



# On love, becomings, and true generosity for science education: honoring Paulo Freire

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## Abstract

In this editorial article, we draw on our experiences to create an opening for critical reflection in honor of Paulo Freire’s centenary. We start by addressing the need to overcome the productivity logic of the Academy and instead prioritize thinking and being in communion with others. We orient toward Freirean critical hope as an impetus to move beyond the limits of commodified time and engage in the process of collective becoming. We share our struggles and tensions through stories of Freirean becomings, reflecting on those “limited situations” in which our critical hope acted as catalysts for us to embrace our unfinishedness. We draw from our collective experiences and becomings to think more deeply about “the heart” of science education. We believe a heart-centered science education is one that forges solidarity with human and more-than-human others, and exploits pockets of resistance in the name of more socially and ecologically just present futures.

**Keywords** Critical pedagogy · Freire · Critical hope · Becoming · Solidarity

## Resumen

En este artículo editorial, nos basamos en nuestras experiencias para comenzar una reflexión crítica en honor al centenario de Paulo Freire. Comenzamos abordando la necesidad de superar la lógica de productividad que gobierna la academia para, a cambio, priorizar el pensar y el ser en comunión con otras y otros. Nos orientamos hacia la esperanza crítica Freireana como ímpetu para movernos más allá de los límites del tiempo mercantilizado y comprometernos con un proceso de devenir colectivo. Compartimos nuestras luchas y tensiones a través de historias de devenir Freireano, reflexionando en esas “situaciones límite” en las cuáles nuestra esperanza crítica actuó como catálisis para abrazar nuestra incompletitud. Construyendo desde nuestras experiencias y devenires colectivos, pensamos acerca de cuál podría ser el corazón de la educación científica. Creemos que una educación científica centrada en el corazón es aquella que forja la solidaridad con otras y otros humanos y más

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que humanos, y explota focos de resistencia en nombre de un presente-futuro más social y ecológicamente justo.

*“No one can be in the world, with the world, and with others and maintain a posture of neutrality. I cannot be in the world decontextualized, simply observing life” (Freire 1998, p.73)*

## Why are we here? why do we write?

Sometimes the (capitalist) machine of productivity is so embedded in academic work that the opportunities to dream of something beyond it become less visible; time is a “commodity” and that drives how we prioritize our academic life (Lynch, 2010). This machinery limits our critical imagination, and focuses our gaze on external “accountability measures,” such as publishing in “higher ranking journals,” chasing grants, and catering to student evaluations. We become caught up in the too often fragmented divisive cultures within the Academy, and forget to exploit its most radical potential. Yet, “hope is a natural, possible, and necessary impetus in the context of our unfinishedness” (Freire, 1998, p. 69) that allows us to move even within those limits. It allows us to see the interstices within spaces of (im)possibility (Hussenius et al., 2016). Hopes and dreams fuel our becomings:

Without a minimum of hope, we cannot so much as start the struggle. But without the struggle, hope as an ontological need, dissipates, loses its bearings, and turns into hopelessness. And hopelessness can become tragic despair. Hence the need for a kind of education in hope. Hope, as it happens, is so important for our existence, individual and social, that we must take every care not to experience it in a mistaken form, and thereby allow it to slip toward hopelessness and despair. Hopelessness and despair are both the consequence and the cause of inaction and immobilism.” (Freire 1994, p. 3)

“Human beings in communion liberate each other” (Freire, 1970, p. 129), therefore being in communion with each other allows us to feel a kind of collective vibration, across and through our diverse positionalities and contexts, reverberating in other corners of the world. As Galeano (1989) said, tiny people in small corners can change the world. There are a growing number of us in science education who understand science and education as inseparable from the sociopolitical, economic, or environmental dimensions of life (Tolbert & Bazzul, 2017)—who see the Academy’s most radical potential as residing within both pockets of resistance in the Academy (hooks, 1994) as well as within fugitive spaces of the undercommons (Meyerhoff, 2019). Our work spans across multiple dimensions of our critical imaginations: “The cyborg is our ontology; it gives us our politics. The cyborg is a condensed image of both imagination and material reality, the two joined centers structuring a possibility of historical transformation” (Haraway, 1991, p. 151). We are (s)cyborgs, “artist(s) in the un/patterning of relations of power” (la paperson, 2017, p.66).

