Introduction to the Special Section on Justice-Centered Computing Education, Part 1

MICHAEL LACHNEY, College of Education, Michigan State University
JEAN RYOO, UCLA Center X, University of California Los Angeles
RAFI SANTO, CSforALL

The ideas we offer below for considering justice-centered computing education point to a broad array of problem-spaces, contexts, and communities that scholars, educators, technologists, and activists might engage with. In exploring and deepening the conversation around this project, the seven articles included in the first volume of this special issue employ diverse theoretical perspectives, methodologies, and frameworks, including but not limited to intersectionality, transformational justice, intercultural computing, ethnocomputing, translanguaging, socially responsible computing, and institutional theory. Across them, rather than consensus on a narrow set of issues, we see the possibilities of a pluralistic and wide-ranging conversation about how we might constitute the meanings of "justice-centered" within computing education, the tools that might be used to produce such meanings, and the actions that might address them.

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1 INTRODUCTION

Welcome to the first of two volumes of the ACM Transactions on Computing Education's special issue on "Justice-centered Computing Education." The call for this special issue has less to do with the need to create a specific, singular definition for clarifying what we mean by the title [13] and more to do with the fact that computing—and thus computing education—is implicated in the crises and injustices that permeate life on earth in the early 21st-century: environmental destruction, state surveillance, disinformation, right-wing extremism, mass immigrant detention, the prison-industrial complex, financialization, police militarization, labor exploitation, and many others. These types of sociotechnical and macro-ethical issues–i.e. issues not easily shaped by individual decision-making or action—are not easy or straightforward to confront in computing education [43]. Double binds abound. Consider, for example, how increasing the amount of technology in schools that serve marginalized communities of color in the United States may be seen

Each author contributed equally, in their own ways, to this introduction and are listed in alphabetical order.
Authors' addresses: M. Lachney, College of Education, Michigan State University, 620 Farm Lane, Room 513D, East Lansing, MI 48824; email: lachneym@msu.edu; J. Ryoo, School of Education & Information Studies, University of California, Los Angeles, 1320 Moore Hall, Box 951521 Los Angeles, CA 90095-1521; email: jeanryoo@ucla.edu; R. Santo, CSforALL. 100 6th Avenue, 14th Floor, New York, NY 10013; email: rafi@csforall.org.

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as nominally beginning to right wrongs of White supremacy and wealth inequalities, but will also harm animal (including human), plant, and environmental health–disproportionately in poor Black and Brown countries–as this same technology ends up in electronic waste dumps. Similarly, broadening participation efforts may seek to support immigrant children's interest in pursuing work in technology fields, but these same fields are deeply implicated in the development of sociotechnical systems that contribute to state violence against immigrant families.

As these examples help to illuminate, we cannot narrow the issues within computing to those of equitable access or participation if we desire to orient computing and computing education toward justice goals; we need systemic understandings of the historical realities, power dynamics, and material conditions that produce injustices, as well as how computing is implicated in them. And we must go further still; we also need justice-centered visions of change with associated strategies and tactics to support researchers, technologists, and educators in working within and challenging systems of oppression and domination. As we argue below, these should be grounded in dynamic and solidaristic coalition building efforts across different communities based on compassion, respect, and love for other people. Toward these goals, we think that the late political commentator Michael Brooks sums up our position well when he said: "be ruthless with systems, be kind to people" [4]. With this in mind, justice-centered computing must be grounded in critique that is both outward and inward: outwardly grappling with how computing is intertwined with systems of oppression and domination that make healthy and meaningful living difficult while, inwardly, acknowledging that there is no purity position outside of these systems that we, who are invested in computing education, can easily access. The goal is to embrace this position, all the while knowing the limitations and partiality of computing, computers, and computational knowledge: these must be understood as only some of the threads in larger tapestries that take many hands (not to mention leaves, branches, mycelia, microbes, fins, claws, and paws!) to create and maintain.

