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RESEARCH ARTICLE

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# There is no room for me for a Hawaiian in science": Rightful presence in community science

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**Abstract**

This paper shares the experiences, engagement, and struggle of one young Indigenous Hawaiian woman as she grapples with her sense of disconnect with STEM while serving as a land protector on the Mauna Kea, the home of the Thirty Meter Telescope being built over the objection of the local Indigenous community. I examine her changing perspectives and connections to STEM through her engagement during a summer school enrichment class focused on science and technology learning in service of community goals. Findings indicate that her sense of agency and autonomy were greatly improved by engaging in a space where science and technology were tools serving her goals of protecting the Mauna Kea from further development.

**KEYWORDS**

community science, culturally relevant teaching, indigenous, making, rightful presence

## 1 | INTRODUCTION

On the Big Island of Hawaii, significant conflict exists between Indigenous Hawaiians and scientists. The recent decision to build a new Thirty Meter Telescope (TMT) on the summit of Mauna Kea, the island's tallest point, has drawn great protest and consternation from the

Indigenous community. Mauna Kea is the tallest volcanic mountain on Earth, rising a mile higher than Everest when measured from its base on the ocean floor. While half of its height is below sea level, the mountain holds great interest for the scientific community, as its height makes it a prime location for telescopes and astronomy research. Two large science corporations populate the surrounding towns with scientists from North America and Europe who are keen to study space from Mauna Kea. However, it is not only to western scientists that Mauna Kea holds importance. While Mauna Kea is a key scientific resource for the island of Hawaii, it is also one of the most sacred places on the Big Island for its Indigenous population. Mauna Kea, or simply *the Mauna* (the mountain) is home to the origin story of the Indigenous Hawaiian people where Papahanaumoku (Mother Earth) merged with Wakea (father Sky). It is considered the first born of their union, the *kupuna of Papa and Wakea* and is the site of many Pu'us—sacred Hawaiian burial grounds. While the observatory brings revenue and scientific discovery to the Big Island, those endeavors reflect a casual disregard for Indigenous culture and religion that sanctify the land itself (Maly & Maly, 2021).

Many Indigenous Hawaiian[1] youth find themselves situated between these two worlds. On the one hand, Hawaii is home to beautiful holy places that center their culture, community, and history across generations. On the other hand, they are modern young people, consuming education shaped by standards and curricular materials developed for and by the U.S. mainland and using technology for their own purposes during their free time. For many, these dual identities, situated within the context of community conflict with science, create a complex—often warring—relationship with STEM (science, technology, engineering, and mathematics). Further complicating community dynamics, there exists a rising tension between both native and Indigenous Hawaiians and the tourists who visit the islands with little knowledge of or care for the customs, behaviors, and expectations of how to engage Hawaii's sacred spaces (Matsuoka & Kelly, 1988; Stevens, 2018).

Although most examinations of community science focus on the activities of groups, this approach misses both individuals and communities who absent themselves from participation—especially those who see the interests of science as directly opposed to the interests of their communities. As a result, understanding who absents themselves from community science opportunities and why they do so is a critical and understudied component of research for expanding community science as a tool of learning and empowerment. To this end, the current study explores one young Indigenous Hawaiian woman's experiences and shifting agency as she participated in a science and technology summer school class. As a distillation of challenges facing Indigenous engagement in community science, I describe how she grappled with a sense of disconnection from STEM based on her community's experiences with scientists. These experiences included her own as a land protector and protester on the Mauna Kea as part of community action against efforts by scientists to expand their own resources on the island without regard for community or culture. However, as she experienced a curriculum intentionally designed to foster Indigenous youths' *rightful presence* (Calabrese Barton & Tan, 2019), she began to engage science to leverage and center her existing community wisdom and values.

Within community science endeavors, it is a common assumption that the groups involved are expanding their understanding of science as a legitimate activity in which they can participate and gain firsthand experience that may prove valuable for future education or employment opportunities. However, the current study highlights the ways in which the decoupling of community needs and values from science undermines community members' willingness to engage or find value within STEM. It unpacks the challenges that play out within individuals whose culture and purpose are not commonly represented in scientific endeavors. Through the

examination of this individual case, it is possible to gain insight into why specific communities may not only avoid engagement with science but may consider conventional community science efforts to be antagonistic towards their values. The study further highlights the ways in which STEM can meaningfully engage those values and needs to foster a sense of compatibility and even enthusiasm for community-driven science endeavors.