The three of us, Alejandra, Betzabé, and Sara, came together, from very different life experiences, positionalities, and geopolitical locations, because we saw synergies in our work and in our commitments to justice-oriented science education, because we believe that change happens through small groups of like-minded people working to make a difference, and because we wanted to cultivate and nourish our hopes in solidarity with others. We recognize that doing justice-oriented work in the Academy can feel lonely, isolating, and depleting, especially during times when the world’s problems feel so big and

overwhelming. We wanted to create a project that would call upon others who embody these commitments and values to join in transcending the feelings of isolation and depletion we experience in the Academy. As the three of us came together to brainstorm possibilities for our creative work around themes of hope, love, and solidarity, we mapped our various academic trajectories and found common roots in the work of Paulo Freire. Given the timing of our collaboration with Freire's centenary, we saw this as an opportunity to honor his legacy and work.

According to Paulo Freire (1970), "in order for the oppressed to unite they must first cut the umbilical cord of magic and myth which binds them to the world of oppression; the unity which links them to each other must be of a different nature" (p. 49). In this article, we share stories of our own individual becomings, of "cutting the umbilical cord of magic and myth," tracing and mapping our earliest encounters with Freire's work. We then reflect on the radical potential of our becomings-in-communion as a minoritarian movement—in other words, a movement from below that works against the majoritarian "thick soup of static, rigid, overarching ways of being that dominate life" (Bazzul, 2019, p.26). We take this opportunity, as Freire says, for "opening windows" to build unity and solidarity and explore our own adventures in "ongoingness" as we read the word and world, together. We humbly share with you our reflections of our unfinishedness as we continue to un/learn, in the spirit of conscientizacao, things we have been conditioned to believe and accept as truths. There is joy in our unlearning, as Freire (1998) reminds us: "I like to be human because in my unfinishedness I know that I am conditioned. Yet conscious of such conditioning, I know that I can go beyond it, which is the essential difference between conditioned and determined existence."(p.54). Whether you have a long standing within the Academy, are early in your career, are just starting graduate school, are a teacher, or a student, or activist, we all have ideas that together can push us beyond our conditioning, toward a pedagogy of emancipation.

## Stories of Freirean becomings

### Alejandra

Seventeen years ago, I became a science teacher and set out to teach science in a way that I longed for but had never experienced in my schooling. Just as education is inherently political, so is our everyday life. The personal is also political and science class is not immune from that reality. As a science teacher, I didn't want students to think of scientists as people that were removed from the world in a lab. For me, science was never removed from my life, the way my science teachers seemed to imply when only certain things were considered "scientific." I became fascinated and curious about science at a very early age; hearing stories from my dad about chemistry and his two years as a student of chemical engineering in Mexico, metallurgy talks among my family members who were jewelers in Mexico, seeing and experiencing curing sobadas, teas, and ointments that were not from a pharmacy or store, seeing my parents plant and harvest food in our backyard, and seeing my grandfather working with the gears of watches and bikes. So I longed to have a science class where students could hear the stories and struggles of people of color, their excellence, thoughts, and contributions too. Just as I had wanted my genius and ancestral history reflected back to me in the textbooks and assignments I was given in school, I also wanted a science class where what we learned had a purpose beyond a test. I never put a

