Land Education and Young People Working Toward SALAMANDER Collective Well-Being in Response to Bioindicators of Socioenvironmental Justice

Rachael Arens (Northern Arizona University), Ricardo Martinez (Penn State University)

Abstract

Our planet is facing many environmental challenges, including climate change, loss of biodiversity and habitat, and pollution, while many of our populations are also experiencing marginalization due to poverty, race, gender, language, ability, and environmental injustices. Environmental hazards and policies often impact those in society who are most at-risk, creating a need for an environmental education (EE) movement that encourages students to challenge and regain control of a system that impacts them. Teachers can implement a reflection tool known as the SALAMANDER Collective Well-Being in Response to Bioindicators of Socioenvironmental Justice Framework to prompt students and other educators to place themselves on the framework after reflecting on their socioenvironmental well-being. The SALAMANDER Framework is grounded in land theory and youth participatory action research (YPAR) and has the potential to facilitate spaces for youth to empower themselves as they work to solve the environmental and political problems within their communities.

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Dr. Ricardo Martinez is an Assistant Professor of Mathematics Education in the Department of Curriculum and Instruction. He joined Pennsylvania State University College of Education in the Fall of 2022 from the University of Nebraska-Lincoln, where he was an assistant professor in the Teaching, Learning, and Teacher Education department. Before earning a doctorate in Mathematics Education and a Master of Education in Curriculum and Instructional Technology (both) from Iowa State University, Ricardo was a high school mathematics teacher in McFarland, California, and Colo, Iowa. Both in and outside of work, Dr. Martinez seeks to create mathematical learning experiences that return the legitimacy of mathematical knowledge creation to the people. His lifework is rooted in Critical Youth Studies and Spiritual Activism, where the goal is to create spaces for young people to liberate themselves both in the classroom and within the community through collective action. Acknowledgments: We want to acknowledge all the youth who make YPAR possible. Even though we rarely see them as co-authors, we must aim to honor their efforts in environmental work.
**Introduction**

We are currently facing a wide range of environmental problems that place the future of our planet in jeopardy. Meanwhile, for those marginalized due to poverty, race/ethnicity, religion, gender, ability, and other facets of their identity, the future is now, as they are already being forced to live with environmental injustices. Saylan and Blumstein (2011) have argued that not enough has been done within our past and current environmental education (EE) curriculum to ward off the impacts of climate change and environmental degradation, and educators need to use their collective power to change the world. Enter youth participatory action research (YPAR) EntreMundos (Torre & Ayala, 2009; Martinez, Lindfros-Navarro, & Adams Corral, 2021), a pedagogy, methodology, and critical epistemological/cosmological approach to research that incorporates youth as co-researchers and inquirers to solve complex problems using community-based knowledge and resources (Martinez, 2020). As a high school science teacher, I (Arens) thought when I came across YPAR, “This is my annual service-learning assignment but on steroids.” I then discussed with my advisor (Martinez) how YPAR could be used to ensure my service-learning projects centered youth opportunities where students could collectively empower themselves. Yet YPAR was still not enough, as it did not meet my needs or those of my students with respect to how we view the land and our roles as stewards of the natural world. Land education, discussed later, was central to my theorizing on and about socioenvironmental injustices. I then utilized YPAR, land education, and my own experience of eight years of engaging high school students in community service-learning projects to develop the SALAMANDER Collective Well-Being in Response to Bioindicators of Socioenvironmental Justice Framework, referred to as SALAMANDER or the SALAMANDER Framework, to make a critically relevant science pedagogy for all students to work toward a healthy planet free of environmental injustices.

In this paper, we explicitly center and value teacher knowledge and experience as valid forms of meaning making that are vital to educational research. Teacher knowledge should be respected within the implementation of educational curriculum; therefore, this paper is written through the lens of a teacher of other educators. SALAMANDER represents my history of experiencing Nebraska’s disappearing tiger salamanders, biology, and social justice and serves as an acronym for Students Assembled in Leadership And Making Action with Nature, Discovering Environmental Responsibility. The word *bioindicators* is used to represent how conditions within one’s social environment may shape health and well-being. In biology, this term is given to organisms whose presence or absence in an ecosystem provides indicators of that ecosystem's health. I experienced the extirpation of tiger salamanders in my Nebraska community due to agricultural runoff and habitat degradation. Salamanders and other amphibians are common environmental bioindicators because of their permeable skin and eggs, which are sensitive to environmental contaminants. SALAMANDER strives for students to work collectively with each other and with nature, each entity having equal power and influence on actionable decisions and environmental responsibility. For teachers, the SALAMANDER framework provides a way to reflect on their own teaching and allows students to learn about their own agency to create collective action for the betterment of our planet (Arens, 2022). The development of SALAMANDER is rooted theoretically in land education and YPAR EntreMundos and grounded in teacher knowledge.