Of course, we do not mean to negate the powerful and unique contributions that computation offers to the communities out of which these tapestries are woven. Just as computing can contribute to injustices, it can also link up with justice-centered projects.[1] As Cueponcaxochitl D. Moreno Sandoval reminds us, computing power contributed to the globalization trade policies of NAFTA while also being utilized by the Zapatistas in Chiapas to spread awareness about their fights against those same policies [49]. The potentialities of computational flexibility and modularity make computing, computer devices, and computational thinking important means to help trade conceptual and material resources between social worlds and epistemic cultures. We maintain that justice-centered computing can use these affordances and the ubiquity of computing to address local community needs, concerns, and issues. Allow us to consider some examples.

We the People of Detroit Community Research Collective (wethepeopleofdetroit.com) is a community-based, citizen-science grassroots organization that brings together activists, academics, designers, and researchers to inform people about and fight against the negative impacts of austerity policies, Emergency Management regimes, and privatization on Black and Brown communities in Detroit. Their 2016 book *Mapping the Water Crisis: The Dismantling of African-American Neighborhoods in Detroit* acts as a critical counter-narrative against the neoliberal status quo through the use of data visualizations that help to illustrate how residential water shut offs across the city disproportionately restricted water access to Black communities [76]. In another example, Kwame Porter Robinson and colleagues have been studying and experimenting with machine learning algorithms that can help distinguish between

[1]Here we use the term "projects" to not only point toward diverse justice-goals, but also as Eve Tuck and K. Wayne Yang do to connote "praxis": "We use project as a way to refer to worldview combined with strategy combined with motive combined with practices and habits" [70].

authentic and fake kente cloth in West Africa. Acknowledging how imported fake kente has restricted economic access for kente artisans, their goal is to support tourists in making consumer decisions that direct money toward the local artisan economy [60]. Consider one more case. Raquel Velho and colleagues paired computer modeling methods from bi-mechanical engineering with social science research to study the weak points in accessibility designs for public transportation [74]. Upon showing "accessibility regulation still straining the bodies of wheelchair users and causing harm" they urge policy makers to move beyond static "solutions" and instead engage in ongoing conversations and iterative design with disabled people to constantly improve public transportation infrastructure [74]. These are just some of the proliferating examples for how computing and computing expertise can help to challenge inequitable and unjust material conditions of people's lives. What they each show is that computing does not become an end in itself, but a means to support a larger justice project. But what about computing education?

2 UNDERSTANDING THE LIMITS OF BROADENING PARTICIPATION THROUGH A JUSTICE-CENTERED LENS

Probably the most prominent area to find justice-centered research and practice within the computing education community is **broadening participation in computing (BPC)**. This work has appeared at the intersections of culturally responsive computing [64], critical digital literacies [26], STEAM education [7], techno-social activism [65], ethnocomputing [37], anti-racist pedagogy [29], techno-vernacular creativity [27], abolitionist computer science education [35], decolonizing educational technologies [19], and other forms of justice-centered research. Unsurprisingly, much of the work represented in this special issue speaks to BPC concerns. But we want to point out that because of the ways that BPC funding and research goals have been defined in the United States–locating the problem as deficient students, defending a curriculum formed by military and corporate influences, among other conditions–BPC has become culturally hegemonic.

According to Antonio Gramsci—an Italian Marxist philosopher who was imprisoned under Mussolini's fascist regime—the concept of cultural hegemony describes how beliefs, values, and attitudes that reinforce existing power systems become so common sense and naturalized (e.g. "programming is a 21st century skill that all children should learn") in specific temporal and spatial contexts that they go unquestioned [31]. Hegemonic BPC discourses are made up of language and practices that are intended to expand the number of people who are schooled in computer science education and work in computing fields. Steeped in nationalistic and economic anxieties about global competition, there is a general goal by liberal and conservative leaders in **science, technology, engineering, and mathematics (STEM)** power positions to increase the participation of *all* U.S. citizens in computing (e.g. CS4All), but within computing education research these discourses often center on those communities who are demographically categorized (within the borders and terms of the nation-state) as *underrepresented* (e.g., by gender, race, ethnicity, disability, and so on).

