships	Trust	Values interpersonal relationships	Community is a part of mentor tenets
Commitments in the learning process	Commitments to engaged participation and contributions to the community		Participants are encouraged to leave cameras on during team activities. Program administrator explains that the group is a family. Legacy is a component of mentor tenets
Political consciousness		Furthers political efficacy of individuals and systems	Implementation of the justice bots project

Note. OLT refers to online learning theory, and CRP corresponds to culturally responsive pedagogy.

Program Description

Program Participants, Funding, and Setting

Bulls-EYE is an engineering camp designed for underserved middle school youth. The program participants include middle school youth, referred to as mentees, undergraduate engineering mentors (UEMs), and teacher mentors (TMs). The program was funded through a National Science Foundation grant award (no. 1734878). The program administrator designed the camp to be an on-campus, in-person engineering camp that took place at a large public research university in the southeastern region of the USA. As such, it was offered in this format during the first two years of funding. However, due to the disruptions of COVID-19, the camp was moved to a virtual setting for the third and final year of programming.

Program Model

The program applied the Plan, History, Act, Score, Evaluate, Shift (PHASES) design process as a mechanism for the delivery of program content (see Gaines & Bergman, 2016). PHASES weaves together middle school engineering Next Generation Science Standards (NRC, 2013) through a systematic "topic-chaining" approach while providing opportunities for critical thinking, self-improvement, and community engagement (i.e., life skill development). PHASES starts with a simple design process and adds additional steps as youth complete projects and become comfortable with learned skills (Gaines & Bergman, 2016). Each day of the camp, program staff give the participants increasingly challenging CRP-informed activities to develop their life and technical skills. For example, one life skill activity includes having participants set life goals considering where they intend to be in five to ten years and working backward to identify intermittent goals to achieve those long-term goals. An example of technical skill development involved youth learning to add continuous rotation servomotors and teleoperation to their designs.

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Table 2
Daily camp schedule and examples of activities.

Time	Daily schedule
10:00 am–12:00 pm	Life skills activities *Discovering what you do well.* *Determining roles within a team.* *Goal setting.*
12:00 pm–1:00 pm	Lunch break
1:00 pm–3:00 pm	Technical skill training and development *Robotics hardware and software construction.* *Evaluating robotic builds.* *Sonar sensors and motors.*

Program Logistics

In the summer of 2021, program staff offered the camp in an online, synchronous format. The camp operated for a three-week period for five days a week, four hours each day. A sample daily schedule, along with example activities and skills, is shown in Table 2. Project teams consisted of one or two mentees and one to two mentors (for a total of up to four members).

Program Tenets

The program is designed around eight core tenets (four for mentors and four for mentees) shared and recited at the induction ceremony during the first week of the program. The mentor tenets are *leadership*, *closeness*, *community*, and *legacy* discussed in the following way:

> *The true meaning of leadership is service. Engineering today is about leadership. Engineers address today's challenges and apply the design process to make the world a better place. Bulls-EYE mentoring is about leadership. We must build strong relationships in our community if we are to become the engineers of tomorrow. We must build meaningful relationships amongst ourselves to support one another. Bulls-EYE mentoring is about closeness.*

The mentee tenets entail *potential*, *humility*, *empowerment*, and *growth* framed as the following:

> *Bulls-EYE mentoring is about realizing our potential. You're never strong enough that you don't need help. If we find something difficult, we will learn to use every resource we can. Bulls-EYE mentoring teaches us about humility. Teach children other people besides themselves are important, and the best thing they can do with their lives is to use them in the service of other people. We are here to learn about engineering because engineers help people. Bulls-EYE mentoring is about empowerment. We will become stronger if we improve every day. Bulls-EYE mentors believe in us, and they teach us about growth.*

Program administrators reinforce the tenets through group activities and the construction of robotics projects as designed to aid participants in developing life and technical skills.

Participants

We recruited middle school youth to participate in the program as mentees by sharing information about the camp with local school districts and teachers. Mentee demographics are provided in Table 3, though mentee demographic data are not complete due to many mentees choosing not to provide their information. We recruited UEMs by emailing all students majoring in engineering at the university where the camp is situated. Finally, we recruited TMs by sharing a recruitment email about the camp with local school district leaders including the director for K-12 science education and middle school math coordinator. All demographics are provided in Table 3.

Data Sources, Collection, and Analysis

Multiple data sources are needed when generating an in-depth examination of a bound case (Creswell, 2018; Yin, 2014). We invited participants to complete a pre- and post-camp survey and two 60-minute focus groups. We further collected 52 hours of observational data throughout the three weeks of the program and collected artifacts and documents relevant to

Table 3
Participant demographics.

