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BOARD # 344: Community Tech Press: Sixth-grade youth expanding engineering through critical multilingual journalism (DRK-12)

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Community Tech Press: Sixth-grade youth expanding engineering through critical multilingual journalism (DRK-12)

In the Community Tech Press NSF DRK-12 project, we are developing, enacting, and studying a critical climate tech journalism curriculum to support multilingual sixth-grade students' engineering knowledge and practices. STEM education scholars have called for the incorporation of justice-oriented design practices and equity-focused lenses into K-12 engineering experiences [1, 2]. Building on these calls, the Community Tech Press unit has a distinct framing: *critical climate tech journalism*. In this approach, students' engineering design work is less transactional and industry-oriented than in an experience where students design for a client. Instead, their engineering design work becomes more democratic and civic-oriented. Students engage in hands-on engineering work to understand and critically evaluate solutions that have already been proposed, and to work toward the end goal of informing the public about technology that is interacting (or intended to interact) with their local community.

This project draws on community-based engineering and science, where students (and their culturally and linguistically diverse communities) are positioned as doers and knowers or "transformative intellectuals" in both their communities and the disciplines [3]. Community-based engineering involves incorporating meaningful social realities in the kinds of problems that get solved and positions the resources of the community (including language) as valuable in engineering. When we view engineering and technology from the lens of communities' lived realities, and not just as context-inspiration for engineering tasks, the communities' language and cultural resources function as bridges between people and engineering.

Because our partner school district community is linguistically and culturally diverse, tech journalism for the community is an authentic context for welcoming students' full set of language resources into STEM. Historically, STEM education spaces in the U.S. have not welcomed languages other than English, and multilingual students quickly learn to only use the dominant language in school [4]. To counter this, teachers must position communities' ways of knowing and speaking as central to the activities, so that students feel that they can draw on their language repertoires and cultural understandings to make sense of ideas and to find effective ways to communicate them [5]. To bring their language, cultural, and historical knowledges into classroom activities, students need to be given opportunities to engage in text or with others in the dominant language and their home language [6].

To ensure students' critical tech journalism pieces are authentically meaningful to the community, the unit focuses on climate tech, an emerging area of STEM that groups together technologies that study or mitigate the impacts of climate change. These technologies are becoming ubiquitous, directly impact communities, and yet, as with most technologies, are often not chosen and implemented with all community members in mind [7]. The communities that have been historically marginalized in STEM are often the same communities disproportionately harmed by climate change. Without explicit attention to sociotechnical concerns, climate tech is likely to further amplify these injustices. A central goal in this project is to help youth develop an informed, analytical, critical stance toward technology. To do this, we draw on emerging work on critical sociotechnical literacy [1], which is related to other recent calls for attention to ethic of

care [8], compassionate design [9], and macroethics and ideology [10]. Recognizing that the effects of technology are typically unevenly felt, and these effects tend to reflect existing power imbalances, we engage students in explicit discussions of who will likely benefit from a given climate tech solution, and who or what will most likely be harmed.

The Community Tech Press Unit
In the first year of the four-year project, we focused on developing the initial version of the curriculum, which will be iteratively revised over the course of three design-based research cycles [11]. We collaborated with district teachers, content experts, and community members to develop the 20-lesson critical climate tech journalism curriculum and supporting materials. The driving questions of the unit are: *How do technologies for fighting and handling climate change work? How do they affect my community?* Over the course of the unit, students work towards their final small group project of creating a multilingual, multimodal journalism piece bringing together their knowledge of tech communication, climate tech design, and the needs and resources of the local community. The final critical tech journalism pieces focus on a climate technology relevant to the community that students believe their community members deserve to be better informed of.

The curriculum and professional development is designed to explicitly support students in translanguaging [6], the dynamic process by which individuals use their vast language repertoires to act, know, and be in the world. Proposed as a social justice tool, translanguaging promises to engage and free students in schools from the restrictions of monolingual norms, allowing learners to build on their language and cultural resources to make meaning [6]. This more linguistically and culturally expansive approach to engineering requires intentional pedagogical and curricular decisions and resources [4].

Implementation and data collection: Year 1
We utilize a design-based research methodology [11] to generate evidence and build theory about the critical climate tech journalism approach to engineering education offered by the Community Tech Press model. Our focus is on characterizing: (1) student learning outcomes, particularly practices of engineering, communication, and translanguaging, their ideas about climate tech, and their perceptions of the value of engineering and technical communication for the community; (2) the community resources students draw on as they participate in the curriculum; and (3) the influence of curriculum resources and teacher facilitation moves on student learning outcomes. To investigate these foci, we use qualitative research methods, including analyzing video-recorded lessons and field notes, interviews with teachers and students, and student and teacher artifacts as our main sources of data.

Our partner school district is in an urban, densely populated small city of over 80,000 people, with about 5,000 students in the public school system. It is a culturally and linguistically diverse community; more than 50% of the students are multilingual, using a total of over 50 languages. In year 1 of the project, two teachers in different schools implemented the unit across their 5 science classes, with a total of 85 sixth-grade students.

Analysis of the classroom data from year 1 will help us understand the key opportunities and challenges presented by this critical climate tech journalism approach to middle school

engineering. We have begun to study the relationships between engineering design activities, communication practices, and climate change education within linguistically and culturally diverse classrooms. Below, we summarize current areas of research based on this year 1 data.