While there is undoubtedly much more work we need to do in regards to increasing representation in computing education and employment, a growing number of scholars have been challenging hegemonic BPC discourses by drawing attention to how the social, cultural, and material conditions of life inside and outside of computing classrooms and workplaces constitute the phenomenon of underrepresentation. For example, Jane Margolis and colleagues show how K-12 computer science education serves as a window into how racial, gender, and class inequalities are reproduced in schools [44]. Institutional structures and cultural stereotypes about who can or should excel with computing inevitably track young women and youth of color out of computing classes. In their work on generative justice in STEM education, Ron Eglash and colleagues point out how racial and ethnic underrepresentation may be fueled by larger structural injustices that

make life generally more difficult for people of color than their White counterparts, including but not limited to the Black-White wealth gap and environmental racism [16]. They make the case that these types of issues must be confronted with more equitable representation, but that increasing representational diversity may not be the answer to overcoming them; more Black technologists working on resource extraction does not, in and of itself, make the process any less ecologically harmful. Indeed, representational diversity alone cannot undo histories of structural injustices, discrimination, and violence.

In terms of looking at the institutions that make up computing disciplines themselves, Black women computing education scholars and researchers have been leaders in making visible how the structures of White supremacy and patriarchy persist in these fields (e.g. [22, 58]). In their discussion about intersectionality theory in the field of human-computer interactions, Yolanda Rankin and Jakita O. Thomas detail interpersonal and structural patterns of exclusion and injustice in how Black women's research—especially research which uses intersectional lenses—has often been devalued and unrecognized as legitimate knowledge production within White institutions [57]. These types of barriers can limit access to funding, promotion, and other career benchmarks that computing disciplines and fields demand. In their sharp structural critique of STEM diversity and inclusion efforts for women of color, Kimberly Scott and Steve Elliott shift our frame of reference for such efforts with an analysis that compares them to southern sharecropping labor markets after the U.S. Civil War [66]. Without smoothing over temporal and spatial contextual differences, they argue that both position women of color as commodities to serve institutionalized capital that is largely controlled by White men, often at the expense of personal health and wellbeing.

One thing that makes Scott and Elliot's critique so powerful is that it clearly shows that *diversity* and *inclusion* are not by themselves liberatory concepts when only bolstering neoliberal policies and nationalistic goals that may not serve the interests of those communities who are the intended recipients of BPC efforts. Indeed, these efforts are often motivated and framed through discourses of nationalism and capitalist competition; giving the fatalistic impression that we are just passengers on a train that is being driven by corporate and state elites. Implicitly, if not explicitly, this pits people of different nation-states against each other, which limits our imagination for international solidarity and creates real problems for figuring out how to confront the global crises we all currently face.

What is more, the nationalism of BPC is often wrapped up in other suspect hegemonic assumptions about technological inevitability and determinism: "The exponential growth of computer power is beyond our control, so we better get ready by making sure every child can code or we will fall behind as a nation!" The idea of technological determinism is that technology acts independently and autonomously (outside of societal pressures) to unidirectionally shape our social worlds [45]. In other words, while the elite are driving the train, not even they can get off the tracks, which is a useful rhetorical shield for guarding against criticism of their own choices and actions. Of course, it is well documented that technological and social worlds are co-constituted and multi-directionally shaped via material conditions, competing interests, and social power (e.g. [20, 9, 32]). Still, technological determinism is strongly rooted in the cultural myths and political orders of the United States, being invoked in nationalistic projects such as the 19th-century settler expansion of "manifest destiny" and the arms-race of the 20th-century Cold War. Historian of technology Michael L. Smith explains how in the 20th-century U.S. technological determinism undergirded the very idea of *progress* [67]. If we consider BPC a *progressive* endeavor, this should make us stop and think: progress toward what? If the answer is increased competition through nationalism, capitalist accumulation, and global imperialism and we have no choice about this because of the inevitable exponential growth of computing power then it is questionable if BPC can ever be justice-centered.

3 CONSIDERING SOME DIMENSIONS OF JUSTICE-CENTERED COMPUTING EDUCATION

The call for justice-centered CS education is not new. Sepehr Vakil argues that justice-centered approaches to equity in CS education must attend to curriculum, the learning context, and the politics of educational reforms [72]. We expand and add to this with some additional considerations. Given that BPC and justice-centered computing often overlap but are not synonymous, we offer here some steps that we believe researchers can take in their efforts to work toward justice-centered computing education. These are inspired by the scholarship we outlined above and the contributions to this special issue that we summarize below and that will appear in the next volume. While there are many ways to work toward justice-centered computing that will undoubtedly not be mentioned here, we have identified five key areas for consideration: historical contexts, power, techno-social politics, coalition building, and continuous change.