Demographics	Mentees (n = 14)	Mentors (n = 13)	MSTs (n = 2)
Gender			
Woman/girl	4	6	1
Man/boy	4	7	1
Did not answer	6		
Year in school			
7th grade	6		
8th grade	2		
2nd year college		4	
3rd year college		5	
4th year college		4	
Did not answer	7		
Race/ethnicity			
American Indian, Black, and White		1	
Asian	1		
Black	5	3	2
Black and Hispanic	1	-	
Black and multiracial		1	
Hellenic		1	
Hispanic or Latino		1	
Multiracial		2	
White		4	
Did not answer	8	-	

Note. We chose to utilize the language that participants used to describe their own racial identities.

the camp. We analyzed data from each of these six sources independently and then compared our findings across data types. See Figure 1 for a model of our study design.

Pre- and Post-Camp Surveys

We asked each participant to complete pre- and post-camp surveys containing the STEM Semantic Survey to assess growth in STEM interest, along with basic demographic information (Tyler-Wood et al., 2010). The STEM Semantic Survey included a series of questions about the respondents' interest in science, math, engineering, technology, and careers in those fields. The instrument has been validated through multiple studies with high reliability estimates, and we confirmed that each of our Cronbach's alpha results was above 0.80 ($0.8 \leq \alpha$) throughout respondent answers.

The instrument asks mentees to rate their interest in science, math, engineering, technology, and STEM careers through the creation of five composite variables. Each composite variable is measured by averaging the scores across five questions using seven-point scales to determine how (1) fascinating, (2) appealing, (3) exciting, (4) meaningful, and (5) interesting science, math, engineering, technology, and STEM careers are to each student. An example question is shown in Figure 2.

To average each composite variable, we assigned numerical values to each response option and reverse-coded the negatively worded items. Descriptive statistics were calculated for all pre- and post-camp surveys in order to examine trends across program participants. While our low sample size precluded us from calculating further inferential statistics, we were able to run paired-sample t-tests between pre- and post-camp mentee surveys to examine if the change that participants reported was statistically significant.

Focus Groups

We conducted two 60-minute focus groups with program mentors and another two focus groups with mentees. The first focus group occurred on the first day of the second week of the program for formative feedback. The second focus group was conducted on the final day of the camp program to capture summative feedback. The focus groups were audio- and video-recorded using the Zoom platform.

Data were transcribed using a third party and uploaded into Dedoose (i.e., software for qualitative data analysis). A codebook was developed using both open and *a priori* codes (Saldaña, 2021) and applied a focused coding procedure. Once all data had been coded, we used axial coding to look for data relevant to our research questions and to explore how mentees and mentors described their experiences participating in the program in their own words (Saldaña, 2021). After completing two rounds of coding, we connected patterns across focus groups and generated four themes: advantages and

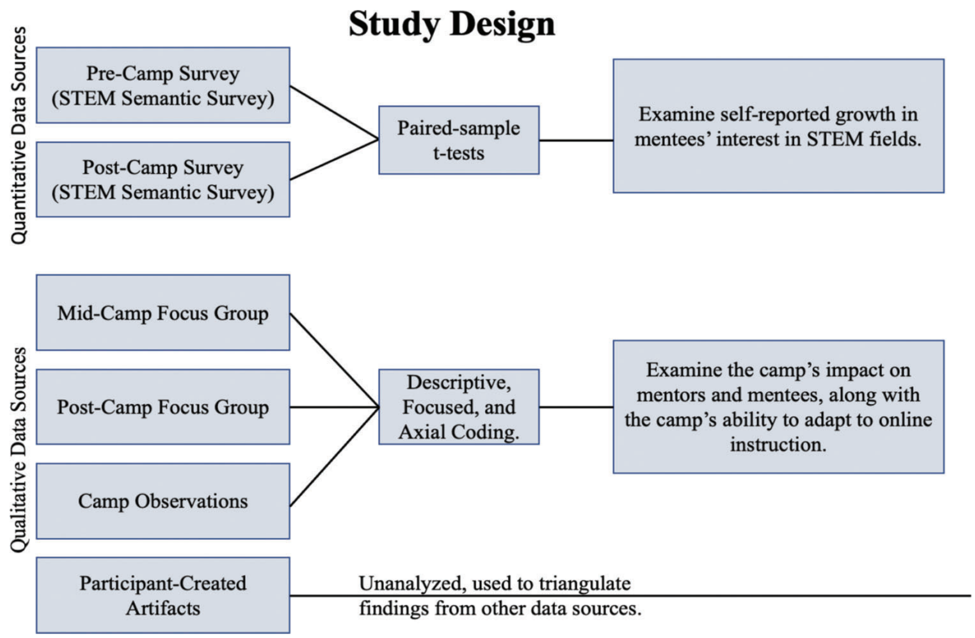


Figure 1. Study design and incorporation of data sources.

Figure 2. Example of scale items comprising composite variables.

disadvantages of an online camp environment, a caring program culture, execution of justice bots projects, and participants' perceived gains.

Observations

We observed each small group of mentors and mentees throughout the three weeks of the virtual camp. To document our observations, we used descriptive field notes, screenshots, and recorded audiovisual data within Zoom. Transcribed audiovisual data were analyzed using Dedoose with the same coding and theme-generating process used for focus group data.