**Land Education Theory**

Incorporating place-based education opportunities has long been an important part of culturally responsive teaching in science education (Gruenewald & Smith, 2014; Semken, 2005; Smith, 2013). Place-based education often centers teaching and students’ learning within their local context and integrates hands-on experiences with local, real-world projects that provide students the opportunities to engage as citizens in their communities (Rural School and Community Trust, 2005). In addition, place-based education can include multiple approaches that include “critical political perspectives in communities, entrepreneurialism, and environmentally centered approaches that take into account the biosphere of the local, culture, citizenship, and community (Smith & Sobel 2010; Sobel 2004)” (Calderon, 2014). For example, pedagogy of place incorporates both critical pedagogy and place-based education so educators can encourage students to find and create (rehabilitate) places that allow them to live well in their environments (rehabilitation) and deconstruct ideologies that harm others (Gruenewald, 2003). Educators can implement pedagogies that allow students to reconsider classrooms as the primary learning site and instead view sites as social constructions that can shape identity. Since place and identity can be influenced by neoliberal practices, educators need to implement pedagogies that “relate directly to student experience of the world, and that improves the quality of life for people and communities” (Gruenewald, 2003, p. 7). If socioenvironmental conditions are not addressed in the classroom, white, capitalistic hegemonic power statuses will continue to persist (Bellino & Adams, 2017). However, Calderon (2014) argued that place-based education fails to connect how learners’ localities in the United States have been connected to the removal and genocide of Native people, continuing settler colonialism. Furthermore, the Intergovernmental Panel on Climate Change (IPCC) recently released their Sixth Assessment Report meta-analysis of climate research with evidence that the historical and continuing impacts of colonialism and capitalism have “dispossessed Indigenous Peoples and disrupted culturally significant multi-species relationships” (Intergovernmental Panel on Climate Change, 2022, p. 213; Whyte, 2017, 2018, 2020; Wilson et al., 2019). Place-based education in practice tends to result in romanticized stories about places and what students can learn (and take from) the location of their “field trip.” Tuck and McKenzie (2015) thus offered critical place inquiry as “a set of concepts, practices, and theories which move beyond understandings of place as a neutral backdrop” (p. 635). Building on the significance of land,
its history and relationality to all of us, the metaphor of land as our first teacher (Styres, 2011), and land as pedagogy (Styres et al., 2013) are important aspects to land education.

Take any culture’s explanation of how the world came to be and you will find a story about the land. These land creation stories are proof that the land is our first teacher. According to Styres (2011):

*The idea of land as first teacher considers the interconnectedness and interdependency of relationships, cultural positioning and subjectivities that extend beyond the borderlands of traditional mainstream conceptualizations of pedagogy. Land as pedagogy opens up possibilities to consider how the learner is grounded, shaped and informed by pedagogies that reflect land as first teacher and how those practices can be (re)membered, (re)claimed, (re)constructed and (re)generated within diverse contexts.* (p. 722)

Thus, land as pedagogy moves away from neo-liberal product-driven learning experiences that only care about final answers. Instead of focusing on the objects created in education spaces, why not think about what can we learn from the complete experience? What can we learn from the land and with the land through the stories of the land (Simpson, 2014)? Calderon (2014) used the term *land education theory* to further the important ideas of land-based education to center Native ethics and counter settler colonialism within environmental education.

For students to truly understand sustainability and land care within environmental education, Calderon (2014) explained that education must center Indigenous people and their knowledge of climate resilience, such as practices of agriculture, fire-adapted management, combating desertification, community responses to environmental risks, collecting ecosystem change data over long periods of time, and communicating Indigenous language concepts and interconnections not understood by Western science alone (David-Chavez, 2022; David-Chavez & Ortiz, 2018; Intergovernmental Panel on Climate Change, 2022). Calderon (2014) also purported that education must confront the evolution of settler-colonial perspectives within environmental practices and policies. To do this, she stated that teachers need to explain that all places in the United States were once Indigenous lands and continue to be their lands despite their forced removal. She also stated that teachers must encourage students to assess how various colonial practices impacted their localities and subsequently shaped them. She stressed that to understand land, we must understand the white settler land ethic of *territoriality* that developed to violently steal land from Indigenous people and subsequently supports mindsets that harm environmental practices to this day. For example, Danzer et al. (2006) described the main differences between white settler land ethics and Indigenous land ethics as white settlers were largely driven by economic incentives:

*The culture of the white settlers differed in many ways from that of the Native Americans on the plains. Unlike Native Americans, who believed that land could not be owned, the settlers believed that owning land, making a mining claim, or starting a business would give them a stake in the country. They argued that Native Americans had forfeited their rights to the land because they hadn’t settled down to “improve” it. Concluding that the Plains were “unsettled,” migrants streamed westward along railroad and wagon trails to claim the land.* (p. 206)

In addition, Calderon (2014) claimed that white settler mindsets have framed settler colonialism as no longer an issue while writing our school textbooks. While the authors of these textbooks do not explicitly make judgments on the differences between Native and white settler ethics, they typically present the material in manners that ignore Indigenous beliefs and frame colonization and expansion as inevitable and necessary for settlers to make better and more efficient use of the land. Settler colonialism has and continues to work toward eliminating Native people and their culture (Johnston-Goodstar, 2020). The settlers believed they had a greater right to the land because their knowledge and skills allowed them to improve it through new efficient technologies that allowed them to develop more wealth than the Native Americans. Therefore, the story told is that settler expansion needed to happen in order for the new culturally and economically superior settlers to flourish (Danzer et al., 2006; Moran, 2002) and that the improvement of land is conducted through extractive and capitalist ethics.