3.1 Situating Research and Practice Within Historical Contexts

Justice-centered computing needs to deeply engage with questions of history, place, and culture. As James Baldwin noted, "the great force of history comes from the fact that we carry it within us, are unconsciously controlled by it in many ways, and history is literally *present* in all that we do. It could scarcely be otherwise, since it is to history that we owe our frames of reference, our identities, and our aspirations" [5]. We believe it is imperative to approach justice-centered computing education with the recognition that teaching and learning are cultural practices, imbued with the values and ways of thinking developed through our unique historical and cultural contexts [48]. People learn through their interactions with one another, not in a vacuum devoid of shared meaning or human communication. The tools we use for teaching and learning—our textbooks, our technologies, our languages—carry with them those stamps of history that Baldwin references above.

What does it mean, for example, that we are trying to align computing education and disciplines with decolonizing and abolitionist justice projects when, as Matti Tedre and colleagues point out, "CS was born and raised in the Western world, shaped by and responding to the varying needs of Western society"? [69] And so as we confront the fact that computing is always already historically situated and pursue justice-centered computing education in our research, teaching, and various projects, we must ask ourselves: how have the politics and cultures of our specific historical contexts shaped people's assumptions about computing, learning, pedagogy, and youth? Whose ideas and voices have been prioritized? Whose have been marginalized? And, what are the historical conditions that create the possibilities for prioritizing some people, purposes, and politics while marginalizing others?

There is a growing body of literature in the history of computing on the historically contingent ways that computing disciplines, fields, and technologies have and continue to be gendered, racialized, and classed. For example, Janet Abbate [1] and Mar Hicks [33] have carried out important research that unveils the charade of technosocial meritocracy in professionalized computing disciplines and fields by showing how historically situated gendered constructs of technical expertise and technological systems have contributed to interpersonal and structural discrimination against women, even when they have skills that are valued in the computing labor market. Many of these histories construct counter-narratives that not only reveal how racism, sexism, ableism, colonialism, etc. are implicated in computing education, disciplines, and workplaces, but also challenge mainstream assumptions of who has contributed to computing technologies, systems, and knowledge.

Charlton D. McIlwain thoroughly details that despite how technologies, educational institutions, and computing professions reproduce White supremacy, Black individuals and communities have,

for decades, played crucially creative and technical roles in developing, shaping, and using the Internet to further racial justice goals. [46] Working in the area of ethnocomputing, Ron Eglash draws a line between Bamana sand divination and John von Neumann's digital computer, revealing African contributions to binary code today [15]. But in an email exchange with author and scholar Emma Dabir, Eglash cautions: "The temptation is to dive into the competition over "who discovered it first". But that kind of competition is a framework created for intellectual property rights, for the "solitary genius" view of history… *Reversal never works. "We discovered it first" is not a rebuke of white supremacy, it is just adopting their tactics. That is what Audre Lorde meant when she said, "the master's tools will never tear down the master's house"* [14].

In addition to histories of computing that reveal structural oppression and make visible the contributions of marginalized people to computing technologies and knowledge, scholars are also interrogating histories of computing education itself. This research has revealed insights that help us to question the material conditions and epistemological assumptions of the technologies and theories of computing education; including but not limited to how military R&D has shaped educational computing [52] and (despite the well documented evidence of Seymour Papert's participation in socialist politics) a techno-libertarian ideology underpinning constructionism [42]. This work provides much needed alternatives to the techno-celebrationist and techno-utopian discourses that pervade computing culture [71] and education [2]. Approaching such discourses through a critical lens will help researchers better assess and respond to the technosocial terrains of teaching and learning.

3.2 Centering Power Relations in Knowledge Production and Decision-making

The term power does not necessarily describe a thing but instead might be better understood in terms of dynamic relationships, which can be structural, interpersonal, and cultural. One of the great contributions of the framework of intersectionality to computing education research is that it helps to remind scholars that power relations do not exist along one axis of oppression (e.g., classism, racism, sexism, ableism, nationalism, ageism, etc.) but instead multiple co-constituting axes: "Within intersectional frameworks, there is no pure racism or heterosexism. Rather, power relations of racism and heterosexism gain meaning in relation to one another" [11]. It can be argued that power relations are always present in all learning, teaching, and research contexts [23]. Centering issues of power can make hierarchies, oppression, and domination more visible in our knowledge production and decision-making.

