



POINTS OF VIEW

STEM Education, Democracy, and Civic Engagement in a Fast Globalizing and Unequal World: Sara Tolbert in Conversation with Geraldine Mooney Simmie

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Abstract

The SENCER Summer Institute 2023 proceedings reported here are an adapted transcript of a conversation between Sara Tolbert and Geraldine Mooney Simmie on the topic of science/STEM education, democracy, and civic engagement in a fast globalizing and increasingly unequal world (2023, August 29). The dialogue draws from the four SENCER ideals to underpin the importance of what the feminist scientist Donna Haraway called "staying with the trouble," where the trouble in this case is implicit in the complexity of constantly changing ethical, sociocultural, and political relations between STEM education and democracy. The speakers aim to critically scrutinize the new framing and lexicon centered on STEM

learning and civic engagement, including phrases such as "teaching and learning," "problem-posing," "civic engagement," and "inclusion" in STEM education policy texts in Ireland and New Zealand. Drawing from critical, philosophical, and feminist perspectives the speakers argue for an urgent reappraisal of the framing of the problem. We argue for the need to reorient STEM Learning toward an expansive view of education that is relational and emancipatory and a view of democracy that is upstream of the instrumental. The original conversation was edited for ease of readability, inclusion of a planning template, the addition of a number of relevant references, and a summary of key insights (see Tolbert Mooney Simmie Dialog).

Introduction

The proceedings from the SENCER Summer Institute 2023 reported here are an adapted transcript of a conversation held on Tuesday, August 29, 2023 between Sara Tolbert and Geraldine Mooney Simmie with a live online audience of science educators and policy decision makers in the USA and internationally. The topic for critical scrutiny was the contemporary framing of science/STEM education, democracy, and civic engagement in a fast globalizing and increasingly unequal world. The conversation draws from the four SENCER ideals to connect science education to matters of public interest and to do so in ways that take into account the power and limits of science for a complex and nuanced understanding of the problem in contemporary times. The four SENCER ideals are as follows:

1. SENCER connects science and civic engagement by teaching "through" complex and unsolved public issues "to" basic science.
2. SENCER invites learners to put scientific knowledge and methods to immediate use on matters of relevance to them.
3. SENCER reveals both the power and the limits of science in addressing the great challenges of our time.
4. SENCER helps all learners connect civic issues of local concern to national and global "grand challenges."

The SENCER ideals underpinned for the speakers the importance of what the feminist scientist and environmentalist Donna Haraway called "staying with the trouble," which is implicit in the complexity of constantly changing sociocultural and political relations between STEM education and democracy (Haraway, 2016). The conversation aimed to critically scrutinize the current framing and associated lexicon centered on STEM learning and civic engagement, including the four phrases: "teaching and learning," "problem solving," "civic engagement," and "inclusion" in science/STEM education policies in Ireland and New Zealand. Drawing from critical, philosophical, and feminist perspectives, the speakers assert the urgent need for an appraisal of this contemporary framing of STEM learning and civic engagement and the necessity to foreground intersectionalities, such

as, gender, social class, race, ethnicity, and disability. This includes the need to reorient STEM learning and civic engagement for an expansive view of STEM education as relational and positioned within a dynamic and deep view of democracy. The original transcript of this conversation was edited for ease of readability, inclusion of the planning template designed by the speakers, the addition of relevant references, and a summary of key insights (see Tolbert Mooney Simmie Dialog).

SARA TOLBERT: This session is really meant to be more of a conversation, a generative dialogue around common yet under-interrogated discourses in STEM education. I'm Sara Tolbert, currently based in Aotearoa New Zealand, formerly in Arizona, and I'm professor of science and environmental education at the University of Canterbury, where I co-direct Learning for Earth/Ako Futures (LEAF), a transdisciplinary research initiative led by faculty from science and education.

I met Geraldine, who will introduce herself shortly, recently at the 2023 Annual Meeting of the American Educational Research Association in Chicago, at a session on science and democracy. She and I have very similar interests, and particularly in our critical feminist approaches to rethinking science and education. Our interests also resonate with SENCER, in that we are all centrally concerned with the sociopolitical and critical participatory dimensions of science and of education. And so I was just really taken with her work, and in the spirit of growing our international SENCER community, I was excited to reach out to her and find a way to partner with her and bring her into these conversations we are having at SENCER. This is just what Eliza and Davida have done with me since I started affiliating informally with SENCER in 2018, when Eliza and I met as keynote panelists for the Human Rights Coalition of the American Association for the Advancement of Science, and more recently in my role as a formally affiliated SENCER diplomat.

Last year during the SENCER Institute, I gave a keynote on thinking about our work as a social movement. I think this conversation today and how it came about is part of that, just continuing to find like-minded and very enlightened thinkers and doers in our fields. It's

really my pleasure to be able to bring Geraldine with me into this conversation today and just talk with you all a little bit about what she and I have been thinking around these common discourses that we hear in STEM education—discourses that we sometimes maybe take for granted, even in this academic space. And so we thought this would be a good time to take a moment to revisit some of these common terms and phrases that we often hear, and to think together about what they actually mean and what these words and phrases actually convey. And then as we problematize them we want to use that as an opportunity to reflect on the SENCER ideals together with you.

