Examining Equity in Facilitation of Tinkering and Making in STEAM

Stephanie Hladik (chair), stephanie.hladik@colorado.edu, University of Colorado Boulder
Shirin Vossoughi (discussant), shirin.vossoughi@northwestern.edu, Northwestern University
Ricarose Roque, ricarose@colorado.edu, University of Colorado Boulder
Ronni Hayden, ronni.hayden@colorado.edu, University of Colorado Boulder
Celeste Moreno, celeste.moreno@colorado.edu, University of Colorado Boulder
José R. Lizárraga, jose.lizarraga@colorado.edu, University of Colorado Boulder
Arturo Cortez, Arturo.cortez@colorado.edu, University of Colorado Boulder
Kate Baca, kaba3090@colorado.edu, University of Colorado Boulder
Ashieda McKoy, ashieda.mckoy@colorado.edu, University of Colorado Boulder
Simren Trehin, simren.trehin@ucalgary.ca, University of Calgary
Apoorve Chokshi, apoorve.chokshi@ucalgary.ca, University of Calgary
Pratim Sengupta, pratim.sengupta@ucalgary.ca, University of Calgary
Jrène Rahm, jrene.rahm@umontreal.ca, Université de Montréal
Ferdous Touioui, ferdous.touioui@umontreal.ca, Université de Montréal
Delphine Tremblay-Gagnon, delphine.tremblay-gagnon@umontreal.ca, Université de Montréal
Stephanie T. Jones, stephanie.jones@u.northwestern.edu, Northwestern University
Sarah P. Lee, sarahlee2017@u.northwestern.edu, Northwestern University
Sydney Simmons, sydneysimmons2022@u.northwestern.edu, Northwestern University
I. Mallwitz, IsabelleMallwitz2022@u.northwestern.edu, Northwestern University
Marc Jiang, MarcJiang2022@u.northwestern.edu, Northwestern University
Megan Butler, MeganButler2021@u.northwestern.edu, Northwestern University
Marcelo Worsley, marcelo.worsley@northwestern.edu, Northwestern University

Abstract: This symposium brings together research that examines equity as it relates to facilitation across a diverse set of tinkering and making activities and settings. Drawing on an equity framework for out-of-school learning, we focus on the potential for facilitation to create transformative learning opportunities for learners who have been historically marginalized in making and tinkering activities, including communities of color; note the complexity of equitable facilitation across settings and contexts; and highlight the importance of facilitator reflection to acknowledge and challenge hegemonic approaches in STEAM. Taken collectively, these papers highlight not only how facilitation is essential for making productive connections between making and tinkering and the sociopolitical issues at play in our world, but how those pedagogical practices themselves are sociopolitical, connected with histories and disciplines in ways that can either reify existing inequities in STEAM or create new, more equitable futures for learners and facilitators.

Symposium Focus and Framing

Tinkering and making activities draw upon constructionist traditions of learning which promote knowledge as something that is constructed through experience and gained while building something that is personally meaningful (Papert, 1980). These activities can offer new opportunities for youth to playfully engage in science, technology, engineering, arts, and mathematics (STEAM) – especially for those learners who have been historically marginalized in formal education settings (Calabrese Barton et al., 2017; Halverson & Peppler, 2018). Thus, tinkering and making spaces and activities are viewed as providing more equitable approaches to informal STEAM education than those in traditional classrooms.

Previous research has examined the ways in which equity can be located in learner agency and engagement in their chosen projects (Calabrese Barton et al., 2017), connections to knowledge not typically prioritised in such spaces, such as e-textiles and crafting (Beuchley et al., 2008), and in the power structures inherent in tools and programs offered by such spaces (Melo & Nichols, 2020). However, only a few studies (e.g., Ryoo et al., 2016; Vossoughi et al., 2021) have focused on equity and *facilitation* in making and tinkering activities - that is, how equity is enacted in the moment-to-moment decisions and actions of adults and youth who support learners in those spaces. Vossoughi et al. (2016) have argued that attending to these pedagogical practices is critical for advancing equity in making and tinkering. Focusing on equity and facilitation can push the discussion beyond considerations of access (which, by itself, is not enough to transform educational inequities; Vossoughi,

2017) to deeply consider what equity *looks* and *feels like* for both facilitators and learners in these informal education settings.