Artifacts

Program artifacts created by mentees and mentors throughout their participation in the camp were reviewed by the research team. While reviewing artifacts, we looked for evidence that would support or challenge our findings generated through the other data sources, though we did not find any areas of discord. Though artifacts were not formally analyzed, we used them to provide context and triangulate our findings from all other data sources. These artifacts included lesson plans and worksheets containing participants' responses. They are detailed in Table 4.

Data Quality

We sought to provide enough information to claim that we are credible in presenting our study, and we utilized ethical commitment and thick description to ensure rigor throughout our study, which we detail in Table 5.

Table 4
Types of artifacts.

Artifact type	Artifact description
Lesson plan	Describe the objectives and activities associated with justice definitions, project option selection, and research
Worksheet	Document used to brainstorm justice-related definitions, problems, and opportunities to develop solution-oriented robots

Table 5
Data quality determinants and their application to our study.

Quality determinant	Application to study
Credibility	We collected a variety of data sources and provided evidentiary proof of our findings from each data source throughout our findings section in order to demonstrate credibility (see Lincoln & Guba, 1985; Tracy, 2010). Further, we sought and reported any discovered disconfirming evidence to ensure that our findings were accurate.
Ethical commitments	Our research was approved by the relevant institutional review board, and our ethical decision-making was consistently revisited to ensure that we were doing what was in the best interest of all study participants. Further, we repeatedly reaffirmed consent throughout the three-week process to ensure that participants knew that their participation was completely voluntary. We allowed mentees to participate in the program without taking part in the research project to ensure that all youth who participated in the program benefited from their participation without potential retaliation due to their assent (see Lincoln, 1995).
Thick description	Along with pursuing multiple types of data sources due to best practice within case study research (see Creswell, 2018), we also utilized multiple types and sources of data to provide a thick description of the virtual camp. Thick description allowed us to explore our findings in sufficient detail so that readers may evaluate the conclusions that we have drawn through our data (Lincoln & Guba, 1985).

Positionality

We chose to include our positional considerations in order to align with the qualitative values inherent in our mixed-methods design. Tonisha is a Black, cisgender woman who is an assistant professor in higher education, where she investigates the experiences and outcomes of underrepresented groups in STEM. Eugenia identifies as a White, bicultural, cisgender woman. She is an associate professor of mathematics education, and her research and teaching focus is on culturally responsive mathematics teacher education. Leia is a White, cisgender, queer woman with a disability, who is an assistant professor in evaluation, statistics, and methodology. Her research focuses on the intersection between ontoepistemological considerations, researcher identity, and ethical commitments. Selene is a Black, cisgender American woman, science education doctoral candidate, and K-12 science educator. Salam is a Palestinian-American Muslim woman, who is a K-12 educator and mathematics education doctoral candidate. Jonathan is a Black, cisgender American man, who is an associate professor of instruction in mechanical engineering. He was also the visionary, creator, and program director for Bulls-EYE.

Findings

Four themes emerged from the data analysis: (1) advantages and disadvantages of an online camp environment, (2) a caring program culture, (3) execution of justice bots projects, and (4) perceived participant gains.

Advantages and Disadvantages of an Online Camp Environment

In focus group interviews, some mentees perceived the online nature of the camp to be advantageous. For example, one mentee shared, “I liked that it was online because I was used to it, having school online, so waking up early, clicking the links, getting on.” Another mentee explained the following: “when you’re at home, you feel like you’re in your home state and you feel a lot more comfortable doing the stuff that you’re doing.” For some participants, engaging in an online camp mitigated some of the anxiety students experienced when transitioning into a new environment with people they are unfamiliar with. For example, a UEM shared,

> *I know one of my mentees the first week, he was like, “I’m really shy in person, but being on Zoom makes me more comfortable to speak and talk to people.” I definitely resonate with the mentees being more comfortable in this space to open up. Even though we’re talking to a screen, we still have that ability to get personal with them.*

Because the participants would be working as teams to develop increasingly complex robots in a relatively short period of time, feeling at ease in the online space aligned well with the pace of the camp. Stated another way, groups would need to become comfortable with each other quickly if they were to complete the upcoming assignments.

The online environment also seemed to work well for more introverted participants. Some participants reported being more likely to communicate with team members in an online space than if the camp was held in-person. Hence, the online space allowed them to remain engaged. As one mentee stated,

> *Mentee: I liked that I didn’t have to be there in person. ’Cause I’m not a very social person, so if I had to be there in person, I’d have to talk to people in person.*
>
> *Interviewer: Do you feel like you were able to participate more comfortably in this online environment? Were you able to share your thoughts or talk more than you would otherwise?*
>
> *Mentee: Yes. It made a difference ’cause, yes, I do feel like I talk more.*

As noted in OLT, trust is essential for getting the most out of virtual learning experiences especially if participants are to maintain their commitment to being an engaged participant and contributor to the community. Our data showed being online minimized the potential stress of building trusting relationships with others in a relatively short period of time.