GERALDINE MOONEY SIMMIE: Thank you very much, Sara. My name is Professor Geraldine Mooney Simmie and I am coming to you today from the School of Education in the University of Limerick in Ireland. I am chair of STEM education and director of the research-led center EPI+STEM National Centre for STEM Education positioned in the School of Education. We have more than 40 faculty in the school, and more than half of this faculty have a specialist research interest in some aspect of STEM education, democracy, and global citizenship education. We have circa 2,000 students in the School of Education (e.g., student teachers, teachers, school leaders), and we provide continuing professional development (CPD) to an online EPI+STEM Academy of STE(A)M teachers across Ireland.

In the school, we understand the importance of working in partnerships, national and international border-crossing partnerships for learning, what we refer to as upskilling in teacher knowledge(s) and advancing the professional conversations expected from an understanding of teaching as an advanced practice (Mooney Simmie et al., 2023). From my perspective, this aligns best within an intellectual tradition that takes account of the complexity and messiness of teaching and teacher professional learning and is always in the direction of human emancipation and for a future of uncertainty (Mooney Simmie, 2023; Mooney Simmie & Moles, 2020).

Holding hands metaphorically across the globe with Sara and other researchers, we have much to learn. We are experiencing common problems. We are hoping to make space to wonder aloud about how science education

and democracy need to be reoriented in order to work toward saving the planet as well as humanity. We have challenges here too for justice and equality. We clearly need new thinking for public interest values that is not about a dominating narrative. We have problems that are bigger than can be solved singularly in each of our own countries, in Ireland and New Zealand.

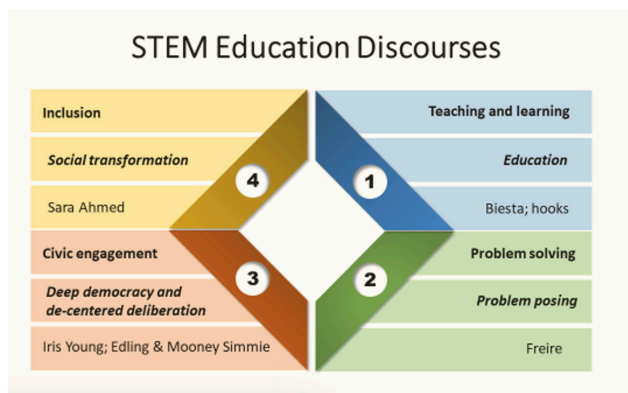
We want to do the best for our countries. So meeting Sara, at AERA 2023 in Chicago this year prompted me to open a new type of productive conversation with colleagues in higher education and to convene a new Critical and Feminist Special Interest Group with the Educational Studies Association of Ireland (C&F ESAI SIG) (<http://esai.ie/critical-and-feminist-special-interest-group-cf-esai-sig/>).

My research interest is in STEM Education, democracy, and civic engagement while researching and working with critical friends to advocate for a transformative difference in this regard. While there are numerous challenges, I am heartened that we are at a time where we can research and advocate for an emancipatory and transformative vision of science education and democracy. This demands a high degree of critical reflexivity on our part; otherwise we run the risk that what we are proposing will be about pushing an agenda of cruel optimism or some utopia that is simply unattainable (Pillow, 2003). Neither do we want to fall into a universalism that is deterministic and smacks of a dominating scientism rather than science working in an open and dynamic system where ethics, philosophy, sociology, and other situated ways of knowing and knowledge are included, valued, and celebrated.

If we look at the policy process in science education today, and the connectivity between science education and democracy, there is a lot taken for granted and normalized. Since the start of this century, education policy in Ireland and New Zealand, across the OECD and the globe, is drawn from a new assumed purpose and discourse of "learning" rather than "education," using phrases such as "teaching and learning," "problem solving," "inclusion," and "civic engagement." When policy decision makers in each of our countries use these terms, what exactly do they mean? What appears framed into the discourse, what is restricted, silenced, forgotten, or indeed erased?

What we want to do in this conversation, this cross-national conversation that Sara and I are having, is to

FIGURE 1. Our planning template for problematizing four discourses in STEM education and democracy



have a purposeful discussion that delves into this problem of discourse and critically scrutinizes the framing of the problem of language use and meaning making in science education and democracy.

You can see from our planning diagram that we will scrutinize the framing of four taken-for-granted words and phrases in relation to STEM learning and democracy (Figure 1). We will use the SENCER ideals to guide our critical and feminist scrutiny, to help us think anew with theory and to allow us to collaborate and to act differently. We are seeking new insights in order to reorient science education and democracy away from a narrow consensus framing that currently feeds the process of social reproduction rather than disrupting the discourse and making space for a new social contract in education and for new ways of being and acting in the contemporary world.