To facilitate this evolution, in partnership with local Hawaiian educators, I designed a class to center culturally responsive curriculum and making as tools intended to support the rightful presence of Indigenous Hawaiian youth within science classrooms. Calabrese Barton and Tan (2019) define rightful presence as "legitimate membership in a classroom community because of who one is (not who one should be), in which the practices of that community work toward and support restructuring power dynamics toward more just ends through making injustice and social change visible" (p. 618). It is not merely the tolerance of non-dominant identities that is the goal of rightful presence; rightfulness of presence requires youth to fully occupy the disciplinary space within their classroom in such a way that they are able to restructure, reimagine, and redesign their learning experience to be compatible with the full complexity of their own identity as situated within their community.

With science as the vehicle, youth in the class engaged in designing and making three projects that are anchored in their lived experiences of their island and their constructed meanings shaped by the experiences of their community. In this regard, they were exposed—many for the first time—to experiences in which science could be engaged without dissociation from their own identities and community interests. First, youth shared aspects of their own identities and personal passions regarding specific social issues. Then they designed computational circuits on 3D printed maps to explore and learn about the volcanoes of the island and their geologic histories. Last, they developed and coded apps to provide information on sacred Indigenous Hawaiian sites around the island with the express purpose of educating island visitors of appropriate behaviors at these sites. As these projects progressed in focus from individual to geographic to cultural, they also shifted from descriptive activities to advocacy activities using science and computing knowledge as tools. Use of these tools in a manner that works with and on behalf of the community inherently exposes students to the core mechanisms of community science in a way that evidently centers community within the science (Ballard et al., 2017).

Leilani, the focus of this case study, navigated her roles as STEM student and a passionate land protector of the Mauna Kea in this context. She was selected as the case for this inquiry because of her articulated wariness about science and scientists. This articulation was echoed by other Indigenous youth in the class. However, Leilani was specifically selected because of her distillation of the underlying tensions between her community and the scientific community. Her perspective was that these tensions effectively precluded meaningful engagement in community science endeavors. Through examination of her experiences and sensemaking, I explore two core questions:

1. As students experience science learning opportunities that are not isolated from their communities and identities, can they experience a greater sense of rightful presence that empowers them to shape science concepts and engagement to meet their own goals and address the concerns of their community?
2. Can rightful presence within students' school science experiences serve as a bridge to position community science as a meaningful tool to support familial and community priorities historically or politically isolated from the scientific community?

For community science to be fully focused on communities, it must be engaged through a lens of rightful presence, ensuring centering of community values, perspectives, needs, and agency. Within this paper, I focus on Leilani's interconnected sense of community including her Indigenous community, her island community, and her school community. By understanding the ways in which rightful presence can more fully center her community, designers of educational experiences may gain insights which help operationalize the scaffolds and supports needed to fully engage youth in community-driven science.

## 2 | THEORETICAL FRAMEWORK

Community-driven science can take many forms. Within the broader science education literature, community and citizen science primarily focus on youth engagement with scientists to address community-based issues (Ballard et al., 2017). This approach to science typically entails participant youth collecting data and possibly engaging other aspects of research, such as hypothesizing, analyzing, interpreting, or disseminating findings (Bonney et al., 2014; Shirk et al., 2012). It is possible for these endeavors to afford communities a unique opportunity to re-center science work around their needs, rather than the priorities of professional scientists from outside the community. However, many community science endeavors are predicated upon the assumptions and values of academic science, which can position communities as entities to be acted upon or through, rather than engaged as empowered partners with their own priorities that can steer activity. Thus, community science efforts at times focus on issues, present content, and utilize framing brought to the community by outsiders whose understandings of the social, cultural, and political contexts that motivate and shape the experiences of those communities are quite limited. While not taken by all, this approach can suppress the community element within community science. In contrast, when individuals and communities engage from a position of empowerment, they exercise power within the activity through application of personally and locally meaningful worldviews and values that shape the goals, methods, and impacts of the scientific work. In this sense, power includes both the ability to influence the ways in which community science is implemented and the right to do so explicitly as partners whose voices carry valued and acknowledged authority. To examine this tension, the current study is framed jointly by a critical perspective on the values, discourses, and assumptions often brought to community-based science by members of the scientific community and a perspective on youth empowerment in science through the acknowledgment of their *rightful presence* (Calabrese Barton & Tan, 2019, 2020).