To that end, this symposium brings together research that examines equity as it relates to facilitation across a diverse set of tinkering and making activities and settings. The goal is to examine how equity may be defined or imagined by facilitators in these spaces, what tensions may exist between those definitions and the moment-to-moment interactions between people in each setting, and what implications attending to equity in this way will have for both research and practice. In order to facilitate the beginnings of a shared understanding of equity across each paper, we draw from an equity framework for out-of-school learning first articulated by Vossoughi (2017). She argues for research that is "animated by an equity framework [which] treats all learning as a cultural and sociopolitical process and foregrounds questions of epistemology, power, and justice" (Vossoughi, 2017, p. 2). Specifically, she highlights the questions of "Access to what?" "For whom" "Based on whose values?" and "Towards what ends?" as critical tools for reflection and action in the equity framework. These questions assist researchers in illuminating "the dynamic histories of practice, ways of knowing, forms of joint activity, and value systems present," (p. 4) aspects of the cultural contexts that we believe are critical to understanding equitable facilitation in tinkering and making environments. We have expanded the framework to specify the "how?" and "why?" We believe that this expanded framework can deepen facilitator and researcher reflection on equitable facilitation in making and tinkering activities.

Major Issues Addressed in the Symposium

Firstly, our collective work showcases the ways in which facilitation is a key part of creating space for transformative learning experiences with making and tinkering, especially for communities of color and other communities who have been historically marginalized in STEAM education, by connecting activities with both current and historical sociopolitical contexts, and creating space for new possible futures. Our second point notes that equitable facilitation is a complex practice: it involves values (personal, institutional, disciplinary, etc.) which then come into contact with different learners, facilitators, materials, and informal education settings. These complex human-material and human-human relations can lead to tensions between how facilitators and learners *think* about equity versus how it is enacted (or felt) in the space. For this reason, reflecting on equitable practice in making and tinkering activities is key in surfacing histories, tacit values, and moments of discomfort, all of which can then be used to create space for intergenerational learning and pedagogies of care.

Scope and Significance of Contributions

The papers included in this session consider the facilitation of making and tinkering activities across a wide variety of settings, including online after-school programs, public computing environments, summer programs, science classrooms, library makerspaces, and museum spaces. Additionally, these papers acknowledge that there are many different roles in which one can act as a facilitator for making and tinkering, each with their own tensions and complexities as they negotiate their own positionalities, values, institutional requirements, and disciplinary norms as they intersect with notions of equity. Taken collectively, these papers highlight not only how facilitation is essential for making productive connections between making and tinkering and the sociopolitical issues at play in our world, but how those pedagogical practices and the facilitators themselves are sociopolitical, connected with histories and disciplines in ways that can either reify existing inequities in STEAM or create new, more equitable futures for learners and facilitators.

Equity as a Moving Target: Engaging Informal Learning Educators' Differing Visions of Equity

Ricarose Roque, Ronni Hayden, Celeste Moreno, & Stephanie Hladik

Science museums, libraries, and other informal STEM learning organizations are increasingly incorporating concepts from computer science alongside other STEM activities and spaces. As these efforts are still relatively new, there's an opportunity to interrupt dominant scripts of what "counts" as computing, who participates, and how someone engages with computing to more meaningfully support groups who have been marginalized from traditional computing spaces. Informal learning educators or facilitators in these spaces make key decisions at the micro (moment to moment interactions) to meso (how space is designed, how they recruit people, how they curate activities) (e.g. Vossoughi et al., 2021). Without careful and consistent effort towards equity, these decisions can influence who and how people can participate risking the reproduction of existing inequalities. As facilitators incorporate computing into their spaces, we wanted to examine how educators are engaging youth and families in equitable learning experiences. Our initial research question was: What challenges and barriers do informal

learning educators, or facilitators, face to engage their learners in design-based activities with computing? As we discussed computing activities with educators, we noticed the ways that educators were talking about and applying equity in implicit and explicit ways into their practice.

