

# Material Entanglements as a Source of Resistance to Educational Injustice in STEM Learning

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## Purpose

Youth centered robotics teams have gained attention as places of opt-in authentic STEM and engineering practice as part of the growth in funding and excitement for making and STEM education (Verma, Puvirajah, & Webb, 2016). Robotics teams are ripe for analysis that includes the materials and tools as integral to the development of the team and how learning unfolds for youth, which is particularly important in addressing issues of equity and justice. In this paper, I take a feminist new materialism lens (building on indigenous ways of knowing and posthumanist perspectives) for analysis to re-constitute the entanglements (Barad, 2007) between materials and humans that colonial notions of whiteness and masculinity often divide (Braidotti, 2018; McKittrick, 2006). Therefore, this study is guided by the question: *How do material-human entanglements unfold with agencies that operate to resist or reinforce oppressive narratives about who can and who cannot contribute to activities in robotics team practice?*

## Setting and participants

Data were generated as part of a three-year digital video ethnography (Goldman-Segall, 1998) with Turing Robotics (TR), a youth-centered team housed at Turing High School in a mid-sized northeastern city. Turing High School serves a population of youth that is almost exclusively Black and Latinx students. The coach of the team is white, as am I. This study focuses one particular team activity that was recorded over forty-five minutes (see Figure 1 & Figure 2) where motor wires on a practice robot were wired into a distribution board by team programmers Nicole (newcomer) and LC (oldtimer) who were recruited by Lando (mentor) to work with two build team members. Over the activity, the power distribution board (PDB; Figure 2) pushes back as youth-screwdriver entanglements attempt to open up the gateway to insert motor wires.

## Theoretical framework

The human-non-human, or nature-culture, binary is a product of western science (Bang & Marin, 2015). Building towards a posthumanist perspective that challenges this dichotomy, this paper explores the enmeshed orientations of humans and non-humans that engage in the unfolding practice of TR. In feminist new materialism, Barad (2008) argues that human-nonhuman actors are not separate but continually unfolding and entangled together. Here, I explore unfolding socio-material practice as the reconstituting and shifting of material-human entanglements. Learning is the becoming of something new, through an entanglement with material actors which forms agencies to take action in the unfolding space. Vossoughi, Hooper, and Escude (2016), beseech a critical analysis of the logics of making and STEM learning spaces that uncover educational injustices and work to eradicate them. The new materialism focused theoretical perspective opens a different opportunity to see how educational injustices are re-produced (or endure). This paper traces the learning of LC and Nicole in their becoming of something different with the coding robot and the screwdrivers.

## Data and analysis

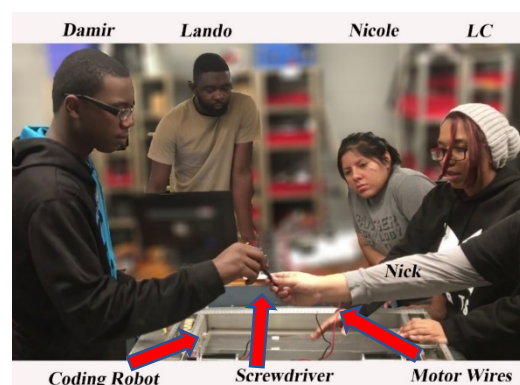


Figure 1. Material & human participants.

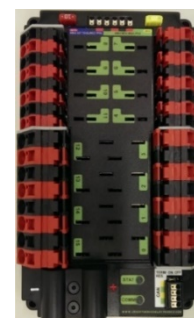


Figure 2. The Power Distribution Board (PDB).

Video recordings were transcribed first for talk and gesture for interaction analysis (Jordan & Henderson, 1995). Once the three screwdrivers emerged as important material actors in the space, I transcribed who/what they were

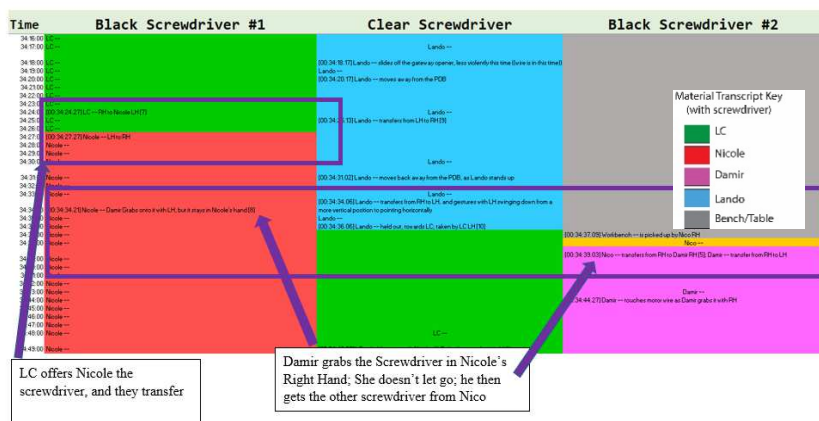


Figure 3. Material Transcript with screwdriver transfer from LC to Nicole.

of Nicole-BSD1. Figure 3 shows the material transcript clip where this occurs. Not even five seconds later, this entanglement is challenged when Damir grabs for it (Figures 3 & 4). Nicole-BSD1 resist this material “turn-shark” (Erickson, 2006) attempt, furthering the unfolding of the entanglement. If Nicole and the screwdriver had severed, it would, for instance, have mirrored experiences women have in engineering (Faulkner, 2007) where their ability to work with materials is challenged as their bodies are read as female. Here, however, Nicole-BSD1 resist, reconfiguring the power in the space. This ripples forward into the future, when a Nicole-screwdriver entanglement performs the task and offers a demonstration that further reifies the entanglement of Nicole-robot. The moment of resistance is a pivotal moment in Nicole-robot becoming.

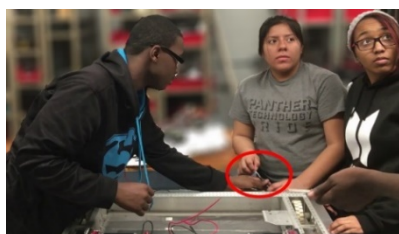


Figure 4. Nicole-screwdriver stay together as Damir grabs.

## Conclusions and significance

Entangled relationships of all kinds matter here. Nicole’s history of a relationship with LC matters and is part of the Nicole-screwdriver entanglement after LC’s offer. Further, entanglements are not just about access to engagement with materials. Nicole’s becoming with the robot is not because she was given access to it or the screwdriver. Instead, they became with it emerged as important to the future trajectory of the activity. In this case, an unfolding entanglement offered a resistance to oppressive notions of who can contribute. This example offers a different view on what developing educational justice might look like in STEM learning spaces which asks where these kinds of entanglements might get severed or not unfold at all, for whom, and why.

## References

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