high value on the banking of knowledge as a student, which I viewed as cognitively less demanding, as memorizing. I know from my own experiences as a student of science that learning and knowing didn't happen when someone told me something, but when we (or I) tried for ourselves. So, I also wanted to make accessible all the equipment and instruments at my disposal so that youth could tinker and discover things and learn about the natural world around them and see themselves as part of it. What I hadn't expected was what I heard from other adults in the school about my students. I was warned consistently that my students, who were predominantly Black, could not be trusted on trips or with our equipment. I was told if they couldn't learn from an outdated textbook that was over 20 years old, they were not ready for labs. I was told they couldn't handle rigorous instruction, and that they wouldn't do well on standardized tests and so they didn't belong in honors or other advanced classes. Nevertheless, I attempted to facilitate learning experiences in my classes that leveraged their curiosities and funds of knowledge, even at the expense of my own reputation and relationship with colleagues, who suddenly started showing up to "get something" from my classroom more frequently while I taught. But that space was harmful for me and I started losing hope. The microaggressions and distrust my students and I both faced, became too overwhelming. I felt confused, powerless, alone, and after two years, I left that school.

My first week at Rudy Lozano Leadership Academy, a social justice alternative high school I would go on to work in for the next 8 years, I was handed a book to read as part of my professional learning: *Pedagogy of the Oppressed*. And I'll be honest, I was resistant at first. The importance of the theory itself was secondary to me. The people who wrote the theory hardly ever looked like me or others in my community and yet claimed to know what we needed. I was tired of people around me just talking about what needed to be done and not doing it and I equated theory to this sort of talk. I was eager to jump in, try things, act with youth and families, and use science to improve our communities now, not after I read a book or journal article and had a discussion about it. In my time at Rudy, I came to understand that without theory, reflection, and practice (praxis), I burn out. It is not easy to work at an alternative school, but at Rudy, I felt loved and seen. Love and solidarity centered me and I felt comfortable talking about what I didn't know and what I needed. I found I needed examples of how others imagine a humanizing and critical science education. I found I didn't know what students, parents and community members wanted from their science education and so I needed frameworks that helped me imagine and design science education for and with the community. After a few months of resisting, I gave in because I was in a space where we were pushing each other to act based on what we read, to imagine other possibilities with youth and community, to try and reflect.

I also began to meet with other social justice science teachers and started co-designing curriculum with them, instead of working alone. The more I learned, the more everything around me had the possibility of becoming a curriculum, which could be re-presented as a problem, investigated and acted upon, then reflected upon and investigated and acted upon again and again. "Problem-posing affirms men and women as beings in the process of becoming" (Freire, 1970, p.84) and together with other science teachers in Chicago, I have learned that the more we uncover about the enterprise of science, the more possibilities exist as critical educators to dismantle hegemonic notions of science and its role in society so that we instead reimagine and present counter narratives that help us ground ourselves in love and solidarity instead of capitalism and individualism. As I reflect on some of my continued becoming, the most important stories to me are those in which I was a learner with students, investigating issues and contradictions I didn't have an answer to, that I also cared about, and or also impacted me. In many ways teaching in a Freirian way has brought

me back to what I loved about science to begin with, learning and acting on the world using my scientific imagination and curiosity. As Freire puts it, “the teacher is no longer merely the-one-who-teaches, but one who is himself taught in dialogue with the students, who in turn while being taught also teach. They become jointly responsible for a process in which they will grow.”(1970/2002, pp 79–80) I remember teaching about eurocentric beauty standards, for example, while studying the chemical composition of products as a way to talk about nomenclature and the properties of matter, and being challenged by my students as to why I straightened my very curly hair. They were calling me out, asking me to face myself, my own internalized oppression and contradictions towards self actualization, just as I was asking of them. I still have old students tell me how important it was for them to learn about what they buy and put on their bodies but it was also transformational for me. Needless to say, I stopped straightening my hair and started loving it instead.