We interviewed 15 facilitators from three informal learning organizations that included a science museum, a network of makerspaces in a library system, and network of community-based technology centers for youth. All facilitators were based in the United States and represented 5 states. During 90-minute virtual interviews, we asked participants to share a computing-based activity that they had implemented in their space. We also asked questions about their background, goals, and how they considered equity in their practice. In the first round of thematic analysis, we noticed the ways that equity was emerging implicitly and explicitly in how they designed activities. To focus our analysis, we used a framework of questions inspired by an article by Shirin Voussoughi (2017), where she argues that out-of-school spaces committed to addressing issues of equity must ask: "Access to what? For whom? Towards what ends? And based on whose values?" We added the question of "How?" After conducting preliminary analysis, our research team conducted 60-90 minute, virtual "share-backs" where we shared and discussed what we learned with interviewees and their colleagues. In addition, we focused sharebacks on how facilitators were considering equity in their work and added "Why?" as a question for them to consider.

Each of the spaces had different stances on their equity work. The network of library makerspaces focused on providing free and open access to their resources. The science museum focused on examining how their equity work manifested in their pedagogy. Facilitators at the community based tech centers focused on being culturally responsive to the communities they serve. In share-backs with educators, we highlighted different tensions within their stances. For example, when considering "for whom," most library educators focused on "for all" which risks continuing to only serve dominant groups who take up these activities and misses opportunities to really focus on engaging some who would benefit the most from meaningful engagement with their resources. While we initially imagined these "share-backs" as member checks on our data, we saw potential for collective reflection and questioning in our discussions with educators around their equity work. By reflecting on "Why?" as it related to their decisions regarding materials, pedagogies, and goals, facilitators began to question and trouble current assumptions around facilitating computing experiences. Future work will continue these conversations with facilitators and incorporate their shifting visions of equity in the co-design of new computing education activities.

Speculative Fabulation: Narrating Fabulous Possible Futures through Remote Making and Tinkering

José R. Lizárraga

This paper presents findings from a study that examined the learning of student teachers in a teacher education course and youth from non-dominant communities who were linked via a remote Making and Tinkering club called the Speculative Fabulation Lab. As part of this remote after-school club, youth and teachers received take-home maker kits (with simple circuits and other craft supplies) and had remote access to a 3D printer. In this work, we consider how *speculative fabulation* is a type of digital fabrication that is "about worlding 'naturaltechnical' worlds [...], worlds needy for care and response" (Haraway, 2014, p. 242). The work presented in here builds on previous projects that have sought to examine how *everyday* cultural practices (Gutiérrez & Rogoff, 2003) can mediate meaningful and consequential learning that is, at its core, socio-political and transformative for communities of color (Gutiérrez, Becker, et al., 2019). The following argues that designing making & tinkering learning environments for the *everyday cyborg* (Lizárraga & Cortez, 2020), in this case novice teachers and middle schoolers in a Latinx-serving after school program, fosters an engagement with everyday dilemmas in ways that serve as catalysts for further learning (Engeström, 2006) and the new world-making or *speculative fabulation* (Haraway, 2014).

Participants of this Social Design-based study (Gutiérrez, 2018) included 14 undergraduate novice teachers from diverse cultural, linguistic, and socioeconomic backgrounds, as well as majors including cognitive science, engineering, business, and computer science. Participants also included 10 elementary and middle school students from schools that served a Latinx community. The study draws from 75 hours of after-school program video data (recorded from zoom sessions), 15 hours of interviews, and 112 digital artifacts produced by 24 participants. Data also included data analytics from a custom-designed digitized learning management system. Video and audio were logged on a variety of metadata, interviews transcribed, and digital artifacts analyzed using multimodal analysis (Hull & Nelson, 2005). Codes were developed inductively (Bogdan & Biklen, 1997). Through these analyses, micro-moments were examined to gain an understanding of how meaning-making mediated in virtual making and tinkering interactions. Through remote making and tinkering (with the use of take-

home kits and remote 3D printing), expertise emerged as a distributed phenomenon which novice teachers and young people collectively examined and developed models for engaging with everyday socio-political issues and designing for new possible futures. I specifically highlight what I have coined as *cyborg sociopolitical technical reconfigurations* (CSTR), where learners assembled ideational and material tools to craft objects of learning activity that went beyond those established by teachers and schooling.

