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Learning to Teach about Climate Justice and Social Justice in Science Methods

Abstract

In November, the Editors of NWJTE sat down for a conversation with Dr. Mindy J. Chappell, a Science Teacher Educator in the College of Education at Portland State University. Dr. Chappell's passions include developing teachers who are prepared to disrupt normative science ideologies and provide young people with science instruction that encourages and empowers them to be leaders in their communities. She engages in arts-based educational science research through the methodology of Ethnodance (a term she coined). She places young people and their lived experiences at the heart of her work.

Keywords

Social justice science, arts-based, science, ethnodance

In November, the Editors of *NWJTE* sat down for a conversation with Mindy J. Chappell PhD, a Science Teacher Educator at Portland State University. Mindy's passions include developing teachers who are prepared to disrupt normative science ideologies and provide young people with science instruction that encourages and empowers them to be leaders in their communities. She engages in arts-based educational science research through the methodology of ethnodance (Chappell & Varelas, 2020). She places young people and their lived experiences at the heart of her work.

Editor: Thank you for being here today. In thinking about the upcoming special issue *Cascading Crises: Climate Change & K-12 Education*, I was really excited to talk with you because I know you do a lot of amazing work with teacher candidates and preparing teachers, and also with young people. Your work is also connected to issues of social justice. And we know that climate justice is part of that. Can you talk a little bit about how you came to your own awareness of, interest in, and passion for issues related to social justice and how climate fits into that?

Mindy: I would say that it kind of happened serendipitously. When the Flint water crisis made national news, I was teaching 10th graders a unit about the cycle of water in biology. They had this conversation about the safety of bottled water versus tap water. And so, as their science teacher, I wanted to use a topic they were naturally interested in to practice our school's powerful instructional practices (close reading, collaborative conversations, and argumentation/ debate). We read a scientific case study exploring tap water being regulated by municipalities versus bottled water being regulated by the FDA and tap water under the EPA regulations. The goal was to use their knowledge of the water cycle and scholarly sources to

construct an argument for class debate. That led to very robust conversations about legality, testing, whether bottled water was safer, and which one of those organizations had the more rigorous quality standpoints. And so, literally in the middle of that unit, the Flint water crisis made national news. It was very challenging as an educator to talk about water and then not figure out how to explore this real-life issue of environmental injustice and help young people understand it through the context and the lens of science. As an educator, that was my entry point into helping young people understand that science learning has to be more than just innovation. Science learning should be a space for young people to use their scientific literacy to advocate for their communities to understand the world that's happening around them, transform it, and help make it safer for them to live. Last year, one of my science teacher candidates developed a unit to explore heat islands in Portland as a social justice science issue. As temperatures continue to rise due to climate change, areas of Portland experience the hotter summer days differently. For example, those summer days will feel hotter in neighborhoods like the Albina District, where several trees were cleared to construct Interstate Five. So, when considering the scientific knowledge necessary for students to understand what's happening in this community related to climate change, we have to move beyond canonical science knowledge and standards about the electromagnetic spectrum and UV radiation. Students need space to grapple with the historical and socio-political decisions that lead to the disproportionate impact of climate change on Portland's Communities of Color. This will support their development as transformative agents who use their scientific knowledge and skills to advocate for the needs of their community.

Editor: That's so interesting. It kind of makes me think about some of the work you're doing in the Freedom Schools. Can you talk a little bit about what you do with the Scholars in that program?

Mindy: One thing that I value most about Freedom School is that it teaches young people the importance of social action, civic engagement, conflict resolution, advocating for your community, and making a difference in yourself, your family, your community, your country, in your world and doing that through hope, education, and action. During my time with Freedom Schools, I created space for young people to engage in inquiry-based learning, using science content and processes to explore real-life issues in their communities. And so, when I think about what I'm doing in Science Methods with my teacher candidates, I hope they're taking away that science learning for young people has to be more than innovating or maintaining America's place in a global market or technology development. It should also help young people develop their scientific literacy and use their science knowledge, regardless of what career they want to have, to advocate for themselves, their family, their community, and their country, and do that through hope, science education, action, civic engagement, and things like that.

Editor: Okay, I want to come back to your methods class in a moment. But can you talk about in what ways this work is personal to you because it sounds very personal when you start talking about it.