A land education approach requires that students understand themselves fully within the context of place. For environmental science students to grasp their context of place, they need to understand the differences between Native land ethics and the neo-liberal land ethics that have shaped the United States’ environmental policies and practices. Tuck’s (2009) epistemological posture of the importance of sovereignty has highlighted the importance of context where “sovereignty encapsulates what I know about knowing, where knowing comes from and goes to, how knowledge stretches and rises” (p. 56). Without fully learning about the evolution of capitalism within the United States, its impact on the students’ lives, and the influence of omitting Native ethics in school curricula, students cannot understand the various perspectives of sustainability and care for the land. Therefore, land education is crucial for environmental teachers and students because it allows students to understand the construction of their identities and unlearn settler identities and grounds their understanding of how we connect to the land, its uses, its history, and its recovery (Calderon, 2014). Moreso, as stated by Korteweg and Russell (2012):

*Indigenous peoples and Indigenous education need Euro-settler allies who can work to provide expertise and service that will help Indigenous peoples with their Land-based struggles. Environmental educators are particularly adept and well-positioned to work towards Land-based education and can welcome inclusive Indigenous knowledge and create respectful spaces within environmental education to help non-Indigenous students acknowledge and respect the increasingly relevant, foundational, and critically important Indigenous knowledge of the traditional territories of Indigenous peoples on whose land they live.* (p. 7)

Furthermore, we teach land education to students to instill relationships with land that transcend environmental teachings.
from a textbook. In line with Styres et al. (2013), “We want to be clear that, in our work, we are not talking simply about a pedagogy of place or place-based education. [We] refer to the spiritual, emotional and intellectual aspects of Land. Land as sentient. Its existence now and since time immemorial” (p. 37).

**YPAR and Environmental Education**

There are current criticisms of environmental research that researchers and educators must consider. Saylan and Blumstein (2011) argued that not enough has been done within our past and current environmental education curriculum to ward off the impacts of climate change and environmental degradation. They stated that more needs to be done to encourage society to use their collective power to change the world and prevent power from being held by political institutions influenced by money, large businesses, and lobbyists. Furthermore, Gough (2013) asked the question, “How can we think globally without enacting some form of epistemological imperialism?” (p. 28). To break down imperialistic methods, he recommended that researchers engage in transcultural “spaces” to co-produce knowledge and decentralize their own ways of traditional thinking and acting to work with (and not onto) others.

To bridge these concerns, YPAR EntreMundos is needed within environmental education spaces. YPAR EntreMundos signifies a pedagogy, methodology, research method, and critical epistemological/cosmological praxis that incorporates youth as co-researchers and inquirers to solve complex problems using community-based knowledge and resources (Martinez, 2020). YPAR EntreMundos has five grounding ideas that seek to move away from product-driven youth engagement to focus on an intergenerational collective committed to improving local and national spaces (Berta-Avila et al., 2021; Yoon et al., 2021). In no particular order, the first relates to the Southern Tradition, which centers Latinx knowledge construction both in and outside of the United States related to the origins of participatory action research. When YPAR is solely connected to the history of action research, it is easy to focus only on products youth create while neglecting the experiences and relationships gained. The second key is a feminist critique to acknowledge that women, particularly Black and Indigenous women and women of color have played a significant role in education. The third idea, critical race praxis, focuses on turning critical race theory into practical actions. The fourth idea embraces Indigenous cosmologies as part of the YPAR process to focusing on the relational aspects of the YPAR experience. The fifth epistemological underpinning of YPAR EntreMundos is collective critical consciousness.

YPAR gains much of its liberating mission from Freire’s (2000) ideas around critical consciousness. Freire stated that members must undergo the process of critical consciousness where individuals gain awareness of societal issues formed through the intersection of history, politics, culture, and power imbalances and gain awareness of their own agency to transform their realities by dismantling oppressions. Critical consciousness develops through dialogue comprised of questioning, discussing, developing, and reflecting with others, and through dialogue, individuals gain knowledge, perspectives, and collective agency (Shor & Freire, 1987). YPAR EntreMundos challenges individualism by making critical consciousness a collective process and recognizes youth as central to holding the power, intellect, and capability to enact social justice and develop collective critical consciousness through cooperative inquiry and dialogue alongside community members and researchers to understand the systemic and educational contexts that oppress students.

Bellino and Adams (2017) have encouraged environmental educators to move away from the traditional models involving pedagogy rooted in nature studies and promoting behavioral changes within the individual to a collective or community-based effort. As a result, Bellino and Adams have argued that these “discourses [have] led to an EE that privileges specific and dominant political and personal agendas about how one should care for or relate to the environment while neglecting the needs, cultures, and values of diverse communities” (p. 271). These pedagogies fail to acknowledge community responsibility and reduce the overarching issues to problems that can be solved by individuals with simple fixes. Instead, YPAR EntreMundos can be lived by educators and youth to critically examine power structures and leverage local knowledge within their communities to transform their environmental, political, and educational spaces. YPAR EntreMundos can be a political ecology lens within these spaces to understand socioenvironmental problems and enact solutions, especially within urban settings where a dynamic interplay of diverse cultures and businesses co-exist with the natural environment.