From Players to Hackers: Intergenerational Tinkering with the Socio-political in Video Game Play

Arturo Cortez, Kate Baca, & Ashieda McKoy

In this paper, we examine young peoples' and educators' learning and development in the context of a video gaming ecology. Online video-game play has gained traction as a site of digital activism, where young people collaborate with others across the world as they respond to anti-Blackness, capitalism, and other systems of oppression (Cortez, McKoy & Lizárraga, under review). In particular, we examine how young people's valued everyday practices can serve as resources for academic learning, with a specific focus on sociopolitical action, as a making and tinkering activity. Given this previous work, our project designs a learning ecology that centers distributed expertise, where young people, undergraduates, researchers, and in-service teachers learn to build together within the context of video-game play. In this regard, this study offers new theoretical insights for examining the development of relational agency (Edwards, 2017; Gutiérrez, et al., 2019), methodological affordances for studying how young people and adults build together, and pedagogical openings (Cortez & Gutiérrez, 2019) for designing learning environments that center young people's everyday cultural and making and tinkering practices. The focus of our study explores the emergence of distributed expertise as young people and educators tinker with and re-imagine racism, gender-based violence, and other forms of oppression in video games and video gaming practices. In this work, we examine the affordances and constraints of leveraging digital technology and new media to open up emerging forms of agency, activism, socio-political critique, and resistance practices for educators and young people (Lizárraga & Cortez, 2019). Broadly, our project seeks to understand how to design for expansive forms of learning in an intergenerational and interdisciplinary learning context, with specific emphasis on how and if young people and adults can identify and collaborate together, using and sharing valued tools and practices, on shared dilemmas that they experience across their everyday lives.

In this social design-based experiment (Gutiérrez, 2018) we centered the iterative process of designing and studying the naturalistic processes that emerge in gameplay. Our study draws from 115 hours of audio and video recordings and participant-generated field notes by 14 (11 undergraduates and 4 high school students). Video and audio data were transcribed. All data were reduced and coded across themes and using inductive processes (Bogdan and Bilken, 1997). Video analysis processes (Erickson, 2006) were used in order to examine the specific micro interactional moments of collaborative inquiry and distribution of expertise. Findings from our study reveal that young people and educators often contribute differently as they examine video game play. However, by examining the moment-to-moment interactions, our study illuminates how educators and young people leverage each other's expertise to jointly tinker with and re-imagine possibilities in game play and video gaming practices. We seek to identify a learner-centered approach, such that adults and young people are positioned as co-learners. The design of such learning environments are rare in formal K-12 classrooms, and, of importance, we have found that these collaborations open up new possibilities for sustained collective inquiry. In particular, our project examines how adults and young people develop critical civic literacies (Mirra and Garcia, 2020); that is, the disciplinary content that is developed over the course of the identification and resolution of a shared project, as well as the relational expertise that emerges when people learn how to collaborate together. Our study has implications for how to design for the development of critical civics and how it is attuned to social and political interrogations and re-imaginings of injustice in our institutional and everyday relational practices.

Facilitating "Reading" Code in the Context of Symbolic Violence

Simren Trehin, Apoorve Chokshi, & Pratim Sengupta

Our study offers an investigation of facilitation in the context of visitors' experiences of symbolic violence (Bourdieu, 1991; Burawoy, 2019) during their interactions with computational models and maps of racial segregation and ethnocentrism (Axelrod & Hammond, 2003; Sengupta et al., 2021). Our work arises from concerns along two dimensions: a) the paucity of scholarship on facilitation of computational models in informal spaces, with only a few exceptions (Hladik et al., 2021; Ozacar et al., 2020); and b) the entrenchment of computational models of racial segregation in White Innocence (Gutiérrez, 2005; Gotanda, 2004), which reframes

racial segregation in US and Canada as inevitable and emergent while ignoring the role of intentional, institutional and systemic racism (Sengupta et al., in press). Specifically, we ask the following research question: What roles does facilitation play in engaging ethically with visitors/learners of color as they are engaging in experiences that may result in symbolic violence?