Mindy: This work is personal for me as a science educator and Black woman. I grew up in a predominantly Black town in southern Illinois, where, unbeknownst to us, we lived proximal to what used to be the Village of Monsanto, now Sauget, Illinois (see Canvas of Ruin Monsanto, Sauget, IL). The surrounding communities were exposed to released toxins like polychlorinated

biphenyls PCBs, and I had no knowledge. So fast forward years later, after being exposed to different toxins and things, there were health conditions and illnesses within our community. When I was in high school, I had always loved science. I had taken almost every science class our school offered, but nowhere in those experiences did I learn anything about environmental injustices, toxins, or contamination exposure to the air, water, or soil. And if someone were to ask me in high school, are these things important to you? I don't know what I would have said because I was unaware of them. However, if one of my teachers had exposed me to what was happening in our community around those topics and then helped me understand how I could use my science to advocate for my community, that would have been a vital component of my learning, and it would have helped me see the value of science beyond just development and research and being in a lab and things like that. So that's one of the reasons that it's very personal for me. So, when I say as a teacher why it's personal for me, I have to be able to look young people in the face and say that I love them and mean it. And I can't say that I love young people and look them in the face, and knowing that I had the capacity to help them understand some of these very harmful things that are happening around them in the name of science, industrialization, and politics, because we love to act like science is objective, and it's not. Science is very subjective, and science has done some harmful things intentionally. Sometimes it falls 'in the name of science' or 'It was an accident' or 'we didn't know.' But that's not true. And so, for me, as an educator, I cannot look young people in the face and say that I love and care about them, knowing that I have the capacity to help them use science to understand the world around them, transform the world, and also advocate for their communities. Because for some young people, specifically from when I was teaching at the high school setting, I was

predominantly teaching Black and Brown young people, and they were living in situations that were endemic in that area, and, so to say I love and care about them, but then not help them use their science knowledge and expertise to really understand things like issues of environmental contamination and heavy metal toxins in their soil, water, or air but say that they can be anything that they want to be felt fake. I felt like I just couldn't do that. So those are two main reasons that this work is personal for me. So, for me, science learning also has to be about liberation, and knowledge is a form of liberation that Black and Brown youth have been denied access to for many reasons.

Editor: And it's just like all the history of schools reinforces that. I'm thinking of some of the environmental things that have happened in the schools here in Portland, but of course, some of the most egregious are the schools that are located right on the freeways, and the air quality is poor. You can drive on I-5 and look up and see the playground of some schools in North Portland, which, of course, is where families of color are consolidated in our city. I hear you talking about love and braiding that together with social justice issues; I don't think you can remove it from issues of social justice, equity, and liberation. So how do you bring that to your students, and what do you really hope they walk away with and then bring into their own classrooms?

Mindy: When I think about a pedagogy of love in teaching, love does not mean taking on a "woe is me, pity you, poor baby, deficit, or savior disposition. Love does not mean you're in this negative or horrific situation, so I will have low expectations and pass you along. Love means having high expectations for students and creating culturally relevant and liberatory learning spaces where young people feel seen, heard, and valued. So, using textbooks like Science in the

City (Brown, 2019), I ground culturally relevant teaching practices into our methods class. In doing so, I hope candidates see the importance of valuing what students contribute to the classroom space and creating space for students to create models and visualize their thinking and just open up the access point into the science classroom for young people through multimodal teaching and learning. We model starting lessons with a 'critically engaged' component, which I learned from one of my mentors, Dr. Danny Morales-Doyle, from the University of Illinois, Chicago (UIC). This lesson style starts by foregrounding young peoples' knowledge. Oftentimes, we just talk about accessing their background knowledge in learning, but that fails to recognize that some information has been intentionally kept from young people, so they may not have background knowledge on it. For example, like my experience regarding contaminations, I didn't have background knowledge as a young person. So, in the critical engage model, teachers foreground student knowledge about a real-life social justice science issue. It is not indoctrination; it's bringing them information they may not have been aware of and allowing them to grapple with it and make sense of what's happening. The next component is raising questions they may not have considered and then using that to provide a compelling reason for exploring the subsequent science concepts. This model helps center science as a tool to make sense of real-life issues. As a high school science teacher, I engaged in Youth Participatory science projects with my students. To understand why heavy metals persist in the soil and how scientists detect metals in the soil, students had to understand solubility, metal reactivity, atomic structure, and things like that. And so, they needed to understand that so they could say why they persist in the soil and then make recommendations for remediation and community advocacy. It just gives a different reason for why they're learning the context