This connects directly to why power relations must be openly discussed in computing classrooms. Not only would this help illuminate the role that computing experts play in today's world (directing both the focus and flow of everyday life), but also the opportunities we have to question the decisions of those who can more easily shape power relationships. As Sepehr Vakil and Jennifer Higgs explain, "A pedagogical focus on power and ethics in K-12 CS education has the exciting potential to forge new disciplinary bridges between the goals and practices of CS and parallel efforts to engage youth in civics and social justice" [73].

Issues of power become more complicated in computing education research when we invoke the Foucauldian concept of *power-knowledge* - "The exercise of power perpetually creates knowledge and, conversely, knowledge constantly induces effects of power" [25]. Returning to BPC helps to illuminate how knowledge about increasing participation in the computing workforce (re)produces and is used to constitute the power and priorities of the nation-state and corporations, not only through top-down funding streams and initiatives but also in bottom-up ways through the likes of researcher-practitioner partnerships. These exercises of power relations constitute specific focuses of study and labels for communities that become the objects and subjects of our knowledge

production, recursively reinforcing the power dynamics of nation-states and corporations with the emergence of new information that they deem appropriately legible and useful.

Given that power relations are present in our immediate actions, justice-centered computing education must examine the epistemic and ontological histories of how computing education research programs and practices have come to look and feel in particular ways. We should not only constantly (re)consider issues of who has a seat at the table but also question the table itself: What is this table? What is it made out of? Where did these conceptual and material resources come from? Why was this table made in the first place?

3.3 Engaging the Techno-social Politics of Computing

Given the centrality of technology in computing education, justice-centered approaches must engage with the techno-social politics of computing and computers. Philosopher of technology Langdon Winner explains two ways that technology has politics [78]. First, technological devices or systems can be political when they are used to resolve a specific issue within a community (e.g. the use of body cameras on police to address accountability or using automation technologies to address worker power). Second, the design and build of technological devices or systems themselves can align with specific types of political relationships or, to put it another way, are inherently political (e.g. the decentralization of the internet or the centralization of a nuclear power plant).

More recently, Joy Buolamwini [10], Safiya Umoja Noble [53], Virginia Eubanks [24], and Ruha Benjamin [6] have been leaders in exploring algorithmic power and bias in computing devices and systems, ultimately illustrating how technologies reproduce societal patterns of racism, sexism, and classism. There is much work to be done to bridge these realities with the core pedagogies associated with computing education both at K-12 and post-secondary levels. Rua M. Williams and colleagues have shown that while CS students can recognize the racist and sexist techno-social politics of AI, they have a harder time recognizing how technologies reproduce ableism [77]. Justice-centered computing education must not only focus on how to better teach young people about the techno-social politics of computing and computers, but must also account for these politics when using systems (e.g. automated grading systems) or devices (e.g. educational robots) that we include in our own research and practice.

But the idea that technologies can ever be apolitical or unbiased is dubious at best. So while there is much work to be done in removing harmful expressions and exercises of oppression from technologies and sociotechnical systems, scholars in culturally responsive computing have resisted the idea that technology can be neutral by turning to the cultural capital of Black, Brown, and Indigenous communities as foundations for educational technology designs that are culturally relevant, responsive, and situated [38]. Consider some examples. Nichole Pinkard's Lyric Reader architecture was groundbreaking in centering the popular linguistic and cultural knowledge of African American children in the design of educational computing applications to support literacy instruction [55, 56]. Juan E. Gilbert and colleagues have centered African American identities in the design of their African American Distributed Multiple Learning Styles System that is intended to support culturally relevant math education [28]. In their efforts to develop ways to bring ethnocomputing research into classrooms, Ron Eglash, Audrey Bennett, and colleagues have developed a wide array of culturally situated design tools that are intended for users to explore the mathematics and computation embedded in vernacular or Indigenous cultural designs and knowledge systems [18], including the parabolas in Anishinaabeg architecture [19], the logarithmic curves of some Ghanaian adinkra symbols [40], the adaptive scaling of cornrow braids [8], and much more.