The context of this study is a public computing environment (Sengupta & Shanahan, 2017) located in a busy walkway at a large university in Canada. The three large touch screens hold a place of prominence, displaying a multi-agent simulation based on Hammond and Axelrod's (2006) ethnocentrism model and a Racial Dot Map of Toronto, based on the Canadian census data. Visitors can interact with the simulation through manipulating sliders that (among other variables) can adjust world size, immigration rates, birth/death rates, with effects visually presented through changes in populations of different colours of agent over time. The Racial Dot Map illustrates the neighborhood-wise racial segregation in Toronto (Clark, 2011), while the simulation positions racial segregation as an inevitable and emergent phenomenon that arises through prisoner's dilemma-like interactions of co-operation and non-cooperation between individuals belonging to different racial groups, even when there is no initial bias toward segregation in the system (Hammond & Axelrod, 2006). The participant in our study, Sapna, is an advanced graduate student in the social sciences whose parents immigrated to Canada from the Global South. Sapna's interaction with the simulation was facilitated by a member of our research team (Apoorve), while another member (Pratim) video-recorded the interaction, which was also transcribed for analysis. Using a constant comparative approach (Glaser & Strauss, 2017), we identify key vignettes in the interaction between Sapna and Apoorve. Based on Espinoza et al. (2020)'s framework of educational dignity, our analysis of these vignettes focuses on the use of first, second and third person accounts of both the facilitator and the visitor, and we identify salient themes in the nature of experiences of symbolic violence when apparently neutral computational representations are "read" through the use of interpretive explanations and queries, only to reveal dissonances, ambiguities and erasures of experiences of immigrants of color, and the facilitator's responses in these moments.

A key finding is that both learning and facilitation involves simultaneous layering of various forms of work, including both emotional and ethical work in contexts of symbolic violence. These labours are interwoven with both the syntactic and semantic ambiguities inherent in explaining and interpreting code. For example, interpreting the different strategies of cooperation in Hammond & Axelrod's (2006) model involved Sapna recognizing the violence of the term "traitorous" as a strategy that immigrants must use in order to assimilate based on first person accounts, while Apoorve offering a similar first-person account in solidarity. We will present the heterogeneity within such ethical and emotional encounters with code that are essential for recognizing the complexity of both learning and facilitation of computational models of race in informal spaces.

The What, How, To What Ends of (Re)Making of Selves, STEM, and Futures, Understood through the Lens of Equitable Facilitation

Jrène Rahm, Ferdous Touioui, & Delphine Tremblay-Gagnon

In this paper, we focus on emergent relations among facilitators and youth in two very different maker activities. Case 1 implies maker activities inside a four-week summer youth entrepreneurship program offered for free to urban youth by a community organization (CO). Case 2 entails a maker project inside a science classroom in a public high school that adheres to the International Baccalaureate (IB) intermediary program, offering enrichment activities in all subject areas. The same CO mediated that extra learning activity in the classroom, working closely together with the science teacher. We bring to the analysis a critical lens to center voices historically ignored. In doing so, we pay attention to first, how structural and political dimensions sneak up on emergent human-material relations, posing a threat to equity and creativity in ways often promised by maker space projects (Marsh, Arnseth, & Kumpulainen, 2018), but also wished for by teachers and facilitators who care deeply for youth of color given their own histories of marginalization. In doing so, we also pay attention to problems of intersectional marginalization (Crenshaw, 2021). Second, we attend to the manner a vision of STEM education as indispensable, objective, and settled truth sneaked up on the emergent relations, despite intentions to center youth voices and multiple STEM perspectives (Vakil & Ayers, 2019). Third, playing with a materialist and posthuman approach to analysis, we will focus in on "material-discursive entanglements constituted through human, non-human, and more-than-human relationships" (Sheridan et al., 2020, p. 1278), and as captured by Barad's materialist notion of *inter-action* (Barad, 2007). Together, these three different lenses will point to tensions that at least in part undermine the equity driven STEM practices the CO aims to support.

The two cases come from a larger video ethnography, conducted in collaboration with the CO over time and part of a five-year partnership and co-design project (2015 to 2020). For each case study, we rely on data that emerged from interaction analysis among the research team, supplemented by thematic analysis of interview data and fieldnotes. Case 1 relates the story of Burak, one of the youth involved in the young entrepreneur program

and participant in the activities by that CO over four years shared with us how he "participated for real" in the program only the year we documented it. He felt respected by his peers who consulted him every time they needed help, as for instance when they made soap together and struggled with chemicals. Participation in the program "helped me to get to know myself better… and know what I like to do with my future…", after a challenging beginning in the school system in Quebec, where he had to repeat his fourth year in the elementary school, upon arrival with his family from Haïti. Case 2 speaks to interesting parallels in relations that stood out from our analysis of the maker project - parallels between the science teacher and some students, who were both entangled in complex ways with subject positions marked by histories of immigration, deep interest in and expertise in science and technology yet unrecognized locally and othered, despite a deep commitment to becoming somebody in science and entanglement with the maker project. The two cases make evident in what ways taking "a more expansive lens to human learning and political possibilities" (Philip & Sengupta, 2021, p. 331), helps center tensions but also new possibilities of being/becoming in STEM, especially if emergent from equitable facilitation.