**Conditions of Justice**

For many years, researchers have investigated theories that address student and school health. Ginwright (2016) mentioned that researchers have often attributed students’ success to individual traits like grit, self-restraint, and meaning, and social emotional learning (Berger et al., 2011; Feldman & Wentzel, 1990; Hochanadel & Finamore, 2015; Pizzolato et al., 2011). However, Ginwright (2016) suggested that this research fails to address the underlying systemic, economic, cultural, and political impacts that shape students’ lives and ultimately impact their socioemotional well-being. Ginwright argued that without addressing these underlying factors, we falsely assume that psychological states are the sole influences that shape student, school, and community health.

Instead, Ginwright (2016) developed a model on radical healing for teachers and activists to foster student health and success by creating a four-part continuum adapted from Prillwitzensky (2008) that measures students’ collective well-being in response to conditions of justice. The four facets of the continuum move from suffering, to surviving, to challenging, to thriving. Permanent conditions of injustice often place students in the suffering stage. Suffering students may experience a loss of hope and power and internalize the oppression inflicted upon them. Persistent injustices may result in students who are trying to survive their circumstances. These students often accept the status quo and consistently navigate and adjust to their circumstances and conditions. Promising conditions of justice allow students to
move to the challenging stage of the framework. These students begin developing critical consciousness to understand and reject the status quo of an oppressive system and rather use their collective power to take action against injustices. Lastly, optical conditions of justice allow students to finally thrive. When students are thriving, they experience full autonomy and control of their lives, they may pursue their dreams, and they collectively take responsibility for conditions of peace and power. I modified this continuum to include intersecting environmental conditions with social justice to understand how students may engage in stages of socioenvironmental justice throughout the YPAR process. The modified continuum can help teachers and students better understand their own agency as stewards and caretakers of the land.

Materials and Methods
My Experiences with YPAR and EE
I have an extensive background in environmental education and am an avid environmentalist. I grew up on a farm in the Midwest and attended a predominately white, conservative, rural, public school throughout my youth. After high school, I obtained a BA in biology and an MS in toxicology and furthered my research on the effects of pesticides on development as a first-generation college student who also navigated the challenges of being a woman in science. While conducting research on a controversial pesticide within my master’s program, I found that there seemed to be a missing link that exposed people to research and then empowered them to use that knowledge and their skills to invoke change in their communities. I went into education to fill in the gap of that missing link. After receiving my science teaching certificate, I began teaching in a diverse Title 1 school district in a large Midwestern city. As a teacher of advanced placement, dual enrollment, and regular environmental science classes, I noticed that many available labs and activities take an objective approach to the unsustainable and damaging conditions created through capitalistic and settler land philosophies. If the content and activities do promote change, the responsibility of change is placed on the individual behavioral level rather than on the collective. Teaching environmental education in this manner fails to acknowledge community responsibility and reduces overarching issues to problems that can be solved by individuals with simple fixes, which is rarely the case. Continually adopting an objective lens toward environmental problems without engaging in collective action perpetuates environmental injustices that marginalize communities and living entities. Environmental education should be grounded in land education theory, conditions of justice, and YPAR EntreMundos to foster student transformation and civic engagement.

Acknowledging that I come from a place of privilege, benefited from a hegemonic white background, and have a narrow perspective shaped by my experiences and education, I began to travel and take doctoral classes to gain a global perspective on environmental and social justice issues and then translate these experiences into my environmental science curriculum. As an environmental science teacher who now holds a doctoral degree in education (EdD), I teach my students scientific inquiry and civic practices to solve problems in their communities that lead to marginalization. Furthermore, my focus on teaching environmental science is to encourage students to develop skills for advocacy, such as honing argumentation and debate skills, properly critiquing research and news sources, communicating with peers, politicians, and scientific professionals, and developing and executing plans for environmental and civic action.

To teach students to become responsible and caring stewards and citizens of the land and their communities, educators need to implement pedagogies that “relate directly to student experience of the world, and that improves the quality of life for people and communities” (Gruenewald, 2003, p. 7) while also showing how their communities are connected to a global scale. I accomplished this style of teaching EE through service-learning pedagogies; however, I realized I needed to add critical discussions that encouraged students to investigate and understand the underlying causes if they wanted to implement change. YPAR EntreMundos gave me the methods and lens to engage students in EE work that is meaningful and transforms students’ hearts. However, lingering questions remained. How could I measure students’ transformation in a way that was both meaningful to me (the teacher) and to them? How could I gauge whether they were understanding the environmental ethics, the science, the social implications, and all the disciplinary subjects that intersect with environmental science? I decided to draw upon my unique history within environmental science to develop the SALAMANDER Collective Well-Being in Response to Bioindicators of Socioenvironmental Justice Framework.