Participants also noted the importance of not feeling rushed when engaging online. One mentee explained it in the following manner, “I would say [being online is a] big help because you don’t feel like you’re being rushed, or the new environment stresses you out, or anything like that.” Because most of the participants were novices in robotics, the ease of not feeling rushed was particularly critical in how they engaged the camp. This seemingly relaxed environment may have helped with promoting socioemotional well-being of the participants. Gay (2021) underscored the importance of creating intellectually challenging educational experiences that also leave students’ socioemotional well-being intact. To this end, participants perceived the online camp to reduce anxiety while exposing them to increasingly rigorous content that was fun and engaging.

During focus group interviews, participants reported several challenges with the camp taking place online. Among these challenges, the most common, reported by participants, was the inability to build the robot in-person. For example, one TM shared the following:

> *That was the hardest piece, not being able to be there next to [the mentee], trying to build that robot at the same time. You see them struggling with maybe a screw or trying to figure out where [a part] goes. When [mentee] holds it up [to the computer screen], I don’t know if her right is my left and you’re trying to say look to your left, and she’s looking to her right. It was hard to tell her, that’s not the right end to the screwdriver. That was the only difficult part with the virtual. I mean the rest of it seemed to be the same. We were interfacing with each other. It was just the hands-on part with the experience. That was different in virtual versus face-to-face.*

Another TM elucidated that it may be more difficult to tell what students are thinking or provide hints to support their learning of a new skill,

> *Showing their thinking about what they’re doing and how they’re doing it, that definitely was a challenge. Face-to-face, you can sometimes hint at it. The other mentor in the room, I think she picked up on what I was doing in terms of phasing out instead of just giving them the answer. Online makes it harder because you just feel like you’re at a disadvantage and not there with them. You wanna try to give them as much as you can, but then in the same sense, it was like I didn’t wanna give too much, while I’m taking away from their learning experience. That’s why it was harder.*

Other mentors pointed out the challenge of implementing the design process online. For example, one UEM shared the following:

http://dx.doi.org/10.7771/2157-9288.1352

Having this design process online is a big challenge because you're not with them. You cannot explain exactly what they ask you. Like, "I don't know where to put this," and then you're like, "Okay, here is the second one," but they think the second one is the other side and then the other side is in the front and then this other side is the other side, and then you say side so many times that they don't know what you're doing. It's really challenging for us to help them…the coding and the design process. You have to give so many brainstorming [sessions]. You have to help them a lot. It was hard, but it was a really good experience.

Other mentors concurred with this participant by highlighting both the obstacles and rewards of working on the robotics projects with middle school youth.

Lastly, several mentors discussed the challenges of being at home during the camp. One UEM stated, "the kids being in their own homes means that there's a lot of distractions that could take their attention away." Another UEM reported, "it's really hard to keep the students in place. They just walk off, and I just don't know where they went. I'm just staring at two empty chairs on my screen. I don't know where they're at. I'm like, 'Okay, I'll just sit here and wait till they come back.'" Further, these behaviors were exacerbated by having to engage in a multistep robotics project that required undivided attention. Applying OLT, this absentee behavior demonstrated a decline in mentees' commitment to remain engaged, or they may not have considered how this behavior disrupted the development of their projects. This behavior also suggested a need to remind participants of their commitments to the community to fully contribute and participate when working in virtual spaces.

A Caring Program Culture

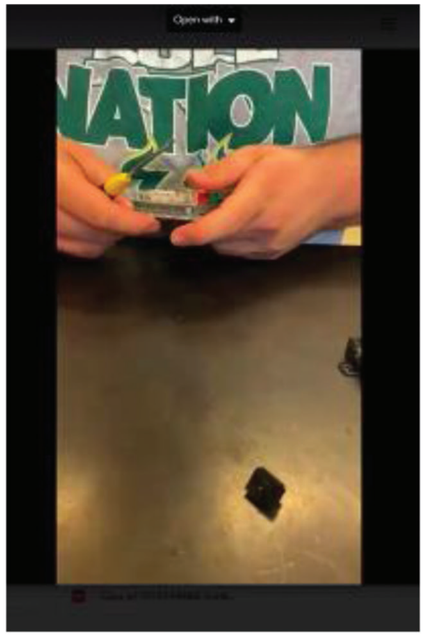
One of the strengths of the program, as discussed by mentees in focus groups, was the mentors' caring nature. As noted earlier, the program tenets highlighted the importance of creating an environment where community, closeness, and empowerment are among other culturally responsive program attributes. As such, mentees reported experiencing these aspects when interacting with the mentors, noting their patience and kindness when engaging in camp activities. As discussed by participants, online learning environments can be stressful when one is less familiar with a task and when one does not have face-to-face interactions. However, we found through observations that mentors went to great lengths to explain concepts and instructions for completing camp projects. Some created videos that allowed mentees to pause and repeat while working on aspects of the project, as illustrated in Figure 3. Others adjusted their camera angles to share content with mentees in real time, as shown in Figure 4.