Humbly attempting to imagine praxis in science class necessitated a problem posing science learning framework that positioned young people as producers of knowledge and culture capable of enacting transformational changes in their communities, which we call Youth Participatory Science, YPS (Morales-Doyle and Frausto, 2021). YPS came from a need to amplify student and community power and voice, rather than simply asking them to collect data or contribute to the work of others. YPS is our attempt at imagining what youth participatory action research, YPAR, looks like in science class, as part of larger intergenerational work. In my work now with the YPS collective, a group of science teachers, scientists, students, and community organizers, we position our students in science class as science (and community) experts addressing issues of heavy metal contamination in and with their community. As I continue to learn to read the word and the world with my disciplinary lens of science, I found myself at the crossroads of other disciplines and being pushed to consider the role of transdisciplinary learning in science class. Most recently, I facilitated a YPS project with 6th graders in my community where we studied the paint chips falling from viaducts, bridge structures that allow freight trains to pass above us. We found that in order to understand and then act upon the high levels of lead we found in the paint, we had to not only understand the science of lead and its impact on our bodies, but we also had to investigate why lead was in paint in the first place. We had to also investigate who is responsible for maintaining the viaduct. We found ourselves writing to and meeting with our local elected official about our scientific findings because science alone can not make our community safe.

I work and hope, as Jeff Duncan-Andrade says, “audaciously” towards science classes that prioritize more-than-human relations, learning and work towards unmasking white supremacy and oppression, towards honoring and nurturing our ancestors, and our individual and shared humanity because that is what we deserve (Duncan-Andrade, 2009). I am and continue to be unfinished as an educator and emerging scholar seeking to understand with others how we teach science for self-actualization and social transformation. I know there are other pockets of resistance, other students, educators, parents and organizers, working alongside me (even if we have never met), grounded in love and solidarity and the more I hear about their stories, the more I feel inspired to dream and imagine.

## **Betzabé**

I grew up in a context where not taking a political stand was not an option. My dad was always talking about politics and making strong statements about the world. He spent his childhood in a dictatorship, and I myself was born in its final years. That fundamentally shaped my views of the world. However, when I entered the physics faculty as an

undergraduate, I did not have opportunities to develop a critical perspective on education as part of my initial education, which always conflicted me. For a while, I thought I needed to separate myself from what I was going to teach, and I did not have spaces to problematise this issue, but I could feel that something was not right. As Paulo Freire says, we learn even with our body and my body was not comfortable, it knew that something was a bit broken. I was part of political organisations and collectives during my undergraduate studies. Still, I never put together my ideas about scientific knowledge and the social world until I went to work at a public school. I had to teach around 600 students each year, all of them with different worlds, problems, and concerns and I could feel that I was not prepared to be the teacher they deserved. I was fragmented. I joined a teacher movement back then, and my brother gave me "Pedagogia de la autonomia". Both things changed my life. With these teachers and with reading the book, I could now make sense of how to put my political views, and myself as a whole, in conversation with my physics teacher "self". That was beneficial for me in the sense of overcoming internal dichotomies and conflicted identities and for my pedagogical praxis as a public school teacher. The world and I were not fragmented anymore. Teachers in this school always understood their profession as something beyond the classroom, as something beyond the subject curriculum. They had (and still have) a sense of community where the aim was moving together with a holistic rather than fragmented view of the world. I wish I had had the chance to read bell hooks back then. Still, when I did recently, her words resonated with my experiences, as she states, "the objectification of the teacher within bourgeois educational structures seemed to denigrate notions of wholeness and uphold the idea of mind/body split, one that promotes and supports compartmentalisation" (1994, p.16). However, I lived and experience this split myself during my initial education; I had the opportunity to move beyond that with other teachers, and with Freire's words: "to teach cannot be reduced to a superficial or externalized contact with the object or its content but extends to the production of the conditions in which critical learning is possible" (1970, p. 33).

That sense of what it means to be a teacher encouraged me to take a different stance. I could learn of the need of having a community mindset. That community mindset was my space for cultivating hope. I could learn how not knowing something is a possibility rather than a weakness. Possibilities such as working on reading comprehension of scientific news and articles, with the help of the language teacher, or the importance of the history of science and its problematisation with the help of the history teacher, among others. These opportunities allowed me to start enjoying teaching physics more but also reflect on which one was my approach and understanding of the curriculum, from a fixed entity to a negotiation opportunity. I moved from a fragmented self to see the world not full of compartments anymore. Instead of the curriculum controlling and limiting my work, I could, as Alejandra says, act upon it.