and the science information they are learning. In methods class, I use the Youth Participatory Science Framework (Morales-Doyle & Frausto, 2021) to help them see how they can explore social justice science issues situated within their local context with their own students. You brought up I-5, specifically the Albina area, where Black families were restricted due to restrictive housing practices. One of the candidates developed a unit around heat zones, specifically in Portland. In this predominantly Black community, trees were cleared to construct the highways, and as a result, this area experiences hotter summers. Another student designed an experiment for their biology students to test the moss on trees to see if there is more exposure to contaminants at different times throughout the year. So, helping the science methods candidates develop a unit to study this local environmental injustice in science methods class helps merge theory and application to explore real-life issues. I have learned that many people want to teach science from a social justice perspective but need an entry point. Science methods help cultivate space for teacher candidates to learn how to teach about local social justice science issues. This involves helping them understand that they don't have to have all of the answers as the teacher. Young people are brilliant, and when you use your platform as an educator to elevate their voice, knowledge, and experiences. My goodness, they will show you the phenomenal beings they are, cultivating a very learning experience with students.

Editor: One thing that comes into mind is that at times you end up with your candidates having such a different background in how they learned science. And so, it feels like as you are designing this, you're also helping them see a new way. I imagine they're critiquing how they've learned science at some point.

Mindy: Absolutely, that happens. And we have conversations about it. I tell them, honestly, if it wasn't for my love of science from a young age, I don't know if my experience in high school science would have pushed me to major in science in college. I was successful in high school science because I was really good at playing a game of being a student, you know. In biology, my teacher went on leave due to health concerns, and we had a rotation of subs throughout the year. In chemistry, we did worksheets daily. And even though we did some labs in physics, we mostly engaged in rote memorization and busting out math problems. By my senior year in advanced chemistry, I had been doing science for four years. And though this class was more lab-based, there was no connection to our real lives. But here I am, living in this community where I'm being exposed to all of these different toxins and learning nothing about it or learning nothing about the harms of science in my classes. So, I grew up loving something that used to harm my community. We talked about sickle cell, but we didn't really learn the geographical nature of sickle cell. I just grew up learning that Black people have sickle cell, like it was just something that was innate to me as a Black or African American person. I share my experiences with my science methods candidates. One of the first things we do is a LENS activity, where they reflect on their learning and experiences along their science journey. We reflect so that our students are not subjected to the same things we were in science. Even though technology and access to instructional materials have evolved significantly over 20 years, many students still learn the same way and things that their parents and grandparents learned, and we consider that okay because it's “the traditional mode” of learning science.

Editor: I’m thinking about the hidden curriculum and Anyon’s work (Anyon, 1981), and the different schools that students experience. But you mentioned your work with Youth

Participatory Research, which I know is also part of your practice. Can you say more about how that ties together with all the other things we have been talking about?

Mindy: The Youth Participatory Science Collective (Morales-Doyle et al., 2022) grew from teachers and educators who wanted to teach science from a social justice lens. We wanted to leverage the science curriculum to help students understand social justice issues in their community. We came together one summer to figure out what we can do. How can we do this in our classroom? More so as a support for each other and not to try to convince each other that teaching this way was important. We were already committed to doing so. Fast forward a year or so, and Danny got an NSF grant for the Youth Participatory Science Project. Community organizations, students, university scientists, university science educators, and science teachers rallied together. We worked to collectively develop a curriculum to facilitate YPS projects in science classrooms across about nine different schools. We were figuring out how to use curriculum and science classrooms to explore environmental contamination issues, specifically around having metal contamination in the soil, which eventually branched out to include air and water. We wanted to do it in a way where youth were participants in the process. Students were involved in the process, from designing experiments, collecting the data, deciding what to do with the data, how to disseminate the information, curriculum development, etc. The most beneficial part of being a part of the YPS Collective is having this network of people I can go to for support, ideas, and feedback. We developed this spiked soil lab because we wanted to be able to have students explore the full process of testing a soil sample to analyze it in the lab and analyze a result, but do it in a way that was less toxic to them than actually getting the soil sample or spiking something with lead nitrate. I remember doing some calculations, but it