Though these instructional strategies proved to be difficult at times, the caring approach the mentors applied to ensure the mentees understood how to build the robots was very meaningful to them. It also made the camp experience enjoyable despite its virtual nature. Consequently, one mentee stated, "I liked working with my team because my mentors always knew what to say." Another participant recounted "They were patient. When we couldn't get the screws in sometimes, they said, 'It's okay. Just keep trying.'" Nonetheless, the rigor of the program was present due to expectations to build autonomous robots having little to no knowledge about how to do this prior to the camp. The program's emphasis on cultivating interpersonal relationships and supporting socioemotional well-being was also critical to sustaining a culturally responsive program environment. Additionally, the level of care exercised in the program eased concerns when asking for help. For example, a TM discussed,

That goes back to closeness, building that environment where it's okay to ask me questions. That's what I'm here for. Move your camera down so I can see your hands moving, so I can analyze it and be there with you in the moment. You don't have to do it all by yourself or get it all right. I think once they got in that safe space with us, it was less of us asking the questions, but them probing us, not really to just get an answer.

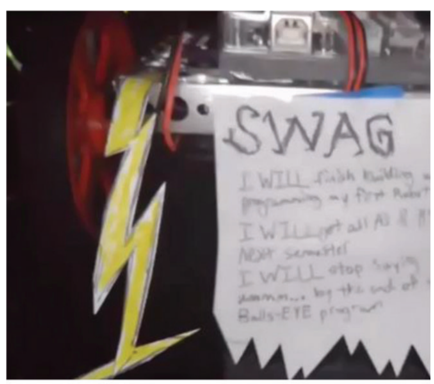
The caring environment was also reinforced by the meaningful connections participants made during the camp. At the induction ceremony, the program administrator informed participants that engaging in the ceremony made them family, he stated, "we're gonna start up our robots on our teams tomorrow. Y'all are Bulls-EYE family now. Today was about induction into that family." He also established a community standard that participants would leave on their cameras and keep their microphones unmuted:

The last rule of thumb is, because this is a mentoring program, we need y'all to be unmuted on y'all's camera at all times so we can see y'all, because we want to be able to see the person that we're talking [to]—even though we're not able to do so in person, I'm looking at a sea of faces, and it just feels almost like we're in person, like I'm there with you, even though I know I'm not. I am on a Zoom call. Having the cameras on will allow you to build that relationship with your mentor.



Note: These figures show screen captures of video. Video was used to help mentees build a stock robot as a starting point for the design process. This stock robot was then customized to reflect their individual and group identity. Each group chose a group name which was the motivation for the group identity customization. Each individual then wrote down personal goals which were the basis for the individual identity robot customization.

Figure 3. UEM demonstrating how to use a tool.



Text in photo: "I will finish building and programming my first robot. I will get all A's and Bs next Semester
I will stop saying "ummmm" by the end of the Bulls-EYE program."

Figure 4. Mentor showing goals on bottom of robot.

These practices were thought to be essential to building relationships within a virtual camp context. Consequently, participants underscored the bonds and connections they established through the program. A TM recalled about her mentees, *They would help each other. I appreciate it because—one of our tenets in terms of [team] building—[is] closeness. This is their first interaction [referring to mentees] working and being together. They both come from two different backgrounds, so seeing them create their bond and friendship and work together to help each other, was truly amazing.*

Though the camp took place in a virtual space, participants were able to foster relationships with ease. Focus groups, observations, and reviews of artifacts that contained reflections suggested the foundation set by the program model and tenets were influential in developing relationships. Based on focus group data, the collaborative project work deepened these relationships as participants became more knowledgeable about each other and felt comfortable working together.

Execution of the Justice Bots Projects

Justice bots was a justice-centered project implemented during the camp. In part, this project was an opportunity to embed justice-related issues in response to the 2020 racial reckoning. However, projects could address other issues such as global warming or similar environmental challenges. To this end, participants were instructed to design robots to address educational, global, and social justice issues. This project also aligned well with one of the tenets of CRP to teach youth political efficacy, empowering them to see their capacity to improve aspects of society.

As a precursor to developing these robots, the program administrator had participants prepare a list of problems that robots could address followed by sharing their ideas in the larger group. To help them identify justice-related problems, the program administrator provided a definition of justice and its interconnectedness with engineering:

Justice is about a desire to see the world change. If we think about what engineers do, when you sign on to be an engineer, you sign on to improve things for other people. Whether you realize that or not, the solutions that you produce are for others. That's why, inherently, a discussion about justice is tied to the field of engineering because engineering is a field where you are helping other people. Engineering justice, the art of problem solving to help other people achieve fairness and human dignity.

The program administrator's assertion illustrates how CRP can be used to help youth in seeing the linkages between them and their communities and "something greater than themselves" (Gay, 2021, p. 220). These connections were critical to showing the linkage between social justice and engineering. For example, one TM expressed how the program administrator's explanation crystallized the interrelatedness of engineering and justice for them:

TM#1: I never put the two and two together, initially, even when teaching or learning about it. It's always been two separate things. With him pointing it out and bringing light to it, you definitely can see the connection instantly. When you've never viewed something from this angle, when you look at it with a new set of lenses, it's just like, oh, yeah, that's absolutely correct. Because really, when you think about problem solving, when you're trying to create justice, something was wrong and now you're trying to make it equitable to solve that problem.