To answer these questions, I conducted a study that investigated the intersecting issues of the civic opportunity gap for underserved youth and the environmental injustices that disproportionately impact marginalized populations. I asked, “How does a high school science teacher implement YPAR within a high school science class?” From this central question, three emerging sub-questions developed: (a) How does a teacher connect the SALAMANDER Collective Well-Being in Response to Bioindicators of Socioenvironmental Justice Framework to AP environmental science objectives; (b) How can YPAR enhance an AP environmental science curriculum for teachers; and (c) How does a teacher respond to the emergent needs of YPAR within her Environmental Science curriculum? Within the study, the students and I collectively conducted a YPAR project that investigated the tree canopy within the city and its connection to community health and climate. Many of the trees within our city had died due to increased drought and summer temperatures and the spread of the invasive emerald ash borer—all signs of climate change. Both my students and I live in an area of the city that experiences air pollution due to the presence of an operating coal plant located near our neighborhoods. Unfortunately, the asthma rate of Blacks/African Americans in this community is 20%, and there are three times as many deaths per million among Black Nebraskans than their White counterparts (Nebraska Asthma Coalition, 2020). Furthermore, according to the Asthma and Allergy Foundation of America’s Asthma Capitals Report, our city ranked in the top 10 most challenging places to live in the United States with asthma due to asthma prevalence, asthma-related emergency room visits,
and asthma-related deaths (Asthma and Allergy Foundation of America, 2019). Because of these issues, my students developed an action plan to work collectively with city officials to plant diverse trees on their school campus and communicate the significance of their project to members of their city. Students selected the project because trees improve air, water, and soil quality and lower urban heat island impacts. To ensure students learned a variety of perspectives to guide their project and understand the historical context of our land, I taught them about the history of the Homestead Act of 1862, the Indian Removal Act of 1830, and the Kansas-Nebraska Act (1854) and invited a member of the district’s Native Indigenous Centered Education program into my class to speak about his tribe’s close relationship with nature and their reverence for the earth and all its creatures and parts.

To identify the community environmental problem and work collaboratively toward addressing it, my students and I underwent a series of YPAR steps and lessons. The structure of YPAR can take different forms depending on the groups completing their projects and their needs. For this project, I used the steps outlined by Valenzuela (2016): (1) construct YPAR collective, (2) identify generative themes, (3) problematize generative themes, (4) generate research protocol, (5) collect data, (6) analyze data, (7) develop findings and create offerings, and (8) take action and dialogue with the community. The steps presented are often not linear and can instead be iterative or cyclic. For this research, I added “develop YPAR critical lens” as the new second step to introduce students to YPAR and foster critical perspectives. Developing a critical lens step can be done throughout multiple steps at any stage of the YPAR process (Martinez, 2020), but it is helpful to devote at least one day focused on developing a critical lens. Teachers may find the YPAR SALAMANDER methodology and structure helpful as they incorporate YPAR and land education into their classes and build a culture that fosters unity and sustainability.

Summary of YPAR SALAMANDER Methodology

1) Construct PAR Collective
   • Socratic Seminar Discussion
   • “Normal” Classroom Culture
   • The Environment and the Economy

2) Develop Critical Lens
   • Introduction to YPAR
   • Land Reflection
   • Ecological Footprint Activity
   • Land Ethics (with guest speaker)
   • SALAMANDER Reflection

3) Identify Generative Themes
   • “I Am” Poem
   • Identify Generative Themes with the SHOWeD Photography Process (Foster-Fishman, 2010)

4) Problematize Generative Themes
   • Problem Tree Activity

5) Generate Research Protocol
   • Hypothesis Development
   • Generate Research Protocol
   • Identifying Allies and Stakeholders

6) Collect Data
   • Collect Data (Internet Searching) Activity

7) Analyze Data
   • Integration: What Is the Data Saying?

8) Develop Findings and Create Offerings
   • Develop Findings and Create a Scientific Poster

9) Take Action and Dialogue with the Community
   • Public Speaking Practice Activity
   • Tree Planting and Video Creation

10) Throughout YPAR Process
   • Teacher Memos

Each step of this YPAR SALAMANDER methodology consisted of environmental lessons that aligned with our Next Generation Science Standards and AP environmental science learning goals while developing the skills the students needed to identify the environmental community problem and work toward a solution. Teachers can access the full lessons (Arens, 2022) if they wish to build them into their environmental science classrooms.

Within these stages, students engaged in lessons that fostered reflection about issues important to them, their connection to the land, how to identify problems and develop hypotheses, identify allies and stakeholders, plan out a project, etc. After identifying a topic, students learned from community partners about the tree canopy of our city, ecosystem benefits of trees, and native and invasive species and also learned from an Indigenous speaker who spoke about his tribe’s relationship with land. These conversations and embedded lessons deepened students’ understanding of Indigenous perspectives as well as their own perspectives of the land and trees in their community.

To gather data on how to incorporate YPAR into a classroom, I wrote detailed memos throughout the YPAR project and coded my memos using two layers of codes. The first layer was open coded with nine emerging themes (see Table 1).