We will draw from critical, philosophical, and feminist perspectives to widen the discourse beyond a limited, narrow, and dominating worldview. We want to make sure that emancipatory science education and democracy gives all young people access to the big ideas and concepts in science, mathematics, and technology. We need to move beyond cognitive and affective development to take justice and equality into account and at the same time maintain an understanding of democracy as a constantly changing project of ethical and social (re)construction of the (political and economic) world we live in.

We need the changing gaze of education to support us doing better for ourselves individually, for our families, our communities, other humans, other species in the environment, and for the sustainability of the planet. We need to assert that education cannot continue to remain

tethered to a mainstream narrative that today is centered on the primacy of the economy, the commodification of everyone and everything for a view of "sustainability" as merely "economic sustainability." We need "sustainability" to reflect public interest values and the greater good of humanity, society, and the planet. These educational emancipatory ideals interest us. I will now hand back to Sara.

Teaching and Learning

SARA TOLBERT: Okay, so as we mentioned, we're going to be dialoguing about some of these common discourses we hear in science, education, and STEM education more broadly, and probably across the disciplines in our various roles. And the first one we want to talk about, as Geraldine mentioned, is this concept of "teaching and learning." I've been talking with colleagues, currently in the midst of a science curriculum reform here in Aotearoa New Zealand, where we started trying to interrogate some of the words that we often use and to think more carefully about what we actually mean by these terms when we use them. And what are their histories? How are they positioned and what do they intend to do? And "teaching and learning" is one of those that we need to consider—and there are other scholars who have talked about this as well, such as Gert Biesta (2020) and bell hooks (1994).

It's this idea of "teaching and learning" that has almost become a technical isolation of the experience of what it means to be a student, or what it means to have an education. And so we will talk about the histories of this term and how it has come to be. But we are really proposing a refocus on the idea of "education" versus "teaching and learning," which has a much broader focus on the whole person. And education is holistic, inclusive of what it means to live well together for the greater good of society and within the world, and how important that is right now in the Anthropocene. So what we are doing in this conversation is this: we are going to bring up each of these phrases and terms, talk about them, and then offer a couple of scholars you may be familiar with, or may not be familiar with, and if not, who might be ones that you want to explore. For me, I love the work of bell hooks (1994), who talked about education as the practice of freedom, or, as she says, "teaching to transgress." Education

is really about a process of becoming, and being, and not necessarily about internalization of content—not that teaching and learning necessarily means the internalization of content, but it really does focus on a very transactional, linear relationship sometimes—and then we might simply forget the whole experience of "education." I'll turn it over to Geraldine now for her thoughts.

GERALDINE MOONEY SIMMIE: Thanks Sara. Continuing our critique of "teaching and learning," we look toward the SENCER ideals, and we find the concepts of the learner and STEM learning gaining ground in a similar way in each of our countries, in policy documents in Ireland and New Zealand. There is equally a big emphasis on "teaching and learning" in the research literature.

The distinction between "teaching" and "learning" and the hidden assumptions behind "learning" is interrogated by Gert Biesta, a philosopher of education (Biesta, 2020). Biesta argues that "learning" is a concept that is restricted to the individual, as a private good for the individual rather than an inclusive and relational concept concerned with the common good or greater good of society. The latter more expansive view of education is that it is relational and emancipatory and is connected to our interdependencies with other humans, other species, and the planet. Education is a far broader construct that is about human becoming and the development of a cultured person, the formation of the person in far bigger ways than mere instruction, beyond cognitive and affective development.

Today, the assumed language connected to the discourse of "learning" and "teaching and learning" is positioned as something interactional and functional that is given to the individual learner, a private good for a life-long evaluative journey of becoming a SMART learner (self-regulated, motivated, adaptable, responsible, and technologically competent; Lee, 2021). There is nothing in this view of "learning" that challenges the ongoing (trans) formation of social consciousness that is necessary for an understanding of education in relation to our human and non-human interdependencies in the world.

Our democratic responsibility involves constantly grappling with scientific and STEM literacies and at the same time stepping up as active ethical and politically engaged citizens to interpret and change the world in the

direction of justice and equality. This concern reflects a growing body of research in the science education literature (Alsop, 2019; Erduran, 2014; Hodson, 2003; Gunckel, 2024) that is deeply concerned with a consensus view of science education and a narrow focus on "teaching and learning."

It begs the crucial question as to what is the purpose of STEM education and democracy in the contemporary moment, especially if reduced to "STEM learning." We are arguing here that science education is concerned with multiple and even contradictory purposes, such as a journey of human becoming as a subject (in one's own right), becoming socialized into the existing social, cultural, economic, scientific, and political world, and at the same time making space for the "new" to emerge.

According to Biesta (2020) there are at least three purposes for education, which he summarizes as qualification (knowledge question), socialization (culture question), and subjectification (becoming a person in one's own right while also becoming a responsible member of society, state, planet etc.). This latter captures something of educating for freedom, emancipation, and responsibility.

We clearly want young people to be qualified for the world they are going into, to have the knowledge, skills, attitudes, and dispositions needed for the contemporary social and material world. We want them socialized into society and into their culture and heritage. We also want opportunities for subjectification, i.e., learning to become a person in their own right and to own a sense of shared responsibility with others for making a difference in the wider world, in the democratic direction of justice and equality.