Supporting Educators Exploration of Making through Intergenerational Professional Development

Stephanie T. Jones, Sarah P. Lee, Sydney Simmons, I. Mallwitz, Marc Jiang, Megan Butler, & Marcelo Worsley

Since 2017, the MAJIC (Making A Just Inclusive Community) team has collaborated with K-8 teachers in the suburbs of a large midwestern city. These teachers were interested in bringing hands-on making into their classrooms and afterschool programs, but found limited opportunities within their district. In summer 2019, we invited five teachers to participate in a professional development (PD) program to design, test, and discuss hands-on making activities alongside their family members. We intentionally curated this intergenerational environment to surface and emphasize making practices situated within culturally sustaining pedagogies and pedagogies of care (Alim & Paris, 2017; Ladson-Billings, 2014).

We continued this PD virtually in the summer of 2020 to assist three teachers in curating intergenerational experiences for students who were now learning from "home," and in environments surrounded by siblings, cousins, elders, and parents. Given the pandemic, we recognized an urgency to continue centering pedagogies of care and educational dignity for both students and teachers (Worsley et al., 2021; hooks, 1994; Espinoza and Vossoughi, 2014). Thus in this paper we explore: what are opportunities to shift the way we imagine what is possible for facilitating making activities virtually and at home?

In this paper, we draw from video recordings of the 2019 and 2020 summers, synthesizing across 9 and 7 synchronous hours respectively and 45-60 minute long interviews with each of the teachers. As a team we open coded each interview for themes, which we then used to review the video data and iterate on the PD program. Themes included challenges of online pedagogy, pandemic constraints, and family engagement.

During PD, teachers engaged in readings and discussion that drew on and expanded their prior experiences making across lab and home settings with family members (Perez et al., 2020; Worsley et al., 2021). Teachers highlighted challenges such as zoom fatigue, material constraints, and availability of help, while recognizing practices from their existing expertise that they could develop. They identified new concepts from literature which led to incorporating pedagogies of care within intergenerational contexts. This deepened their sensemaking around hands-on making.

Teachers then wanted to create an environment to allow young people to explore literacy and making alongside family members as an additional community. We see this as a way teachers challenged ideas around participation and knowledge and opened opportunities for intergenerational making at-home. This culminated in a virtual Family Maker Night where teachers designed and mailed several book themed hands-on activity kits that students could choose to work on with siblings or adult guardians. The selected book was read in both English and Spanish. Families could incorporate other materials that they had at home and the activities could be worked on in several stages or beyond the synchronous time together. Since then, students that participate in the literacy and making program are selected on a rotating roster with optional family involvement. The ways teachers distributed materials, reduced language barriers, and created an ongoing literacy community highlight how teachers can support equitable intergenerational making.

Future considerations respond to tensions that teachers faced to fulfill district STEM requirements alongside invitations to hold and value other forms of knowledge and experience. As such, we see our role as a team to work with teachers to continue to develop ways that we can make outside of the constraints of schooling and model alternative facilitation for classroom settings. Finally, from holding space for teachers' multiple identities as family members, to the shifting vulnerabilities unique to video calls, we continue to wrestle with how this work looks in different home contexts and what that means for access to materials and support within making.

References

Alim, H. S., Paris, D., & Wong, C. P. (2020). Culturally sustaining pedagogy: A critical framework for centering communities. In *Handbook of the cultural foundations of learning* (pp. 261-276). Routledge. Bacon.

Barad, K. (2007). *Meeting the universe halfway. Quantum Physics and the entanglement of matter and meaning*. Duke University Press.

Barton, A. C., Tan, E., & Greenberg, D. (2017). The makerspace movement: Sites of possibilities for equitable opportunities to engage underrepresented youth in STEM. *Teachers College Record*, *119*(6), 1–44. https://doi.org/10.1177/016146811711900608

Bogdan, R., & Biklen, S. K. (1997). *Qualitative research for education*. Boston, MA: Allyn & Bacon.

Bourdieu, P. (1991). *Language and symbolic power*. Harvard University Press.