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Collective</td>
<td>A classroom dynamic where students operate together to learn, brainstorm, and solve problems. Aiming for a positionality where teachers and students are of equal authority.</td>
</tr>
<tr>
<td>Culture</td>
<td>Related to customs and attitudes influenced by the demographic makeup of the class, school, and community.</td>
</tr>
<tr>
<td>Environmental Philosophy</td>
<td>The knowledge, ethics, attitude, reality, consciousness, and relationship with the environment.</td>
</tr>
<tr>
<td>Engagement</td>
<td>Students’ attention, joy, and senses invested into a lesson.</td>
</tr>
<tr>
<td>Teacher Hindsight</td>
<td>What I wish I would have done differently. Recommendations for teachers implementing environmental YPAR are also included.</td>
</tr>
<tr>
<td>Teacher Hope</td>
<td>Teacher’s feelings/thoughts toward the future that focuses on the outcomes of the project and students’ progress</td>
</tr>
</tbody>
</table>

Table 1. Brief Overview of First-Layer Codes and Descriptions
Throughout the year, students’ experiences and feedback on using the framework created new markers, so the development of the SALAMANDER Framework became an iterative process. Once finalized, the second layer codes based on the four stages (suffering, surviving, challenging, and thriving) within the SALAMANDER Framework were used. I also created a YPAR curriculum for teachers and curriculum developers that can be integrated into an AP Environmental Science or regular science classroom. While creating the curriculum, I worked with my doctorate advisor (Martinez) to ensure that land education was centered in my activities. We had multiple conversations about Indigenous cosmologies and countering U.S.-centric thinking and being before and during my project. What emerged from land-based environmental science YPAR is a process that can help schools, curriculum developers, and policymakers understand the ways educators can teach environmental science students to use their agency through the civic process to dismantle power imbalances that relate to environmental injustices.

**Results**

**Emerged SALAMANDER Framework**

Since achieving socioenvironmental justice still includes reaching critical consciousness and working toward dismantling oppressions, I kept all the facets of Ginwright’s (2016) Collective Well-Being in Response to Conditions of Justice Framework in place. However, I added new markers (see Figure 1) to display the intersection of social justice with environmental justice based on

![SALAMANDER Collective Well-Being in Response to Bioindicators of Socioenvironmental Justice Framework](image)

*Note. Adapted from Ginwright (2016) and Prilleltensky (2008).*
my knowledge of land education and experience as a teacher. I will discuss the new markers later in this section.

Figure 1 is not intended to remain unchanged, as it reflects my experience of engaging students while being new to land education. The individual bullet points represent my own knowledge and expertise as a teacher, and other teachers should feel encouraged to add to and edit the framework to meet their own context.

Within the suffering column of SALAMANDER, individuals experience permanent conditions of socioenvironmental injustice. It is important to acknowledge that students experiencing a suffering or surviving state is not necessarily bad; rather, it is an opportunity to understand where their environmental well-being is and to know that they have room to grow and heal. I introduced “local land is abused for profit and human benefits” to demonstrate how Westernized exploitation of land for economic gain (i.e., mining, pipelines, etc.) causes suffering in communities and within ecosystems for all living entities. In this state, sustainability for future generations and alternative perspectives of land are not considered. Rather, the focus is on profit and/or jobs even if the activity is detrimental. Because industries and economic gains are often the focus in the suffering stage, environmental contamination and degradation occur as a byproduct. To reflect these dangers, I added “exposure and bodily harm for individuals and other living entities from environmental contaminants/ degradation.” It is important to note that suffering does not only occur in the individual since humans are connected to the natural world. Therefore, if other living entities are suffering, individuals also suffer. For example, if the pollinators have experienced population decline in many rural communities, this decline also impacts human food security. I also added that the “individual participates in environmental degradation with purpose, apathy, or helplessness.” Apathy and helplessness reflect common attitudes individuals express when participating in destructive behaviors such as littering, burning gasoline, purchasing plastic, etc. These individuals may be uneducated on their impacts, they may not think their behaviors matter, or they may feel like they have no alternative options. Lastly, I added that students may be “resistant to collaboration” and that “others create policies and make decisions.” Therefore, individuals are always at the mercy of those who have voices in the decision-making and civic process, even if they do not reflect their values or have their best intentions in mind.

Within the next column, I added two new markers to indicate how individuals survive under persistent conditions of socioenvironmental injustice. In this category, “compromises are made for local land use” and “individual mitigation of environmental contamination/degradation” occur. The compromises do not ultimately fix the problem but rather mitigate its effects. For example, large-scale monoculture farming may cause dangerous and contaminated runoff into local streams. Rather than changing farming practices or implementing stricter regulations on chemical treatments, an individual farmer may build Riparian buffers (a man-made or naturally vegetated area located next to water that serves to protect the water from nearby land uses) to mitigate the effects of the runoff into the shared stream. Instead of responsibility being placed on the collective of communities, industries, and politicians, the responsibility is placed upon each individual’s behaviors to fix or mitigate problems that incur.

The challenging stage focuses on promising conditions of socioenvironmental justice within the collective rather than the individual. I edited Ginwright’s (2016) “rejection of status quo” to instead state “collective rejection of status quo, including Westernized environmental policies and practices.” In addition, I edited Ginwright’s (2016) “critical consciousness” to state “collective critical consciousness” (Cammarota, 2021). “Centering Indigenous land ethics” and “collective rejection of environmental contamination/degradation” must also occur to challenge the status quo and reject policies and practices that reflect capitalism exploitation of the land. It is important to achieve a culture shift of land ethics among the collective in this stage to lead to sustainable action. Without the collective understanding and centering of Indigenous ethics, Westernized environmental policies and practices will continue to be the hegemonic norm and negatively impact the environment.