If we are doing that as educators and researchers, at this moment in time, we clearly need to work with others, in our own countries—and across the globe—to rethink how we should be together as human beings in non-dominating (egalitarian) ways and what it might mean today to say that someone is truly educated, in a world that is increasingly complex, a highly scientific and technological world. What might it mean to be educated today in that complex and contradictory space? I will hand back to Sara.

SARA TOLBERT: And one of the things we've been talking about here, and also in New Zealand, as we're

working on refreshing the science curriculum for primary and secondary students, is the four purposes of education. That is how we have been framing it—the four purposes of education, which include the personal, the participatory, the pathway, and the planetary. The personal is your felt sense of wonder and joy, right? There is a lot of wonder and joy in science education, for example, learning about the natural world. The science pathway is what we often think about in terms of the STEM pipeline to degree programs and careers, but we're really thinking about a pathway, vs. pipeline, not just into science degree programs, though that could be one possibility. But how does science education for example, help cultivate multiple pathways that might be related to science and society, or just an interest in science that helps you pursue an interest in another subject area, for example, or another discipline, or thinking in between the disciplines as pathways into future careers or opportunities?

Participatory is really about how science education helps students be able to participate as members of multiple communities and collectives—including counterhegemonic communities (Tolbert & Bazzul, 2017). And then finally, planetary, how does a science education in Aotearoa New Zealand help prepare me to help sustain the planet? As Geraldine said before, science education has to help me think about how to protect the planet, because it is a really important consideration in this particular moment. It is interesting to think about the ways that we are revisiting these terms and notions in this particular moment in time in the Anthropocene. Now we will move into the next discourse that we wanted to talk about, which is "problem solving." And I am going to turn this one over to you, Geraldine.

Problem Solving

GERALDINE MOONEY SIMMIE: Yes, indeed, Sara. We noticed how in my country, in Ireland, and as you have noticed as well Sara, in New Zealand, that a new terminology of "problem solving" has entered into the lexicon of our national policy documents in STEM education and democracy. At this time it is tightly defined in ways that suggest we want students to become "mini-scientists" learning how to engage in inquiry, gathering evidence from reputable sources to justify and support their claims,

to work in teams, to examine some new and unforeseen problems and come up with viable solutions.

There are few who would disagree that learning the skills of being a mini-scientist and "problem solver" is a good thing. However, what we have noticed is that while the skills and language of "problem solving" is located in all policy texts/documents, there is normally no mention of any requirement for a problem-posing science education. This absence concerns us. Stating the problem-posing aspect explicitly is important, because it opens science education outwards as relational and collaborative and as a sociological project, a social good for the greater good. It acknowledges that we do not have the answers to everything. We want our students to own a healthy skepticism, and not just to say to them that we have it all worked out, that it can all be controlled and predicted, and all you need to do in the science classroom is to follow a formula of plan, engage, execute, evaluate, end of story.

Sara and I do not want science teaching becoming a narrow black box of tools and skills. We want students to be able to reason with evidence and at the same time to draw on other ways of knowing, the ethical, philosophical, sociological, indigenous, and other situated and reflexive ways of knowing. This staying with a more complex struggle is grasped in the SENCER ideals as taking into account the power and the limits of science and the multiple and contradictory purposes of science education.

We both place a high value on science knowledge, nature of science, and access to a quality STE(A)M education. While we want young people to learn to become "mini-scientists," that is but a part of a bigger picture in any journey of human becoming. UNESCO asserts that a fast globalizing world needs a new social contract for a new view of knowledge in contemporary times (International Commission on the Futures of Education, 2021). What is the place of ethics, moral and political philosophy in a highly scientific and technological world that is placing such a high priority on the evidentiary and the empirical?

The concept of a problem-posing education for emancipation was brought into the education discourse by critical pedagogy theorists, such as Paulo Freire and more recently by Henry Giroux, Sheila Macrine, Donald Macedo, Antonio D'Arder and Peter McLaren (Freire, 2018). Human emancipation for (trans)formative action was also introduced by radical feminist theorists, such as

bell hooks and others (hooks, 1994; Lynch & Crean, 2019). In recent times, Judith Butler, writing about the university, asserts the importance of this emancipatory view for education for the greater good of individuals, societies, and the future sustainability of the planet (Butler, 2017).

Our critique here shows that a policy demand for "problem solving" may become narrowly interpreted as students learning to think logically and laterally with others in order to fix problems by formulae. On the other hand, a problem-posing education acknowledges that some problems are bigger than the individual and that we need to work on a societal level in collaborative, reciprocal, and democratic ways that are upstream of the functional and instrumental, i.e., in ways that take the irreducibility of human dignity into account and the need for a pluralist view of a just democracy and a just global world.

For example, in working with crises such as climate change, there is something upstream of mere problem solving for "self." How will young people know they need to open these controversial conversations outward unless we teach them? For science education and democracy, we need not only to teach young people science but also to teach them about how science interacts as a sociological project in our cultural world in ways that require recognition of our interdependency with other humans, non-humans, the environment, and the planet. We are social beings living interdependent lives with others. The emphasis on a problem-posing aspect brings that into play. I will now invite Sara back in.