3.4 Building Solidaristic Coalitions that Include Computing Experts, Computing Educators, and People Involved in Justice Projects

Elsewhere we (i.e., Michael, Jean, and Rafi) have made cases that broadening participation and establishing equity in computing requires a *village* of more than just teachers and students but also administrators, researchers, community leaders, and others [61, 63], including cultural experts [41]. However, arguing that "it takes a village" does not, in and of itself, lead to a justice-orientation if, for example, the village includes people (maybe institutional brokers?) who actively encourage the exploitation of workers, shallow teaching and learning environments, and/or the pollution of air, water, and land. Here we take this initial stance of "it takes a village" a step further and argue that justice-centered computing education should selectively engage in building dynamic and broad coalitions that connect justice-concerned and -oriented people inside of computing and education to people actively involved in justice projects. The goal here would be to foster communities of collaboration where computing education, computational knowledge, computer power, and justice-projects can come together to open spaces (i.e. an open village) for new relationships (including relationships based on refusal to collaborate) to emerge from trading ideas and sharing resources.

However, there are always risks, if not inevitabilities, when these spaces include actors from state and private institutions (e.g. schools, government agencies, technology companies) that colonial logics of extraction and assimilation will shape action. Indeed, coalitions must not be built for their own sake—they must be rooted in goals of solidarity and anti-oppression across justice-oriented individuals and communities, which, in the political realities of our world, will mean that there are positions, goals, and associated institutions that must be actively *opposed*. Such a solidaristic view would mean that coalition building within computing education would have to contend more deeply with questions of how groups working against justice goals—technology companies that profit from spreading misinformation, intelligence agencies that surveil marginalized communities domestically and globally, to name a few—be engaged with or be seen as contestable targets of such coalitions.

Even in the case of education institutions that many in the CS education community see as primary partners in achieving goals of equity—K-12 schools—many such colonial logics are often at play. As a counter to such logics, we might look, for example, to Cueponcaxochitl D. Moreno Sandoval's research on *Critical Ancestral Computing* [49, 50, 51]. This work helps to confront the colonial logics of compulsory schooling without losing sight of schools (and thus computing education) as sites that can connect to broader social change and justice projects. Moreno Sandoval's work does not start or stop with computing education for computing education's sake, but situates it within socio-historical and cultural contexts of colonialism and Eurocentric epistemic cultures. Centering her own Mesoamerican ancestral praxis, Moreno Sandoval embraces scholar and activist positionalities to help support and participate in computer science learning that not only becomes a site to critique colonization and the colonial underpinnings of schooling, but also a bridge to student-led activism and community assets. For example, through connecting a CS high school teacher to Indigenous scholars and activists at a food justice symposium, student activism around cultural awareness and community health, and opportunities to learn about culturally relevant CS education, Moreno Sandoval found that, "He began to see computing as a potential form of activism that could speak to the needs of the community in which he served" [49].

3.5 Being Open to Continuous Change

Finally, we must resist the idea that justice-centered computing education is singular, homogeneous, and static in ways that lend to institutionalized forms of box checking. Justice-centered

computing education is not a standardized curriculum or predetermined set of expectations. It should be constantly evolving, made up of iterative processes of accountable relationships and responsive collaborations. The conditions of injustice are dynamic and emergent, so computing education's participation in justice projects must be as well. To clarify, consider how the need to be adaptable and responsive to global and local conditions based on solidarity with others has been foundational to mutual aid networks that were strengthened or emerged as the result of the COVID-19 pandemic. Knowledge and practices of mutual aid are fundamental to many Indigenous communities (e.g. [47]), as well as strategies for direct action (e.g. [36]). Within the academy the concept has varying meanings across the sciences (e.g. [30]) and social sciences (e.g. [34]). Here we use the concept of *mutual aid* to denote the idea that by strengthening the well-being of other individuals we strengthen the wellbeing of ourselves and the whole community: "Mutual aid is collective coordination to meet each other's needs, usually from an awareness that the systems we have in place are not going to meet them" [68].