Sometimes we forget that the sense of wonder that science evokes should also be for ourselves, as we are also part of the learning experiences with our students, other teachers, and the natural/social world as an ongoing process, positioning ourselves as "a knowing subject, face to face with other knowing subjects...constantly readjusting our knowledge" (Freire 1970, p.26). However, this is not usually understood by policymakers and those in power. During 2015 I was part of one of the biggest teacher demonstrations that lasted for a few months. That shaped not only who I am now and what kind of themes I am exploring in my research and my life as a teacher, but also what kind of commitments I was taking, what type of physics teacher and teacher educator I wanted and still want to be in this ongoing process.

I realised back then that there were so many things about the profession that I did not know, national policies that perpetuate inequalities between “types of teachers”, different work conditions for the same work, and so on. Why did I not know about this? Probably because my initial education was also in a vacuum, but also, I was in a vacuum because I did not engage with this before even though I knew it indirectly. As Freire always reminds us, if we need to transform the world, it is necessary to name it, but to name it we need to know what we are naming, and then, public time and education is key, and Critical Education is vital. That is my commitment today. Knowing about physics is not enough because this knowledge exists in a world where too many other things happen that are necessary to learn physics and to live in the world (I know this sounds circular because it is circular). But what do I mean when I say that Critical Education is vital? If not for the teachers I worked with, I would probably still hold that internal dichotomy with myself as not belonging, as not being part of it. I would probably feel alone during my years working as a school teacher. But I did not because they gave me the possibility to be vulnerable, ask, and learn with them, rooted in their commitment to solidarity and creating communities for ourselves and our students. To a certain extent, the teachers I worked with and Critical Education rooted in Freirean commitments were and continue being, paraphrasing Roque Dalton, the aspirin of the size of the sun that I needed.

The same happens to me now. I first started to learn English a few years ago. At first, save for a few exceptions, I thought I was “alone” in the world of science education. Not having access to what it was been doing in other places, I did not feel belonging; however, access to another language allowed me to see beyond my corner in the world, allowed me to recognise more “pockets of resistance” as Sara says, or a “sea of fires” (in Galeano’s terms). These seas of fires I could read about in other places have been working with different approaches to science. They are valuing local communities’ knowledge, bringing dialogue and politics back to science education research, considering the epistemic value of a transdisciplinary view of science, and so many other initiatives than embracing a reading of the word and the world but also a collective writing of it. That is why Critical Education is vital, because we could feel belonging, because it keeps us as part of something, and we also create the conditions for others to feel part of that something. Those others are our students, our colleagues, the people who engage and dialogue with us about science or not science-related issues. The people that affect and are willing to be affected with us. Who we are and how we position ourselves and our knowledge in those conversations is elemental to make dialogue happen, a dialogue that can create new knowledge instead of imposing it.

## Sara

I was raised in a socially and politically conscious—though not activist—white middle class household in the southeast US (described more fully in Schindel et al., 2019), with roots in Appalachia (mom’s side) and southern Louisiana (dad’s side). But I think my journey into critical education probably didn’t begin until I attended a summer program in communicative arts in Valdosta, Georgia. A handful of radical (and probably subversive—given the highly ideologically conservative location) professors there introduced me to queer theory and feminist theory including the work of the provocative feminist performance artist Karen Finley, which helped me understand some of my own gendered experiences in school. At university I became involved with activism around wolf reintroduction in Colorado, and learned through my participation in these movements, and the organic intellectuals who led

them (Gramsci, 1971), about the power of multiple groups coming together to effect social/ecological change (against powerful interests). Through my environmental studies program which included science coursework alongside coursework in American Indian studies, philosophy, political science, social action, and others in humanities and social sciences, I developed a sense of the generative possibilities of transdisciplinary science education—in stark contrast to high school science coursework which I found completely disconnected from sociopolitical (or socio-ecological) contexts.