SARA TOLBERT: I think this one is really interesting for me, and particularly right now, in Aotearoa, we have been focusing a lot on the role of indigenous knowledge in science, for example. And so, for me, this really is a very deep and necessarily slow and thoughtful process of the different considerations, the ethical tensions in moving forward with this project, with integrity, making space for divergent perspectives, particularly those within Māori communities. I think I sometimes feel with students at the university level that this problem-posing space is very uncomfortable. I think there are unresolved tensions that we have to sit with in any problem-posing space.

Feminist scholars have written about this a lot, including the more recent work that has been done around matters of care, for example, by Maria Puig de la Bellacasa

(2017). She writes about matters of care, building from Latour's notion of matters of ethical concern. For Latour, matters of concern shift discussions from matters of fact, which Latour views as unhelpful framings for democratic debate; matters of concern necessitate interconnected attention to facts and values. Puig de la Bellacasa focuses more specifically on care relations as a cornerstone of ethics in matters of concern. Matters of care are more explicitly about an acknowledgement of our interdependent existences but also of the gendered relations of power that constitute those existences. She writes of matters of care as thinking about and attending more thoughtfully to "neglected things," as well as neglected human and more-than-human¹ actors, which are not always apparent, or dimensions/entanglements of a matter of concern that are not often seen or heard. There will be necessary troubles that come up and emerge because of our interdependent existences and different histories and positionalities and agencies, so we have to slow down and really take time to think and to consider and to truly engage with each other (and with more-than-human actors) around those tensions and challenges.

If we think about problem solving, there is no perfect solution. A lot of these socio-scientific issues or environmental challenges do not have perfect solutions, as you all know, because you have all been engaging in this work. They are really messy. And so we have to slow down and think about ethics in more complex and nuanced ways and help students become a little bit more comfortable with slowing down— and with understanding that there is no perfect solution. But in order to think about these big challenges we need to really take time to consider the multiple perspectives and multiple potential outcomes at hand. So with that, we will turn it back over to you, Geraldine.

Civic Engagement

GERALDINE MOONEY SIMMIE: Thanks, Sara. What is wonderful about this SENCER Summer Institute 2023 on STEM education and democracy is the sophisticated and nuanced ways you are looking at the

¹ More than human (versus non-human) is commonly used in fields such as feminist science studies and posthumanism. It is a subtle linguistic and ontological turn that rejects anthropocentrism and promotes an interconnected orientation to the world.

problem of civic engagement. We found it helpful to connect our examining of some phraseology of STEM learning to the SENCER ideals for a critical and philosophical scrutiny. We clearly need to find new ways to converse together in order to reorient this discourse, so that policies do not proceed with formulaic, dominating, and functionalist solutions. Functionalist solutions are prescriptive solutions that come from an atomistic view (sum of the parts) rather than a holistic view (more than the sum of the parts) of what it means to be human.

We now turn our interrogation to the assumed framing of the concept of civic engagement, mentioned in the SENCER ideals and in the actual title of this SENCER 2023 Summer Institute, and clearly connected to the wholesome project of STEM education and democracy.

I am deeply interested in researching the connectivity between STEM education and civic engagement for a view of democracy as a dynamically changing ethical, scientific, and political system that is concerned with public interest values, with the greater good of society, and with assuring equality and justice. The relations between STEM learning and civic engagement are complex, and we need to ensure that the framing of this social scientific problem as a contemporary policy and curriculum reform is not blocking the development of justice and equality.

I have worked with Professor Silvia Edling at the University of Gavle in Sweden for the last seven years, exploring the connectivity between teacher education and democracy and (science) teachers' democratic assignment to assure what has been referred to as "deep democracy" (Edling & Mooney Simmie, 2020; Mooney Simmie & Edling, 2019). Taking a holistic stance, deep democracy is dynamic and always in constant motion in a changing world and is always more than obedience to laws and regulations. We therefore need to interpret what it might mean for the (STEM) teacher in the classroom, and for our democratic societies, and what it might mean to be (science) educators in the world of today, what civic engagement might mean in theory, in policy, and in practice.

Therefore, we found that education and democracy go from one end of the spectrum, from a thin or electoral democracy—where peoples' passive participation in the political world involves voting—to a deep view of democracy—where people are actors, involved as activists assuring a dynamic view of democracy. This dynamic view

rests on the constantly changing needs of society for a just global world.

The crucial question as science/STEM educators and researcher(s) is how we might move civic engagement from an assumed thin view of democracy to a deep view of democracy. Time is not on our side, given the crises gripping the world in relation to socio-scientific issues. We cannot afford for science/STEM education to get this wrong. We do not want reproduction of the status quo. We need to move beyond the primacy of the economy (Pederson et al., 2024).

It makes sense to us that every nation seeks to socialize young people into the history, culture, language, myths and narratives, rules and regulations of the society in which they live. The notion of civil engagement for civic responsibility/obedience aligned with the rules and regulations of a peaceful society is an important aspect of every educational intervention or reform.