wasn't coming out as expected. I called Danny, and we talked through them similarly when Tiffany and her students were doing the lab, we were able to talk through the lab and calibration of the spectrophotometers. We were a collective network of people committed to teaching from a social justice perspective and supporting each other through the process. I think that was the most beneficial part. And so that's why I try to bring the YPS framework into my science methods. We use the YPS framework, not in a prescriptive way, to develop social justice science issue-focused units specific to the context and students in front of them. So, as an avenue of support for teacher candidates who often did not learn science this way and do not see the practice being modeled at their placement, methods class is an avenue for them to develop a social justice science issue curriculum with support and build their own network.

Editor: That really has potential to transform the way science is taught. It's incredible. So, this is a total side note: Youth Participatory Science. Is that something your group created?

Mindy: Youth Participatory Science Framework was developed by scholars Daniel Morales Doyle and Alejandra Frausto (2021). When we met for the institute after the NSF award started, Danny shared how the Potawatomi people called Chicago the wild onion because the soil was rich for growing onions. But then, when it became contaminated, of course, that impacted the health of the soil and different vegetation. And so, we internally called ourselves the poison onion group in reference to the impact of industrialization on a once-rich food source. But we've shifted more to calling ourselves the Youth Participatory Science Collective externally, as this name reflects the scope of our work and the community we foster with each other.

Editor: Here's another sidebar: I know you love to dance and you use ethnodance methodology in your research. Can you just speak a little about that?

Mindy: I used to think for a while that my two selves were separate. I've been in love with dance for as long as I can remember, and I've always been fascinated and curious about elements of science and investigation and things like that. And for the most part, those were separate. It wasn't until my doctoral studies, where I was working with young people as a dance coach and teaching science, that I found a way to bring them together. I wanted to explore the authentic experiences of young people in science to identify the hidden structures creating barriers to access for students and shift their perspectives regarding their competence and belonging. Being their dance coach, while also having anecdotal informal conversations with them about their science experience, I wanted to use the artistic form of dance in order to explore their science identity construction and narrate in a way that honored who they were, in this case, as Black youth, but also who they were in terms of being dancers and acknowledging that from an arts-based educational approach to research. Art is not just a buttress to oral and written language. Artistic representations, such as dance, have their own modal ensemble of resources for making meaning. For people who use the artistic form of dance to express themselves, it can be more expressive than written or oral language for some dancers. So, in my research, I use ethnodance, an embodied representation of one’s narrative via a dance performance, to explore young people's science identity construction and narration in order to cultivate a liberating form of expression and a window into their experiences (Chappell & Varelas, 2020). I connect that to methods by helping candidates identify structures that can hinder or exclude students in science and help them build arts-based and multimodal methods into their instructional practice to support all learners. I encourage them to create opportunities for students to make sense of phenomena and science discourse by constructing

models, skits, songs, and other multimedia formats as a vital aspect of learning, not just this cute art project we do to display in the room.

Editor: I imagine you had students who were able to have an entry in and then have that expression who might not in a traditional setting.

Mindy: And some candidates even expressed how they could explain things better when they were drawing it out and mapping it out versus just talking about it or just using the definition and explanations. Through assignments, I was able to see some of the work they were doing with their students creating space for them to construct models as explanations instead of making models as replicas. Some teachers perceive meeting the NGSS science and engineering practices on constructing models as having their students create replicas of an atom or a plant cell, which is not the same as constructing a model as an explanation. In methods, teacher candidates developed lessons on modeling. One candidate had their students construct a model to explain what happens to the body during exercise and how the body maintains homeostasis. Another candidate had their students construct models to explain what happens to the body right before and after being struck by lightning. So, it was beneficial for them to practice constructing models as explanations in science methods and then take that and use it with their students.

Editor: I've come to the end of my questions, Mindy. Is there anything else you would like to add?

Mindy: I could end with, if you ask people, what's the purpose of education, you're going to get a varied answer depending on who you're talking to. When I think about the purpose of education, specifically science education, science education has to be more than about

innovation. It has to be a place where people can use their knowledge to help liberate them from notices of hopelessness and despair and historical and current environmental issues in their communities. In this way, science education helps students read, write, and transform their communities through a scientific lens while learning to appreciate and critique science.

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