As an idealistic (and somewhat naive) beginning teacher at 22, and in my own early development as a (science) educator, I always felt like something was missing. Structural oppression undeniably constituted teaching and learning at Community Junior High School 145 in the South Bronx, yet I felt haunted about the ways in which I often taught around—and by teaching around, reinforced—savage inequalities (Kozol, 1991). Both Alejandra and Betzabe's early experiences as science teachers resonate with my own. Students were not allowed to change classes for fear that allowing them to do so would lead to violence in the corridors. Students were walked down by administrators—who demanded order and silence—to electives, lunch, and any other activity that required them to walk the halls. Teachers, not students, changed classes, so I pushed my science cart from room to room and looked for small pockets of resistance. Resistance to the dominant mode of instruction, for me, was rejecting what Freire calls the banking method of education in which students were expected to stay silent in rows, and copy notes from the blackboard, despite the repetitive intrusions of my Assistant Principal into classrooms demanding silence when students were working in groups. Students learned how to quickly move their desks into and out of group formation between classes. Students learned how to repeat the "Aim" (learning objective) when school and district administrators walked in, but also understood that why/how doing so was very much performative. Resistance was taking regular field trips on the subway around the city and refusing to leave any student behind for "poor classroom behavior."

The students were never the 'problem'; the system was. I hustled for resources from around the city—petri dishes with agar from local labs, guest drama teachers, performance artists, and the walls between our classroom and the city around us became more porous. I left after a few years, feeling like I was a decent science teacher, but, like Betzabe describes, I was not the teacher that my students deserved. I left feeling like I had done little to contribute to changes in the material or structural conditions that systemically limited my students' opportunities to thrive. In that respect, I left feeling like I had failed. Years later, CJHS 145 was shut down by the state, and the communities it served lost their neighborhood school. Yet, I still felt that there was immense power in teaching, but wasn't sure how to harness it.

I left CJHS 145 for a 6-month volunteer teaching opportunity via a partnership with Rare.org and WorldTeach, where I worked in Chiapas and Quintana Roo, Mexico, to support students, several of whom were Indigenous (Tzotzil, Maya) to develop and run ecotours in their communities, located in and around Reservas de Biosfera (biosphere reserves)—part of an effort to maintain local sovereignty over ecotourism and promote conservation efforts (and in the face of growing foreign tour operators in the region). During this time (2000–2001) the Zapatistas were actively fighting for recognition of their sovereignty, which was finally issued by the Mexican government in 2001 (though the struggle for Indigenous rights in Mexico continues). After completing the six month position, I was hired as the training coordinator/assistant director for the next iterations of the program, located in El Peten, Guatemala, and later in Baja California, and then the Yucatan. It was in Guatemala working with community members that I became acutely aware of the ongoing lack of my own critical education, even



naivete, specifically about US involvement in the political instability of many Latin American countries. For example, I became more informed about the devastating and lasting effects (even in 2001–2002, while I was there) in the military coup that overthrew the popularly elected socialist Guatemalan president (Jacobo Arbenz).