However, what is often missing from this discourse is how we might also leave space for something new to emerge, so that we are constantly working with others seeking new ways of "doing" the world. This idea of democracy goes back to the American philosopher in the 1930s, John Dewey. Dewey said that education was actually the midwife of democracy and needed renewal with every generation (Dewey, 2011). What Dewey meant is that the needs of society change. They change rapidly nowadays. We therefore need to have an understanding of democracy as an organic, dynamic entity that can change course with the changing needs of society and for the greater good of society. Democracy, in the first instance, is about reason over power. It is not about powerful interests or an elite running the world, it is about the power of reason in the direction of justice and equality (Fraser, 2009; Lynch & Crean, 2019). This public interest value underpins my research work with Edling, and is found in the theorizing of Iris Young and Jesper Sjöström (Young, 1996; Sjöström, 2018).

Young (1996) provides us with a word of caution as we move from a thin and passive view of democratic participation to a more nuanced and activist view of democratic participation. At a base level, Young argues that democracy can merely be about voting for an aggregate view of self-interest (a narrow majority rule disconnected from the central tenets of justice and equality). Moving

upstream of this base level, Young notes that Habermas and others advance a notion of deliberative democracy for the greater good. Deliberation involves a process of argumentation and is about winning the better argument based on the best evidence. However, taking this view, deliberation remains firmly in the hands of experts only, and often works to silence the voices of women and minorities. Instead, Young calls for a de-centered deliberation that foregrounds intersectionality and works to provide fruitful conversations for the greater good for all. So what kind of activist imaginary do we need nowadays in the science/STEM classroom for a new type of activist imaginary for civic engagement? I will leave you to ponder this question and hand back to Sara.

SARA TOLBERT: Thanks, Geraldine. I love your work on deep democracy and Iris Young's concept of decentered deliberation as well, because for me what it also represents is that, for example, if we bring everyone together as a public into conversation, let us say, as a town hall, often we have marginalized voices or underrepresented voices that do not get their fair share or fair say or are not heard in the same way as the majority. And so this idea of decentered deliberation is more about communities being able to have mechanisms for representing their interests and their voices, which then are brought forward to bear as part of this larger conversation in a sort of "multi-publics" approach. So there might be multiple spaces of deliberation. And then from those multiple spaces of deliberation, which are decentered, we can think collectively but from across those different communities to really deliberate over an issue of concern. Jesse Bazzul and I have also written about the role of dissensus (Tolbert & Bazzul, 2021), drawing from the work of Jacques Ranciere (1991)—and how science education should pay more attention to the struggles of marginalized communities, and how they, in their struggle for equality, reconfigure the social (and socio-ecological) world. By paying attention to these communities, we can move toward justice, in a way that protects the interests and agency of marginalized groups. Dissensus, versus consensus, is counterhegemonic. It goes beyond active participation or democratic citizenship. According to Ranciere, dissensus is critical to democracy, because it means that those who have been marginalized make themselves seen and heard to challenge hegemonic

practices and make way for new possibilities. For Ranciere, this kind of disruption is essential to democracy.

And I think it also resonates with the conversations we had last year, around thinking like a movement as we talked about where we go from here—after we have this amazing and powerful experience at SENCER, where we all come together and everyone is doing this phenomenal work. And we all feel inspired. Where do we go afterward? How do we continue on with the momentum? And so this idea of thinking like a movement develops: we are all going back to our own communities where we are active members and are really continuing to bring people in, to try to make those connections across these different multiple communities that we're a part of. We want to continue to build trust and solidarity, engaging in counterhegemonic work together, which is really what we need to effect real and lasting change, i.e., building solidarity across different groups.

Diversity and Inclusion

So we now move to the last of our "discourses," which is this notion of "diversity and inclusion." This has become a big one, especially at the university level. It has even become an acronym, the whole idea of DEI, or diversity, equity, and inclusion. And so we draw here from the work of Sarah Ahmed (2012), who talks about the danger of overusing the words diversity and inclusion as non-performatives, in her book *On Being Included: Racism and Diversity in Institutional Life* and in her more recent book (2021) *Complaint!* She talks about how a lot of times diversity initiatives are actually superficial commitments that become a way of not doing things with words. So she calls them non-performatives. Essentially, what that means is that we have a statement now instead of action and activism. So we know we are all about justice. And we know we are all about diversity, equity, and inclusion. And we have this committee over here, and we have that office over there. So therefore, we do not actually have to fundamentally transform our policies and practices, because we have our statements, and we have our offices. And so she encourages us not only to think about what are the transformative elements of these inclusion initiatives but also to think about what they allow us to hide, or how they operate as window dressing for deep structural inequalities.