Lastly, the thriving stage reflects the optimal conditions of socioenvironmental justice. This stage is represented by “collective power, including all living and nonliving entities sharing the land.” This inclusive collective power among both living and nonliving entities fully represents the interconnected and intricate balance of nature and the roles each entity plays. Therefore, by fully reaching a thriving state, “control of life for all living entities” is achieved and humans are no longer solely responsible for the fate of organismal populations or land use. Rather, all entities have an equal stake and voice in their connection to the land. Also, “sustainability is in place for future generations” so the land is fully balanced and shared with past, current, and future generations without compromise. To do this, a “clean environment free from contaminants/degradation” must be achieved so that “all living entities experience a healthy body free from environmental contaminants.” Again, because all living and nonliving are intricately connected to the land, humans cannot achieve healthy bodies free from environmental contaminants if the animals, plants, water, air, and soil are also not free from pollution.

A second layer of coding (Saldaña, 2021) using the SALAMANDER Collective Well-Being in Response to Bioindicators of Socioenvironmental Justice Framework as an analytic framework was conducted. Frequencies of first- and second-layer codes allow the visualization of how much time was spent in each stage of the SALAMANDER Framework throughout the experience in my class and how students may progress as they move through YPAR stages. The majority of the YPAR project in both semesters was spent in the challenging phase with environmental philosophy and building collective making up 33.5% of all codes. The following frequency percentages are represented in Figure 2.

The composition of the suffering stage was dominated by the emergence of four first-layer codes, with environmental philosophy and culture composing 56% of YPAR suffering followed by both teacher emotion and pandemic impacts, which collectively made up another 31% of suffering. Additionally, teacher hindsight, environmental philosophy, and building collective made up...
74.1% of surviving. Environmental philosophy and building collective composed 63.3% of challenging, and teacher emotion, building collective, and environmental philosophy made up 70% of the thriving stage. Figure 2 was beneficial to me as a teacher because I was able to see the importance of ensuring students had multiple opportunities to build a collective. My students grappled with the tensions of unlearning previous assumptions of the environment, learning new perspectives of land, and building their own environmental philosophies. This development required multiple conversations among peers and community members, so we had to be intentional about ensuring the classroom culture was a safe space for them to discuss and challenge ideas and to move from a surviving to a challenging state. Figure 2 can also be helpful for other teachers to reflect on how their students may engage with environmental justices and the areas they may need to develop additional materials for support within each stage of the SALAMANDER Framework as they implement their own projects.

**Discussion**

**YPAR Impacts**

Students responded positively to the YPAR project. On the day of the tree planting, the news media interviewed the students, and they spoke about the powerful benefits trees provide the community and how much they enjoyed the experience. They detailed how they appreciated that they were able to apply science skills and content in a way that benefited the community and allowed the students themselves to build public-speaking skills and confidence to move forward conducting further environmental work. After the tree planting event, students even took the initiative a step further and created a how-to video for the entire school district’s Curriculum and Instruction Department—reaching over 50,000 students—so other schools and students could learn from their efforts and continue to plant trees on their campuses. This video will continue to have a great impact on our community, as it can be watched repeatedly and inspire new projects for many generations of students. In addition, another school has already been inspired to plant a certified arboretum on their campus and is currently in the planning stages to implement this arboretum in the next year.

The YPAR project and SALAMANDER Framework gave students the tools to move forward and continuously reflect on their interconnection to the land and well-being. When interacting with their community, place, and environmental problems, students are encouraged to ask how they can learn from the complete experience of the land, its stories, and the Native peoples who were forcibly removed even though they were the first stewards of the land. Students are concurrently challenged to unlearn their destructive capitalistic views and uses of land, and instead move toward dismantling environmental problems and helping their community strive toward a state of harmony and well-being with the land.

The YPAR project not only impacted my students but also changed the way I teach environmental science. In former years, I chose students’ research projects and overstructured the protocols to ensure my comfort to answer students’ questions and to align with outcomes I thought were feasible. However, by choosing students’ projects, I unintentionally removed their autonomy and voice in discussing events important and relevant to them. I also only included Western perspectives in structuring environmental projects because that was the only perspective I knew and was exposed to for many years—both culturally and in the textbooks.

Land education and the SALAMANDER Framework further
impacted me as a teacher to make sustainable positive change in the environment. Students need structured opportunities to reflect on their own cultural beliefs and learn from Native peoples who live harmoniously with the land. Exposure to Indigenous perspectives may change the students’ frames of reference and allow them to reconsider new meanings on their view of land. Non-Western perspectives on land provide students (and teachers) a new view of themselves where “place is always in the making through our movements and relations . . . Non-movements are social constructs—humans, like all life, are mobile” (Bang, 2020, p. 441). When students know that they are alive, like the land, and constantly creating movements, they begin to acknowledge the power already inside of them.