TM#2: I never thought of it like that, putting the two together trying to solve a social [issue] with engineering. You're always thinking I'm doing this engineering to help out somebody, maybe who's disabled or an elderly person, but trying to solve it from a social aspect, I didn't think of it like that, even though the two can be closely mixed together, 'cause you're really solving a problem.

One of the strengths of implementing this project included a stated objective to develop robots that would address real-world problems as well as the opportunity to discuss inequities and social justice in the USA. Some mentors also noted how engaging in this project helped to better explain the engineering design process.

Notable challenges, expressed during focus group interviews, entailed concerns with the broad nature of social justice as a concept and how to convey these ideas to middle school youth. One UEM recounted,

…for my group, it was very hard. They're [referring to justice concepts] very broad concepts to talk about, like worldwide or social justices to middle schoolers. It's very hard for them. It's easier to go almost in a line of questioning. Basically, we're asking them, "What is a hindrance? What are some difficulties you feel in your day-to-day [life]?" It's hard to ask them, "What do you think's affecting your community or your society as a hindrance?" Then you ask 'em on a worldwide scale, and it's like, "I don't know pollution." It's the best one they know of 'cause they're just not educated.

Some mentors struggled to help their mentees complete the assignment because of implicit biases about the mentees' knowledge and capabilities. CRP suggests educators and mentors should empower youth in their learning, and they should expect more, not less, from their students and mentees (Gay, 2021). While the UEM appropriately connected what students currently knew (e.g., pollution) to the information they needed to learn, the mentor should have employed a strengths-based assessment considering the assets of the youth rather than their shortcomings.

Some participants were concerned with the lack of depth in some of the projects, given the justice-related theme. Mentee participants tended to focus on environmental and safety issues because these elements were most relevant to their local context. For example, one mentee explained their project in the following way:

> *My justice bot was like a security guard. The robot will track down bad guys and burglars so that it will be safer for the owner or other people. It is social justice, and I think it's a pretty cool idea. I just need to finish building the robot.*

Mentors perceived that robots like the one the mentee described above were less credible. While the projects met the technical requirements, the mentors expressed that the robots fell short in connecting to larger social issues such as those outlined by the participants when brainstorming possible projects. In examining the brainstorming worksheet as an artifact, participants were instructed to define global, social, and educational justice. They were then asked to identify problems that could be solved using STEM knowledge and tools. Participants provided a myriad of responses including addressing cyberbullying, police brutality, fixing autonomous vehicles to mitigate racial bias, incorporating financial literacy in schools, delivering food supplies to people without homes, mental health, pollution, prioritizing knowledge over grades, and coronavirus. However, as discussed in their focus group interviews, some mentors contended that the execution of the justice bots did not align with the ideas brainstormed earlier in the development of the robot. To this end, one TM asserted,

> *When [mentees] present [their robots], [mentors] should highlight this is what you did, so they could make that connection and not just you design something and you made it and here's the prototype but coming back and making that connection to the social justice piece, how they created a solution. I don't think it hit home all the way, but this is a great foundational piece to begin to build those steps for them…just imagine if they make that connection on their own on another project, and they came back full circle to what they did over the summer.*

Given the amount of time and students' varying exposure to justice-centered lessons in their own schools, students may have needed more scaffolding to complete projects that address larger systemic issues. However, selecting and researching an idea and developing a solution using engineering skills demonstrated the cultural responsiveness of the camp. Thus, it is possible that this TM overlooked connections mentees formed that demonstrated their agency and empowerment to solve a real problem. For example, most mentees developed robots that addressed problems relevant to their communities or what they were exposed to in the news. To this end, one team developed a firefighter robot that could aid firefighters in reducing their exposure to dangerous fires and support them in saving more people (see Figure 5). Mentees in this group also connected their interests in firefighting with the forest fires in California at the time of the camp.

Participants' Perceived Noncognitive Gains

The program promoted intellectual and personal development through scaffolding technical and life skills training and development. There was also critical messaging provided throughout the camp to encourage participants to grow and develop in a multitude of capacities. All participants reported learning new skills, knowledge, and competencies. For TMs, some of these new competencies entailed knowing when to intervene and when to allow students to learn content organically through trial and error. As such, one TM stated, the camp helped her with "backing up" so that students could learn more through their own means. She explained,

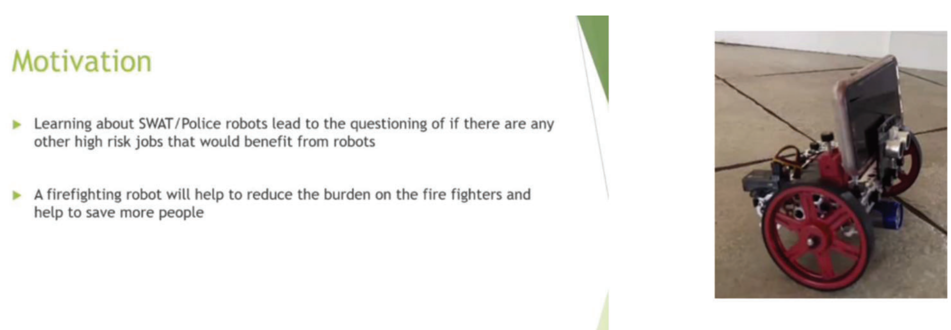


Figure 5. Team's firefighter robot.