We also have to question the idea of "inclusion"—what are we recruiting into? Are we recruiting women and people of color into a toxic environment in STEM departments, for example? We simultaneously have to think about the transformative potential of diversity work, and how it disrupts versus reproduces the status quo. Expanding participation in STEM Education is one aspect of this work. But if we are not at the same time thinking about restructuring those fields, so that they are more justice oriented and less toxic and hostile to women and people of color, then we are actually doing a disservice to our students who we are trying to recruit into those fields. And I think that is a real challenge. And one that I know that many of us have called out in our institutions. I think it is important to think about inclusion as social transformation, disruption of the status quo, and really question what we are "doing" with the words, because if we are only writing the words and putting words on websites, for example, in our diversity statements that actually, potentially, can be more harmful than good. I'm going to turn it back over to Geraldine and have her chat about this one.

GERALDINE MOONEY SIMMIE: It is productive for me, and I hope for all of you, opening this cross-national conversation with you, Sara. Seeking a more cutting-edge and inclusive STEM education for democracy and civic engagement with young people remains a challenging issue for everyone today, especially because we have a very long history of not humanizing the science disciplines.

The natural sciences rest on a canon of powerful knowledge depicted as cool, objective, neutral, counter-intuitive, and universal knowledge. This canon, and the scientists who work within the disciplines, have traditionally prided themselves on their detachment, objectivity, and neutrality (Muller & Young, 2019). Now this presentation of the purity of intention connected to science neglects what the SENCER ideals regard as the power and limits of science. History has an abundance of examples that cast doubt on this apolitical view and show how science is indeed political (Hoeg & Bencze, 2017).

Moreover, the bigger issue for us as science educators is to bring into play not only the "hard science" but in addition another complexity, how to "educate" and "teach" science to (young) people? While teaching young people to become mini-scientists is necessary (e.g., inquiry, evidence, justification, source), it will not be sufficient if seeking to

educate young people in science as a critical sociological and cultural problem. That is the great dilemma for the science educator. Besides, it is not a dilemma that needs to be solved, but rather one that must be lived with. Donna Haraway asserts that we need to "stay with the trouble" so that we can teach young people to care deeply for their environment and their fellow "kin" (other humans, other species), as custodians of the planet for a future of uncertainty (Haraway, 2018).

How might we humanize the disciplines of science and STEM in the classroom and laboratory in ways that foreground intersectionalities, such as gender, social class, race, disability? Maybe through storytelling, the philosophy and history of science, connecting science-in-context to the controversial socio-scientific issues of our times. How do we develop the social consciousness required for young people to appreciate at a deep level just how interconnected we are as a human species with one another, with non-humans, and with planet Earth as our collective dwelling home? This requires STEM education to include the arts and humanities as co-equal partners—ethics, philosophy, and politics—not just as a way of assuring creativity and critical thinking but also as a substantive way of interrupting the discourse. In this way, we strive to "stay with the trouble" and work proactively for a more just global world.

We have long gone from the day when science literacy is a privilege for just a few. The policy decision makers in Ireland are concerned more about STE(A)M education today rather than STEM education. We need the arts in STEM education as a co-equal partner, rather than as an add-on, so that we can stay with the tensions and living contradictions evoked by the clash between different forms of scientific knowledge, situated knowledge, and different ways of knowing. We want students wrestling with counter-intuitive knowledge, ethics, creativity, and critical thinking and the social consciousness that facilitates de-centred deliberation for political decision-making upstream of self-interest (Young, 1996). I will hand back to Sara now and look forward to opening our conversation with you all shortly.

SARA TOLBERT: Thank you, Geraldine. Your comments remind me of Myles Horton and Paulo Freire's (1990) book, *We Make the Road by Walking*. It is a really great book; in one part of it, they talk about the challenges of ensuring that students in science have the skills to be

politically conscious beings while at the same time gaining familiarity with those core scientific concepts. For me, it is really about deliberating carefully over the question, what are the core concepts that are essential in the Anthropocene? It is a really tricky question. And it is causing a lot of angst I think, here in our curriculum reform at the moment, because you know, people are really worried that if you remove something from the science curriculum, students are going to be vastly unprepared to understand the science behind the socio-scientific issues. It is an ongoing debate, but I think someone mentioned that some of these debates are not new, right? These are debates that we have been having since the 1960s, or as Eliza mentioned earlier, probably since the early 1900s. I think it is interesting, because I think more and more, there are all kinds of new transdisciplinary and interdisciplinary programs that I think are going to help push us, and push the boundaries of our thinking about how science matters for all students in public education, in ways that open up spaces for students who see themselves as really interested in science and wanting to pursue STEM-related career pathways. But at the same time we need to help students and educators understand science—and really, transdisciplinary science, alongside arts, and humanities, as tools for justice, for social change.

Summary of Key Insights

The following provides a summary of key insights gleaned from our cross-national conversation about four STEM discourses frequently mentioned in policy texts in Ireland and New Zealand. They become for us the starting point for future collaborative research and activism.

The concept of teaching and learning

- In Ireland and New Zealand, there is a big emphasis on "teaching and learning" in the STEM education policy and research literature.
- We show that the concept of learning connects to change and the development of the individual as a private good, rather than as an individual who has a responsibility for the greater good of society.
- The distinction between the individual nature of learning and the relational nature of education is made by Biesta (2020) and Sjöström (2018).