Study 1: Enacting Critical Science and Engineering Agency
In this study, we extend Basu et al.'s work [12] on critical science agency to include engineering. We investigate how students leverage their own identities and community-knowledge resources as they iterate on possible actions during the Community Tech Press unit. We focused on end-of-unit interviews with three students who represented the wide racial, ethnic, and linguistic diversity of the classroom: Jon, who is Haitian, Dominican, Puerto Rican, and American; Andrea, who is Hispanic; and Quinn, who preferred not to say (all names are pseudonyms).

We found that each of the three students leveraged their identities and resources in the video journalism they produced while also recognizing constraints in the process. Jon leveraged his identity as Haitian-Dominican-Puerto Rican-American and his understanding of racism in the U.S. to lead the group video project section on the inclusion of how climate change was affecting communities of color more in their community. Quinn drew on the community knowledge shared by her mother when asking her group to include a push for property owners to replace impermeable paving. While she was in agreement with her group on some of the video design choices, she recognized that her group had different motivations. Andrea recognized her family's lived experiences in El Salvador and would have liked to explore how people's lives were personally affected by natural disasters like hurricanes. However, she decided to follow a strong-willed group member's vision for the project.

All three students centered their own experiences and community resources in their final video journalism projects, whether that meant focusing explicitly on differentially racist climate change impacts or the technical knowledge of how a particular climate tech works. At the same time, all three students recognized tensions constraining the possible actions they could take to push for change in their own community and in their video journalism project. These tensions included classroom time constraints, limitations in power, and majority norms and practices.

Study 2: Perspective and Context Bids in Sociotechnical Discussions
In this study, we explore how sixth-graders engage in a sociotechnical whole-class discussion about the unequal impacts of technology and engineering on their own communities. A key aspect of the Community Tech Press model is providing space and support for students to adopt a critical sociotechnical lens [1] towards engineering and climate tech, pushing back against taken-for-granted ideas in society that may serve to protect the status quo [10]. The day before the whole-class discussion, student groups explored GIS maps of urban heat islands in their city. First, they looked at potential physical causes of urban heat islands (e.g., degree of tree coverage) and then compared urban heat island maps with income and diversity maps. During the discussion, the class responded to two main questions posed by the teacher: (1) Why do lower-income areas correlate with urban heat islands? (2) Why do more diverse areas correlate with urban heat islands?

To analyze the discussion, we conceptualize two types of micro-interactional moves the students make: perspective bids – including and considering the experiences of different groups of people;

and context bids – considerations of technology and design in specific locations and situations. We argue that the inclusion of different perspectives and contexts can help to maintain the complexity necessary for adopting a human-centered systems-level understanding [13].

We found that the class engaged in expansive thinking as they focused their collective attention towards systems of inequity that limited choices available to certain communities, rather than placing sole responsibility for the unequal impacts of climate change on individuals. For instance, when students compared people who can and cannot afford air conditioning technology, they pushed back against common narratives that hold low-income people as individually responsible for their own welfare. They adopted a human-centered systems-level perspective as they made connections between climate change impacts and how the built environment places an unequal burden on low-income and diverse communities. This research showcases the rich community insights that middle school students are able to draw on when engaging in sociotechnical discussions that are rooted in local community contexts.

Study 3: Supporting Multilingual Competencies in Climate Tech Journalism
The third study focuses on how multilingual students drew on their linguistic and cultural resources when learning about engineering through the climate tech journalism curriculum. We are interested in how the curriculum supports multilingual students in bridging their engineering worlds with their lived-realities, particularly through translanguaging, the dynamic process by which individuals use their vast language repertoires to act, know, and be in the world [6]. Data for this study comes primarily from student interviews conducted while students were finalizing their group community tech journalism projects. Student interviews were analyzed using a grounded theory approach, using elements of in-vivo and line-by-line open-coding.

What emerged from this analysis were the various ways youth engaged their language and cultural repertoires while working with one another. They described access to learning in different languages as a way to (i) create possibilities for solutions to address the cultural traditions of people, (ii) expand the messages for external audiences, and (iii) to listen and be listened to through experiences and artifacts. First, students proposed engineering solutions that sustained traditions. For instance, they identified solutions for cooling down a local park so Brazilian people can continue the tradition of playing soccer barefoot. Second, some learners proposed using translanguaging to incorporate multiple languages in their journalistic piece as a way of expanding the reach of their messages. Daniela pointed to the role of language in audience reach, stating "if you have two languages, that's like two times the more people that can hear it." Third, students felt invested in using their journalistic piece and engineering designs to be heard and hear other voices for humanistic goals. For example, Jade explained, "I've always been someone that's trying to be aware of other people's situations. So, I guess I got to show that I'm able to listen to other people's stories and be able to communicate them to other people."

Conclusion
The Community Tech Press project aims to empower diverse youth to critically analyze and communicate climate justice in their community while enhancing their capacity to participate in engineering design practices in culturally meaningful ways. In our analysis of data from the first year, we find that students enacted critical engineering agency even while facing tensions constraining their actions, that perspective and context bids by students in a whole class

discussion led to more expansive framings of the problem, and that students understood the value of their own multilingualism in this curriculum and welcomed the opportunities to draw on their vast language and cultural resources.

Acknowledgements

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