As the pandemic has revealed that we cannot rely on many politicians and employers to look out for our health and safety or those of our loved ones, local networks of people—often connected to social movements, grassroots organizations, and labor—have stepped up to provide immediate information, food, medicine, shelter, and more. These bottom-up networks are based on interpersonal relationships and direct action, making them fortified and responsive to local needs and concerns as the sociopolitical terrain shifts. The idea that computing is helpful within these 21st-century networks is unsurprising. Take the Hong Kong pro-democracy protest movement's mutual aid response to the lack of government intervention to slow the spread of COVID-19 in the early days of the pandemic. When Hong Kong chief executive, Carrie Lam, was unresponsive to the pandemic, people from Hong Kong's protest movement not only defied the government by wearing masks and distributing them to vulnerable people, but also set up a website to track cases and outbreaks, report on hospital wait times, counter misinformation, and more [68]. These actions were not charity but direct responses—greatly aided by decentralized computing power—to the changing conditions and power dynamics on the ground.

Teachers have been no strangers to mutual aid before the pandemic or currently. Those who spend any time in schools have most likely seen mutual aid at work when, for example, a teacher or staff member provides a student with clothes, food, or other necessities that not only make the student's life easier but contributes to a productive learning environment for the whole community. This has been on display during the pandemic. For example, as the ineffectiveness of state and federal government to help children came to light, the Chicago Teachers Union organized to get students whose communities had been ravaged by the virus not only school supplies but also basic necessities for their families, including diapers and food [12]. What if computing education built on these cultures of mutual aid that are well established parts of the teaching profession; using them as places to begin that not only prompt project-based learning but leverage computing teaching and learning to serve larger community goals? This would encourage an educational ecology that went beyond the school and required constant curricular changes and updates in efforts to be responsive to school-community relationships. Toward these goals, it has been argued that the field of culturally responsive computing is theoretically and methodologically well suited for supporting such justice-centered brokerage processes [39].

4 EMERGING SCHOLARSHIP IN THIS ISSUE

The directions we offer above for considering justice-centered computing education imply a broad array of problem-spaces, contexts, and communities that scholars, practitioners, and activists might engage with. In exploring and deepening the conversation around this project, the seven

articles included in the first volume of this special issue employ diverse theoretical perspectives, methodologies, and frameworks, including but not limited to intersectionality and Black feminist thought, intercultural computing, ethnocomputing, translanguaging, and institutional theory. Across them, rather than consensus on a narrow set of issues, we see the possibilities of a pluralistic and wide-ranging conversation about how we might constitute the meanings of "justice-centered" within computing education, the tools that might be used to produce such meanings, and the actions that might address them.

In the first article in the issue, Rankin, Thomas, and Erete challenge the field to contend directly with the realities of systemic oppression within computer science education by drawing on the testimonial authority of Black women [58]. Through an intersectional analysis that focuses on power relations and is attendant to epistemic violence that pervades multiple sites of activity in the CS education ecosystem—K12 classroom experiences, post-secondary CS departments at predominantly White institutions, and supplemental internships—they invite those in power in CS education to look squarely at the lived experiences of Black women. In doing so, they lay bare the inadequacy of efforts that see access as the "solution" to inequities in CS education, and the need for those in power to actively lead processes of dismantling repeated sites of violence against Black women in CS.

In what might be seen as a response to the call to action laid out in the first article, in the second, Erete, Thomas, Nacu, Dickinson, Thompson, and Pinkard report on almost a decade of work associated with the Digital Youth Divas initiative. As an effort aimed at addressing historical inequities for Black and Latina girls in computing, the transformative justice approach taken within the project brings to light the need for, and power of, developing "counter-structures" directly aimed at specific harms associated with socio-political histories of oppression [21]. As they state in the article, "We must acknowledge the histories of harm and work to hold ourselves—as educators, researchers, computing professionals, academics, etc.—accountable for continuing these harms by working to build structures that counter racist systems and grow capacity for healing." [21] Their analysis highlights the need for initiatives that work both at micro and macro levels of activity. They maintain the importance of inclusive pedagogies, but argue that in order to address historic structural harms—of redlining and attendant fracturing of a community's social capital, of exclusion from CS learning opportunities and industries, and of deleterious impacts of computing "innovations" on communities of color—efforts must go beyond what courses or afterschool programs look like from a pedagogical standpoint. Through exploration of the Divas program's attention to structural harms, they highlight how it developed "counter-structures" operating at the levels of community capacity and sustainability through engagement with "the social and political structures that shape learning" [21].