The most challenging piece, and it's something that I just work on as an educator, kinda just backing up and letting not the failure, but the mishaps happen. I had the two mentees in the room, so instead of being so quick, my colleague said to just maybe even show a model. I wanted to hear and see their thinking of why they did it this way in looking at it. Then for me, it was more or less just fading to the back and letting the two mentees help each other so that then they could talk that sixth-grade language. I think that's something that I worked on full circle, just kinda not always having to give instructions and tell it and say it, but letting them learn.

Several mentors shared that learning how to write a computer program was a beneficial aspect of the program. One UEM stated,

I learn[ed] a lot of coding. I thought that I knew, but I don't know anything. I'm not good at coding in Arduino. I learned [Arduino] and how to build a robot. I never did this type of material because I am always working with 3D printing, and it's totally different.

Finally, another UEM noted learning more in the engineering camp than what was offered in the engineering curriculum, "I've learned a lot, also, in this program, than just being in engineering. Even though we learn the theory, just actual engineering things, I've had more experience here than my entire college career so far."

As previously stated, participants highlighted the challenges with communication, yet these issues resulted in them strengthening their skills. When responding to the focus group question, "what is something you learned this summer?", one UEM shared,

The communication aspect is [worth] mentioning when we had to physically build the robot like you saying, "Yeah, no, this side or to the front." I would say better communication in terms of being specific and exact with your words to say, not just here but, in the front to the left, two screws behind or something like that. That was definitely one skill.

Several mentees also reported improving their communication throughout the program. One mentee elaborated on the significance of this skill for team-based engineering:

Mentee: The few things that I learned throughout the summer is so much about robotics and I learned how to code the robot, and make it move. I learned how to communicate more with my team.

Interviewer: Tell me about how important that was to be able to communicate with your team.

Mentee: It was important to me because if we needed ideas with the robot, we had to talk to each other about each of our own ideas through brainstorming.

Here the participant described communication as critical for brainstorming ideas and moving the project forward. As echoed throughout our focus group interviews, strong communication skills became especially important in a virtual camp environment.

Changes in Mentees' STEM Attitudes

During the camp, mentees showed notable positive changes in their science, math, and engineering attitudes. After reverse-coding the negatively worded items on the STEM Semantics Survey (Tyler-Wood et al., 2010) to ensure that larger values reflected a greater appreciation of the construct, we conducted descriptive analyses and a paired-samples two-tailed t-test for each composite variable. There were statistically significant differences between pre- and post-camp means for science attitudes ($p < 0.05$), math attitudes ($p < 0.05$), and engineering attitudes ($p < 0.05$), though the differences in teaching attitudes and STEM career attitudes were not significant (see Table 6 for information about these variables).

Discussion

This study contributes to the literature showing how STEM OST spaces were maintained and evolved in response to the disruptions of COVID-19. As Amunga (2021) pointed out, the constraints of the COVID-19 pandemic inspired educators to use new technologies and ways of teaching. The summer engineering camp described in this paper was no different. Had it not been for the impacts of COVID-19, program staff may not have considered the possibility of a virtual camp. Consequently, virtual camps such as the one described in this paper may be a mechanism for increasing accessibility to

Table 6
Means, standard deviations, and t-test results for composite variables.

Composite variable	Pre-test		Post-test		t-test
	Mean	Standard deviation	Mean	Standard deviation	
Science attitudes	5.39	1.19	5.84	1.12	2.51*
Math attitudes	4.96	1.85	5.47	1.53	0.63*
Engineering attitudes	5.54	0.65	6.18	0.97	3.25*
Technology attitudes	5.75	1.23	5.67	0.96	0.12
STEM career attitudes	5.73	1.26	5.96	1.04	0.81

high-quality OST engineering experiences for underserved youth of color even after COVID-19. Additionally, the racial reckoning of 2020 motivated program staff to implement a justice-centered robotics project. This program modification is critical because, amid the disruptions of COVID-19, there is a persistent epidemic of racial injustice in the USA, both of which disproportionately impact communities of color. It is also significant because of the scarcity of engineering programs that focus on justice at the pre-college level.