After working in Latin America for 3 years, I went back to teaching later in Atlanta, GA, and felt the same kind of frustrations that I had while teaching in the South Bronx. I then enrolled full time in a Masters in education program but felt similarly underwhelmed with the constructivist theories and ideas about scientific inquiry in my science education major that were meant to help me learn to be a better science teacher. My minor was in social studies education, where we skimmed the surface of some critical texts, e.g., James Loewen and others (mostly white men)—but nothing of the sort in science education—despite the very palpable inequities along the lines of race, class, and immigration status I observed in field placement science classrooms—and off hand racialized and classist remarks from students (and some instructors) about “these [Black and Latinx] students” who “don’t want to learn.” I remember venting about all of it in my weekly online teacher education reflections, why are we not talking about this? What if a starting point for science education was students’ lived experiences—and political imaginations? Why is our science curriculum so far removed from the complex sociopolitical and sociohistorical contexts of both ‘science’ and ‘schooling’? Are we not lying when we tell students they can be anything if they ‘just work hard enough’? How do we ‘dismantle the system’? Why isn’t anyone teaching me how to teach ‘beyond science’? I complained a lot, and my adviser nodded empathetically, and typed supportive comments on my heartfelt rants. But no one could answer my questions. I remember being angry that no one was teaching me what I felt I needed to know most. It wasn’t until I went back to grad school for my doctorate in 2006 and was finally introduced to Freire that I suddenly felt like I had found what I had been searching for, a praxis for making sense of my experiences and education in the U.S. and abroad. I read *Pedagogy of the Oppressed* and *Pedagogy of Hope* alongside bell hooks’ *Teaching to Transgress* during my first year of my doctoral studies and immediately felt that worlds had been revealed. Their words formed powerful lenses to replace the rose-colored glasses and myths of meritocracy that had been removed through my experiences as a young adult.

Since then, in working alongside teachers, students, families, and communities, I have continued along in my problem-posing journey, humbled by the power of praxis: theory–action–reflection, and how small groups coming together can topple injustice. A former high school student collaborator in Tucson so eloquently stated, “Looking at how we can make those connections in the community with different organizations—that helped a lot....Because the bigger the group of people that have the same ideas as you, or want to tackle the same issue, then the stronger the cause you have now to fight” (Tolbert et al., 2019). Yet, I very much see myself as being in a constant state of problem posing, of (un)learning, even now as I still reflect daily on what it means to grow critical consciousness among science teachers in new contexts, in new places, and build critical solidarities with students, families, and communities, particularly within conservative institutions. As Winona LaDuke (2016, p. 1) has stated, “we need a new era of monster slayers”.

## On love and unfinishedness

“In limited situations, beyond which lies “untested feasibility” alone -sometimes perceivable, sometimes not - we find the why of both positions: the hopeful and the hopeless one.” (Freire 1994, p.9)

We aspire toward "the creation of a world in which it will be easier to love" (Freire 1970, p.40), yet while we are writing this, elite billionaires are visiting space in the name of their “*love for science*.” What does an act of love in science look like? It cannot possibly be space tourism, in the midst of a pandemic, that has no regard for the impact that such tourism can have on the environment, or how many lives we could save by redistributing that money toward more humanitarian or ecological efforts. Love is a revolutionary feeling. As we have stated elsewhere,

true love is not pursuing critical or transformative projects purely as/for an end to our own personal pain but must instead be grounded in the pursuit of a *collective freedom* from domination. Only an ethic of political love can “intervene in our self-centered longing for change.” (p. 244, hooks 2006) (Bazzul & Tolbert, 2019, p. 306)

An “armed love” looks at the world to denounce, but also to announce joyfully (Darder 2002). These forms of political love are counter hegemonic, worldmaking practices. Together at the margins of hegemonic school science, we work toward a science education that resists violence and the exploitation of bodies, beings, and land, and that welcomes our anger as a catalyst for love and solidarity.

The three of us, as critically oriented science educators, have each had experiences where we have encountered, in the Freirean sense, a limited situation—something that was wrong, that we could feel in our bodies, in our hearts, in the sense of un-belonging. A humanizing *sentipensar* science education for the future demands this kind of thinking-with-feeling. Emancipatory education is about becoming. What is at the heart of “science education”? Where does our hope lie? From a Freirean position, from our small pockets of resistance, or seas of fire, we work against a hegemonic schooling and toward a science education that allows students and teachers to “engage in the experience of assuming themselves as social, historical, thinking, communicating, transformative, creative persons; dreamers of possible utopias, capable of being angry because of a capacity to love” (Freire, 1998, p. 45). Indeed,

the goal [of becoming] is to open lines of flight toward different modes of living and existence...(p. 42). The political significance of tiny becomings is that they loosen/move the larger static structures, identities, ideologies, and concepts that already exist. More precisely, they render those larger static structures and identities as different than before. (Bazzul, 2019, p.45)