Buechley, L., Eisenberg, M., Catchen, J., & Crockett, A. (2008). The LilyPad Arduino: Using computational textiles to investigate engagement, aesthetics, and diversity in computer science education. *CHI 2008 Proceedings - Aesthetics, Awareness, and Sketching*, 423–432. https://doi.org/10.1145/1357054.1357123

Burawoy, M. (2019). *Symbolic violence: Conversations with Bourdieu*. Duke University Press.

Clark, J. (2011). Racial Dot Map of Toronto. Retrieved from: http://neoformix.com/Projects/DotMaps/TorontoVisMin.html *communication*, *22*(2), 224-261.

Cortez, A., & Gutiérrez, K. D. (2019). Socio-spatial repertoires as tools for resistance and expansive literacies. In M. P. Pacheco & P. Z. Morales (Eds.), *Transforming schooling for second language learners: Policies, pedagogies, and practices*. Charlotte, NC: Information Age Publishing, Inc.

Cortez, A., McKoy, A., & Lizárraga, J. R. (under review). The future of young Blacktivism: Aesthetics and practices of speculative activism in video game play. *The Journal of Futures Studies*.

Crenshaw, K. W. (2021). *A primer on intersectionality.* American Policy Forum. https://www.aapf.org/publications

Edwards, A. (2017). Revealing Relational Work. In A. Edwards (Ed.), *Working Relationally in and across Practices: A Cultural-Historical Approach to Collaboration* (pp. 1-22). Cambridge: Cambridge University Press.

Erickson, F. (2006). Definition and analysis of data from videotape: Some research procedures and their rationales. *Handbook of complementary methods in education research*, *3*, 177-192.

Espinoza, M. L., & Vossoughi, S. (2014). Perceiving learning anew: Social interaction, dignity, and educational rights. *Harvard Educational Review*, *84*(3), 285-313.

Espinoza, M. L., Vossoughi, S., Rose, M., & Poza, L. E. (2020). Matters of participation: notes on the study of dignity and learning. Mind, Culture, and Activity, 1-23.

Glaser, B. G., & Strauss, A. L. (2017). *Discovery of grounded theory: Strategies for qualitative research*. Routledge.

Gotanda, N. (2004). Reflections on Korematsu, Brown and white innocence. *Temple Poltical & Civil Rights Law Review*, *13*(2), 663–674. http://eprints.uanl.mx/5481/1/1020149995.PDF

Gutiérrez, K. D. (2005). White Innocence. *International Journal of Learning*, *12*(10). https://doi.org/10.2307/j.ctv11cw6fs

Gutiérrez, K. D. (2018). Social design–based experiments: A proleptic approach to literacy. *Literacy Research: Theory, Method, and Practice*, 67(1), 86-108.

Gutiérrez, K. D., & Rogoff, B. (2003). Cultural ways of learning: Individual traits or repertoires of

Gutiérrez, K. D., Becker, B., Espinoza, M., Cortes, K., Cortez, A., Lizárraga, J. R., Rivero, E., Villegas, K., & Yin, P. (2019). Youth as Historical Actors in the Production of Possible Futures. *Mind, Culture, and Activity, 26*(4), 291-308.

Halverson, E., & Peppler, K. (2018). The maker movement and learning. In F. Fischer, C. E. Hmelo-Silver, S. R. Goldman, & P. Reimann (Eds.), *International Handbook of the Learning Sciences* (pp. 285–294). Routledge. https://doi.org/10.4324/9781315617572

Hammond, R. A., & Axelrod, R. (2006). The evolution of ethnocentrism. *Journal of Conflict Resolution*, *50*(6), 926-936.

Haraway, D. J. (2014). Speculative fabulations for technoculture's generations. Taking care of unexpected country. In *The multispecies salon* (pp. 242-262). Duke University Press.

Hladik, S., Shanahan, M., & Sengupta, P. (2021). Centering Praxis in Design-Based Research: Insights from an Informal STEM Research Practice Partnership. In de Vries, E., Hod, Y., & Ahn, J. (Eds.), *Proceedings of the 15th International Conference of the Learning Sciences - ICLS 2021*. (pp. 645-648). Bochum, Germany: International Society of the Learning Sciences.

Hull, G. A., & Nelson, M. E. (2005). Locating the semiotic power of multimodality. *Written*

Ladson-Billings, G. (2014). Culturally relevant pedagogy 2.0: aka the remix. *Harvard educational review*, *84*(1), 74-84.