In the third article, Vogel shifts focus back into the modes of practice that push inclusive pedagogies into the sphere of justice, interrogating inter-relations of power, criticality, and language within classrooms [75]. The piece helps advance this conversation into the realms of critical computing and sociolinguistics, grounded in rich classroom examples of how multilingual students use their funds of linguistic knowledge to support their engagement with computing learning, question digital tools, and support their sense of agency in the classroom. Vogel introduces the concept of *critical translingual computing education* as a much-needed approach to computing teaching and learning, especially in our increasingly language-diverse classrooms.

Continuing this exploration of culture and power in computing education, Eglash, Bennett, Cooke, Babbitt, and Lachney offer a unique perspective in their piece that is simultaneously critical and generative through their offering of the concept of *counter-hegemonic computing* [17]. Rooted in recognition of the unique computational assets of Black communities and cultures, they see counter-hegemonic computing transcending narrow conceptions of culturally linked computing

education; moving beyond essentialist pedagogies that simply "fit" computing to student identities, beyond one-sided critiques that lack positive visions of computing, and beyond human-capital orientations that construe the value of computing education in terms of entry into the STEM pipeline. In doing so, they push the field to consider the ways in which hegemonic ideologies—of extractive economics, of settler colonialism—are embedded in much of Western computing culture. And they offer new frameworks and methods to incorporate counter-hegemonic practices that utilize computing to actively generate and circulate value within communities.

Similarly orienting toward alternative visions of the purpose of computing education, Arawjo and Mogos consider the goals, and tensions, associated with utilizing computing education as a site of cross-cultural bonding [3]. In their conception of *intercultural computing*, they draw on peace education, prejudice reduction, and sociology of racism and ethnicity in ways that orient the field toward goals of achieving understanding and solidarity between people of different backgrounds, a goal they see as a prerequisite for collective engagement in broader justice projects facing our world. In exploring youth programs rooted in intercultural computing that they enacted both in the United States and Kenya, they highlight design tactics and pedagogical moves that provide space for "fostering bonding across difference" [3]. Critically, they acknowledge that such tactics can potentially be in tension with other equity goals associated with critical pedagogy, such as those oriented toward facilitating belonging for racially marginalized peoples, highlighting the complexities of integrating multiple perspectives on justice-oriented computing education.

The next article in the issue, by Ryoo, Morris, and Margolis, builds on the foundational research of scholars who, for decades, have been examining issues of power, politics, ethics, and social responsibility in computing that have finally been coming to the fore in recent years, not only in critical computing circles, science & technology studies, and the computing education community, but also in mainstream media contexts (e.g., news, widely viewed documentaries, etc.) [62]. While arguments have been made and are beginning to be heeded about why issues of ethics and social responsibility must be taught in computer science classrooms, there are few examples of what this actually looks like and the pedagogical considerations needed to support such efforts, especially in K-12 contexts. The authors address this through their piece exploring both how and why socially responsible computing must be centered in computer science education contexts. Their work examines the value of such approaches for supporting student engagement and learning, but also for elevating student agency and voice.

Finally, in their piece exploring educational systems change through youth leadership, Phelps and Santo provide an important opportunity for our computing education community to consider the enormous potential and deeper complexities of supporting students to shape computer science in their school districts [54]. In justice-centered computing education, scholars often want youth to have the agency and voice with which to shape their education. But in doing so, adults have an important responsibility to facilitate an experience that allows students to successfully impact district-wide change and go beyond lip-service toward youth agency. While providing a space for youth to speak is essential to such efforts, as Phelps and Santo explore, adults must also provide scaffolding, infrastructure, clear roles, room for student autonomy, etc. to truly ensure that youth have a seat at the table in educational decision-making. Their framework and rich examples of varying levels of success from school districts across the U.S. fill a current gap in the broader knowledge-base about how we can keep students at the center of positive social change.

While nowhere near comprehensive, across the scholarship included in the first volume of this special issue we can begin to see the broad diversity and plurality of questions possible within the frame of justice-centered computing education. As work around this project expands, we hope and expect that others will both deepen and broaden the inquiries included here, and form around them a convivial orientation towards what it might look like to achieve a more just world.

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