It is in/through encounters within collectives, as “tiny becomings,” such as the one in which we write together here, we have found opportunities for these “untested feasibilities,” spaces where our dreams and visions can be unapologetically shared and seen by others. Engaging with others in the imagining of radical possibilities, of dreaming about the world we want to live in and the feelings we want to have for each other, while being practitioners who try, and sometimes fail, to enact those dreams in real time helps us stay hopeful. We prevent each other from falling into the fatalism and false pleasures of neoliberalism: “Political imagination and love become forces that make different possibilities visible” (Bazzul and Tolbert, 2019, p. 307).

## Critical hope and solidarity: from false generosity to true generosity, from extractivism to extra-activism

One way to overcome this impoverished desire is to think and act, ethically, with others in solidarity, not just with humans, but with/in our cosmos, within the space of possibilities that always constitute human/more-than-human encounters (Grosfoguel, 2016). We, like other justice-oriented scholars, reject notions of equity or multiculturalism in science education that fail to address oppression, that fail to engage in conversations around structural change and systemic injustice (Morales-Doyle, 2019). We similarly reject fatalistic approaches to science education in an era of ecological precarity that focus only on teaching students about the “science,” or focus only on individual acts with little attention to ecological justice and critical hope. Such limited notions of equity or neoliberal multiculturalism characterize what Freire refers to as “false generosity” (Freire, 1970)—generosity that can only exist if/when the unjust order exists. For example, the seemingly generous acts of a more “inclusive” science curriculum (Morales Doyle, 2019), an institutionalized diversity committee (Ahmed, 2012), new urban STEM schools (Bullock, 2017), or elite dual language programs (Chavez Moreno, 2020), often do little to dismantle material inequities in racialized and economically oppressed communities—in fact they can even exacerbate those inequities (Morales-Doyle and Gutstein, 2019). As we have stated elsewhere, “if educators are not challenging the juridical and political order of things in times of ecological and social crisis they may be missing the point” (Bazzul and Tolbert, 2019, p. 305). Dismantling material inequities produced through environmental injustice (Bullard, 1996), a tiered schooling system (one differentially funded by property taxes) (Dumas and Anyon, 2006), the rising student debt required to obtain a degree (Price, 2004), or a system of tracking in STEM that produces unjust material and racialized outcomes for minoritized students (Tate, 2001) requires what Freire refers to as “true generosity”—toward a transformation of these inequitable systems. True generosity (e.g., Fig. 1) is achieved through revolutionary love, solidarities, and “extra-activisms” (Morales-Doyle and Frausto, 2021; Torres-Olave and Bravo, 2021).

Shirley Steinberg & Joe Kincheloe, (2012) remind us that “Critical science education researchers use their work to empower science educators to construct their practice along well-analyzed moral, ethical and political principals (p. 1489)...As [critical science educators] produce knowledge, they remake their professional lives and they rename their worlds....In this context, science educators gain the ability to step back from the world and look at it anew (p. 1499)”. Echoing the words of Indigenous rights and environmental activist Winona LaDuke (2016), we “would like to see an elegant society, not a city of

**Fig. 1** True generosity: On revolutionary love, solidarity, and extra-activisms. Photo: Creative Commons License



decay and sorrow” (p. 298). (How) can science education catalyze such radical desires, we ask—nurturing critical scientific literacy, Freirean scientific consciousness, ecological conscientization—as the “heart center” of science education? How can science and science education overcome its extractivist origins, and embrace pedagogies of hope, resistance, activism, and ongoingness? These are questions for which there are multiple possible answers. We leave you with these questions, and your own, in anticipation of the special issue, forthcoming.

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