Lastly, I now teach students to become lifelong advocates for positive environmental change and well-being. I do not strictly teach to a textbook and expect students to memorize definitions and calculations. Rather, I teach them science, engineering, and social skills that allow them to continue identifying root causes, developing protocols, creating collective change, reflecting, and communicating the importance of environmental well-being throughout the entirety of their lives. I teach them to work collaboratively to strive toward thriving states and reject suffering and survival states of the environment because by continuously challenging the Westernized capitalistic use of land, we (both living and nonliving entities of land) may experience a clean environment free from contaminant and sustainability in place for multiple generations.

**SALAMANDER Framework**

The SALAMANDER Collective Well-Being in Response to Bioindicators of Socioenvironmental Justice Framework represents a process rather than a destination. Students may find themselves in different parts of the spectrum when faced with varying situations, cultures, contexts, or timeframes. Therefore, it is meant to encourage those using it to strive toward a thriving state, while understanding that reaching “thriving” in one environmental realm (e.g., waste management) may not be thriving in other realms (e.g., water quality). Since environmental systems are intricately connected, a thriving state is very difficult to achieve. However, students are still encouraged to continuously work toward thriving to ensure sustainability and current and future health of all living and nonliving entities. Students should know that it is okay to not always be thriving and completely aware of all forms of environmental injustice because through the power in the collective, someone else may have the needed supplemental knowledge. SALAMANDER can furthermore help students see and learn about each other to gain collective critical consciousness.

I, from the teacher’s perspective, used the SALAMANDER Framework to help me understand students’ well-being in socio-environmental justice. After key activities, I asked students to perform a freewrite exercise with prompting questions to reflect upon where they lie on the scale (Figure 3). Also, I used student assignments and group dialogue to determine where individuals fell on the scale throughout the semester to support or challenge where the students believed they lay. The multitude of data illuminated whether students had progressed throughout the semester and achieved a transformation in their socioenvironmental beliefs. The data informed me whether my students were learning the environmental content and experiencing transformation due to their YPAR project. SALAMANDER is a powerful analytic and methodological framework for YPAR, but SALAMANDER is also a stand-alone way to better understand yourself, others, and the natural shared world.

**Figure 3. Example of Prompts When Using SALAMANDER with Teachers or Students**

**Concluding Thoughts on SALAMANDER: Hopes for Teachers and Students**

We return to teaching and learning in that “land informs pedagogy through storied relationships that are etched into the essence of every rock, tree, seed, animal, pathway and waterway in relation to the Aboriginal people who have existed on the land since time immemorial” (Styres, 2011, p. 72). Place-based engagements in science education must acknowledge the history of land—from how it is stolen to how it is currently being exploited—and what the land has taught and will continue to teach us. The SALAMANDER Framework (see Figure 1) can be used by both students and teachers to gauge their knowledge of environmental well-being and personal transformation by returning to and reflecting on land education. For non-Native teachers, SALAMANDER is a first step toward transforming how they view their class and challenging individualism through a commitment to environmental justice. For Native teachers, I encourage utilizing SALAMANDER by
transforming it with their own cosmological views on nature and stories of overcoming suffering and surviving to further emphasize challenging and thriving. The framework allows any teacher to see how their content is being understood as well as how they are reaching the hearts of their students.

As discussed earlier, land education and YPAR can provide an experience that moves students toward a state of challenging socioenvironmental injustices by using science and engineering practices to solve relevant environmental problems that impact their local communities. Both students and teachers benefit because YPAR can enhance critical thinking and inquiry skills and may enhance academic achievement and school engagement (Cabrera et al., 2014; Cammarota & Romero, 2006; Romero et al., 2009). For instance, Cabrera et al. (2014) reported that the engagement of youth using YPAR in a Mexican American studies class was a significant predictor of high school graduation rates and passing mandated state standardized tests. Students also learn to work collectively with other students and community stakeholders, and they learn how to reflect upon their own environmental ethics while considering alternative views of others. YPAR and land education in environmental science classes seek to bring the benefits of YPAR and the enlightenment of land education together. By continuously striving for an environment that is free from degradation and contamination, current and future students, humans, and living entities can experience health and exist symbiotically together in the interconnected systems of earth.

Teachers are also encouraged to reflect and place themselves on the framework. The continuum challenges all of us to continuously strive for better conditions and to ensure our science teaching practices prepare our youth to actively engage in their civic spaces. The framework encourages us to ask ourselves, “Am I teaching toward suffering, surviving, challenging, or thriving conditions? Am I ensuring my pedagogy meets my students where they are, honors the knowledge and culture they bring into my classroom, exposes them to alternative views through dialogue, and encourages them to translate skills learned in the classroom into their community and future experiences?” I hope educators find the SALAMANDER Collective Well-Being in Response to Bioindicators of Socioenvironmental Justice Framework useful as they work toward teaching students to become current and future environmental leaders of our planet. As stated earlier, environmental allies are needed (Korteweg & Russell, 2012), and teachers are important knowledge creators and facilitators for young people to transform the world. Teachers should incorporate land education to ensure that they are true allies whose action works to dismantle capitalism and a legacy of colonization that still exploits the land. YPAR is important as it provides young people an opportunity to know if they are experiencing suffering, surviving, or challenging conditions of socioenvironmental injustice. The goal of our work is to strive for collective moments where we and the land are thriving together. The SALAMANDER Framework provides people with steps to learn how they can be or continue to be stewards of the land.

References