Lizárraga, J. R., & Cortez, A. (2019). #gentrification, cultural erasure, and the (im)possibilities of digital queer gestures. In A. DeKosnik, K. Feldman (Eds.), *#identity: Hashtagging race, gender, sex, and nation*. Ann Arbor, MI: University of Michigan Press.

Lizárraga, J. R., & Cortez, A. (2020). Cyborg jotería pedagogies: Latinx drag queens leveraging communication ecologies in the age of the digital and social displacement. *Association of Mexican American Educators Journal*, *14*(2), 44-66.

Marsh, J., Arnseth, H. C., & Kumpulainen, K. (2018). "Maker Literacies and Maker Citizenship in the MakEY (Makerspaces in the Early Years) Project" *Multimodal Technologies and Interactionm 2, 50*, 1-19.

Melo, M., & Nichols, J. (Eds.). (2020). *Re-making the library makerspace: Critical theories, reflections, and practices*. Library Juice Press.

Mirra, N., & Garcia, A. (2020). "I Hesitate but I Do Have Hope": Youth Speculative Civic Literacies for Troubled Times. *Harvard Educational Review, 90*(2), 295-321.

Ozacar, B. H., Hladik, S., Shanahan, M., & Sengupta, P. (2020). Centering and Decentering Participation in Public Computing Through Co-operative Action. In Gresalfi, M. and Horn, I. S. (Eds.), *The Interdisciplinarity of the Learning Sciences, 14th International Conference of the Learning Sciences (ICLS) 2020,* Volume 1 (pp. 246-253). Nashville, Tennessee: International Society of the Learning Sciences.

Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas*. Basic Books.

Perez, M., Jones, S. T., Lee, S. P., & Worsley, M. (2020). Intergenerational Making with Young Children. In *Proceedings of Fablearn conference (Fablearn '2020). Fablearn, New York, NY, USA*.

Philip T., M. & Sengupta, P. (2021) Theories of learning as theories of society: A contrapuntal approach to expanding disciplinary authenticity in computing, *Journal of the Learning Sciences, 30*(2), 330-349.
practice. *Educational researcher*, *32*(5), 19-25.
Research: Theory, Method, and Practice, *67*(1), 86-108.

Ryoo, J. J., Kali, L. & Bevan, B. (2016, October). Equity-oriented pedagogical strategies and student learning in after school making. In *Proceedings of the 6th Annual Conference on Creativity and Fabrication in Education* (pp. 49-57).

Sengupta, P., Chokshi, A., Ozacar, B.H., Dutta, S., Sanyal, M. & Shanahan, M.-C. (In Press). Language and Symbolic Violence in Computational Models of Ethnocentrism: A Critical Phenomenology and Southern Re-Orientations. *International Journal of Qualitative Studies in Education.*

Sengupta, P., Dickes, A., & Farris, A. V. (2021). *Voicing code in STEM: A dialogical imagination*. MIT Press.

Sheridan, M.P., Lemieux, A., Do Nascimento, A. and Arnseth, H.C. (2020), Intra-active entanglements: What posthuman and new materialist frameworks can offer the learning sciences. *British Journal of Educational Technology, 51*, 1277-1291.

Vakil, S., & Ayers, R. (2019). The racial politics of STEM education in the USA: interrogations and explorations. *Race Ethnicity and Education*, *22*(4), 449-458.

Vossoughi, S. (2017). Access and Equity in Out-of-School Learning. In *The SAGE Encyclopedia of Out-of-School Learning* (pp. 1–5). https://doi.org/10.4135/9781483385198.n7

Vossoughi, S., Davis, N. R., Jackson, A., Echevarria, R., Muñoz, A., & Escudé, M. (2021). Beyond the binary of adult versus child centered learning: Pedagogies of joint activity in the context of making. *Cognition and Instruction*, 1–29. https://doi.org/10.1080/07370008.2020.1860052

Vossoughi, S., Hooper, P. K., & Escudé, M. (2016). Making through the lens of culture and power: Toward transformative visions for educational equity. *Harvard Educational Review*, *86*(2), 206–232. https://doi.org/10.17763/0017-8055.86.2.206

Worsley, M., Lee, S. P., & Jones, S. T. (2021). Family-Friendly Teacher Professional Development. In *Proceedings of the 15th International Conference of the Learning Sciences-ICLS 2021.* International Society of the Learning Sciences.