- Education has multiple and often contradictory purposes and therefore cannot be understood from the perspective of the primacy of the economy (Pederson et al., 2024).

The concept of problem solving

- The concept of problem-solving STEM education suggests that all young people need to learn are the skills of inquiry and justification while learning to become mini-scientists.
- This problem-solving framing of the task of the science/STEM educator presents a narrow and limited view of the purposes of STEM education and fails to acknowledge the necessary struggle between different types of knowledge and ways of knowing.
- By contrast, a problem-posing education—brought into the literature by critical pedagogy and feminist theorists, such as Freire (2018) and hooks (1994)—presents STEM education for emancipatory purposes and opens the possibility for (trans)formation.

The concept of civic engagement

- Here we examine relations between STEM education, democracy, and civic engagement, what it might mean to be educated to make good decisions in the complex scientific and technological world of today.
- We outlined the democratic responsibility of the STEM educator in relation to working with young people to induct them into the norms of society and at the very same time working with them to have affordances for something new to emerge.
- While democracy is deeper and more dynamic than simply electoral democracy, and can include argumentation and deliberative democracy, Young (1996) reminds us of the hidden danger inherent in using an elite approach to civic engagement and the importance of a de-centered deliberation that is inclusive of all voices.
- John Dewey, the 1930s American philosopher of education, reminded us that the education system is the midwife of democracy and that democracy is a dynamic system that needs reorienting by every new generation, connecting it to changing societal needs.

- The concept of de-centered deliberation can be used as a mechanism for communities to move forward in a way that protects the interests and agency of marginalized groups. This is a central tenet of democracy.

The concept of inclusion

- In STEM policies today we have a new emphasis on words such as inclusion, equality, and diversity. We need to scrutinize the framing of these concepts for STEM education and democracy. If framed within a commodified view of education for the primacy of the economy, it becomes unlikely that the greater good of society is considered.
- The idea of thinking like a social movement and continuing to build trust and solidarity is an important aspect of STEM learning and civic engagement. These are central public interest values for authentic inclusion in a pluralist democracy.
- Inclusion as a social transformation clearly requires the arts and a discursive ethics for interruption of the status quo and for humanizing what are traditionally known as the neutral and objective, moral and apolitical "hard sciences."
- Nancy Fraser's work on justice and on the importance of interrogating the "framing of problems" as the third wave of feminism, Donna Haraway's concept of "staying with the trouble," and Sara Ahmed's work on words/discourses as non-performatives offered valuable insights and helped advance our theorizing in relation to STEM learning and civic engagement.

About the Authors



Professor Geraldine Mooney Simmie is Professor of STEM Education and Director of [EPI•STEM](#) National Research Centre for STEM Education at the School of Education, University of Limerick (Ireland). Geraldine's [research interest is in emancipatory teachers' practices](#) (e.g. teaching, upskilling in content knowledge, professional development), scientific literacies for all, epistemic justice for girls and minorities in the STEAM classroom, policy enactment and the linkages between STEAM Education, Discursive Ethics and a constantly changing Democracy.

In Ireland, Geraldine is convenor of the [Educational Studies Association of Ireland's \(ESAI\) Critical & Feminist Research Policy Analysis Special Interest Group \(SIG\)](#). Geraldine is a member of the [American Educational Research Association's \(AERA\) Paulo Freire SIG](#). See link to her recent [EPI•STEM paper](#). In her role as Director of EPI•STEM, Geraldine recently interviewed Professor Luke O'Neill, a biochemistry professor [Trinity College Dublin] on his new book. They spoke about the importance of nourishing joy as well as building scepticism, creativity, collaboration and cool thinking when teaching young people science in the lower secondary school classroom: "Real Science" in School Science? With Prof Luke O'Neill, Prof Geraldine Mooney Simmie and Dr Regina Kelly ([epistem.ie](#))



Sara Tolbert is Associate Dean for Research and Professor of Science and Environmental Education in the Faculty of Education at University of Canterbury (UC), Aotearoa New Zealand, and SENCER Ambassador (2022-present).

Her areas of scholarship include participatory science and environmental education, critical feminisms and critical pedagogies, teacher/youth empowerment, transdisciplinary climate change education, grassroots education reform, and multilingual education. She is co-director of the UC Learning for Earth/Ako Futures (LEAF) research collaborative, and lead researcher in the UC Community and Urban Resilience Initiative. Some of her current projects are Postdigital Citizen Science, with Petar Jandric, Sarah Hayes, and Michael Jopling; [Pāngarau Unleashed: A multiple case study of de-streaming secondary mathematics](#), with David Pomeroy and Kay-Lee Jones, and [Reimagining Science Education in the Anthropocene](#) with Jesse Bazzul, Marc Higgins, and Maria Wallace. Sara is Section Editor (Critical Perspectives) for *Science Education* (Wiley), Associate Editor for *Journal of Environmental Studies and Sciences* (Springer), and Lead Editor for *Cultural Studies of Science Education*. She is co-founder of [Science Educators for Equity, Diversity, and Social Justice \(SEEDS\)](#), which just held their first F2F biennial conference this year (January 2024) since 2019.

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