There were several notable strengths of this program. As Gay (2021) pointed out, there is much theorizing about CRP, but very few studies describe the practices that make learning spaces culturally responsive. In this study, we elucidated how the program model, participant tenets, the caring program culture fostered by mentors, and the justice bot project contributed to the cultural responsiveness of the camp. These approaches created an atmosphere that was conducive to synchronous online learning of technical and life skills despite the barriers embedded in the online environment (Baucum & Capraro, 2021). While many participants noted in their focus group interviews that being online was not the same as face-to-face programs, the participants built community and meaningful connections. Anderson (2008) noted that developing an authentic community in virtual learning spaces can be difficult because learners may have different goals and expectations for interactions and different levels of comfort. However, this did not seem to be a problem in this program due to participants living out program tenets and a willingness to help everyone involved. In part, this was done by being more creative in a virtual environment such as recording instructional videos or using different camera angles to aid teams in understanding the intricacies of building the robots. Mentors also shared a substantial amount of advice in a caring and nurturing manner, demonstrating to the mentees their desire for them to be successful. While there were some challenges, mentees expressed that the opportunities to learn robotics and connect with other youth and mentors outweighed any barriers or disruptions they encountered.

Additionally, mentees and mentors reported gaining new skills and competencies from the camp. Similar to previous studies (Kupersmidt, et. al., 2018; Lewis et al., 2018; Nelson et al., 2017), mentees' positive attitudes about math, science, and engineering increased. This may be due to mentoring relationships they cultivated in the program, as noted in other studies (Azevedo, 2011; Leggon & Gaines, 2017). According to our participants, these relationships were deepened through collaborative and project-based learning enacted in the camp. As mentees reported, team members were patient and supportive which eased their concerns when learning new technical skills. These increases in positive STEM attitudes may also be due to the CRP approaches applied in the camp. Previous research shows that when educators create caring environments with family-like communities of practice and make learning enjoyable, they may be more motivated about academic knowledge (Lane & Id-Deen, 2020; Sleeter, 2012).

Challenges discussed in the study included an inability to build the robot in-person, teaching the design process virtually when one is unable to physically touch objects, mentees being distracted by home life, and communication. While participants indicated their communication skills improved through their participation in this program, they also asserted it was difficult communicating when team members did not express their needs or were unable to explain why they were unable to follow through on an aspect of the project. Sometimes this was due to being unfamiliar with the tools or components of the engineering design process. Home life distractions may have also impeded mentees' capacities to follow instructions.

Lastly, the initial goal of the justice bots project was meant to connect engineering with social justice. To this end, the project was designed to explore the possibilities of using robots to solve problems connected to larger socially charged issues. In planning meetings leading up to the introduction of the justice bot project, program staff mentioned George Floyd and the importance of social media and cell phone videos making a difference. Climate justice, national protests connected to police brutality, and economic and political unrest were also among the issues discussed in these conversations. However, given the constraints of the program, there may not have been adequate time to have an in-depth discussion around the meaning of social justice (Leggon & Gaines, 2017; Tan & Calabrese Barton, 2018). Though participants brainstormed definitions and possible directions for their robots, scaffolding a project of this magnitude takes ample time.

Additionally, some mentors expressed concerns with the justice bots project. Several mentors indicated it was a substantial task to undertake given the age of the mentees and their perceived lack of knowledge or capacity to understand social problems. Ironically, the perception that children lack the ability to grapple with social problems contradicts tenets of culturally responsive pedagogy (Gay, 2021). In fact, Gay (2021) argued that we should demand more and not less from youth. As such, this finding may have implications for training mentors to shift their worldviews about who is apt to engage in justice-oriented projects. Some mentors also purported it was not their "place" to engage in conversations about social justice. These mentors' concerns may have been due to their own discomfort with this topic. It is possible that they did not feel adequately prepared to discuss concepts and ideas that they continue to grapple with in their own lives. Despite these concerns, mentees reported enjoying the justice bots project, which is a culturally responsive outcome that can contribute to academic achievement (Gay, 2021; Sleeter, 2012).

Implications for Engineering Education

Based on this study, we offer three implications for engineering education. First, sustaining online camps in-person post-COVID may increase accessibility to engineering education in out-of-school contexts. Though we offered this camp in-person for two years prior to the virtual offering, there were some mentees who shared that they had been unable to participate because they traveled to visit family members during the summer. Because of the critical role family plays to communities of color, and in some cases serving as a conduit for STEM education (Lane & Id-Deen, 2020), if there are ways to help students participate despite their geographic location, they should be considered.

Second, for programs that may return to fully in-person offerings, program administrators should consider ways to maintain hybrid options or adopt aspects of online program offerings. For example, can participants be allowed to take parts home to continue building and developing their robots while away from the camp in the evenings and weekends? Can asynchronous recorded videos and synchronous real-time demonstrations be provided virtually? We suggest these different opportunities be considered when planning in-person and hybrid programs.

Third, it is important to note that one iteration of a justice-focused project may not suffice in building capacity for students to understand how to address larger systemic problems. Instead, educators and program administrators should see camps, like this one, as stepping stones towards developing teachers' abilities to facilitate learning connected to social justice and students' abilities to address increasing degrees of complex social issues within their engineered solutions. This creates a culturally responsive approach to justice-centered programming.

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