### 2.1 | Situating community science

Disenfranchisement from STEM for members of minoritized groups is a robust and longstanding concern. As noted by Carlone and Johnson (2007, p. 1207), "'the institutional and historical meanings of being a scientist actually means 'being a white male .'" From a young age, children are often acutely aware of whether or not STEM careers are for people *like them* across lines of gender, race, and socioeconomic status (Archer et al., 2013; Archer et al., 2015; Godec et al., 2021; Morales-Doyle & Gutstein, 2019). To facilitate access and inclusion within science, new ways of deconstructing what constitutes science and who does science are needed.

One of the historic challenges of community science is its implementation within educational settings in ways that presume the proper preeminence of perspectives customary to canonical science and scientists. Curricula and lessons built for community science endeavors are often fully developed prior to engagement with the local community—especially its youth. While these materials may well offer productive and valuable learning experiences in relation to standardized science content, they run the risk of positioning scientific participation as isolated from—rather than integral to—participants' existing affinities with community and individual identities. In doing so, such approaches sustain the colonial traditions of social sciences and educational research rooted in the early mission of anthropology to understand societies at the margins of governmental state structures with the intention of exerting increased control or fostering assimilation (Patterson, 2020). For example, prior work with the community participating in the current study has demonstrated that traditional science instruction in schools positions science as an ostensibly value-neutral content area, intentionally voided of cultural connection in service to an illusory sense of objective truth (Tofel-Grehl, 2017).

This approach silences the historically fraught relationship between science (and scientists) and the Indigenous Hawaiian community that is built on community disempowerment in deference to the demands of science (i.e., the destruction of holy sites on Mauna Kea for the purpose of constructing powerful telescopes). Such framing leads Indigenous Hawaiian youth to disengage from science learning, mentally dividing themselves into discrete identity categories of *Hawaiian youth* and *students in a science class* wherein one has no meaningful connection to the other (Tofel-Grehl, 2017).

In contrast, when community science deliberately engages both identities and values historically excluded or marginalized by science, it can become a focal source of local science engagement that helps participants to experience a sense of rightful presence within the scientific enterprise. In other words, rather than dividing themselves into Indigenous Hawaiian youth who on coincidentally participate in science content learning, students experiencing rightful presence in school encounter an education that centers around issues and questions of great importance to them within, rather than divorced from, their home communities (Mattheis et al., 2020). To that end, the current work emphasizes co-design between the researcher and collaborating teacher in service to the goals and needs of the communities they represent in accordance with the principles of rightful presence (Calabrese Barton & Tan, 2019, 2020). In addition, this study focuses on community science as immediately relevant for participants, rather than a vehicle for bolstering future STEM opportunities for participants. While the temporal focus of the current work has significant implications for the essential value of community science for Indigenous Hawaiians, that significance stems from the interwoven nature of community science and rightful presence.

## 2.2 | Rightful presence

Rightful presence calls for a deconstruction of the power structures that are fundamental to schools. First, the very notion of a choice to extend rights to all parties inherently requires a brokering of power wherein those with power choose to permit rights for those without it (Calabrese Barton & Tan, 2020). This structure implies that the rights of some are contingent upon the benevolence of others—something that inherently undercuts rightful presence. Rights cannot be given; they either exist or do not exist. If rights are given, they can be removed by the giver at any point, preventing them from being rights in a true sense.

Power structures around rights and authority play out in classrooms in myriad ways. The discourse in middle and high school classrooms frequently embodies this power differential. Students and teachers do not typically refer to *the classroom* or *the eighth-grade science room*. Instead, people most often refer to *Mrs. Jones' room*. Students' engagement and ownership in the space is transactional as they move from classroom to classroom. As they move from one teacher's space to the next, they do not typically leave behind evidence of their own presence or efforts in the space. This is particularly poignant for students of color who rarely experience a teacher of their own race (Bitterman et al., 2013; NCES, 2014). They spend their days moving through spaces functionally and discursively owned by white people whose culturally and historically afforded rights differ from their own. This subtle but unmistakable disempowerment reminds Indigenous students that their classes, communities, and spaces are not their own.

Second, rightful presence requires the acknowledgement that science cannot be divorced from the political (Calabrese Barton & Tan, 2019). Rather than conceptualizing science for science's sake, rightfully present spaces recognize and make visible the political struggle of minoritized individuals that is central to the history and structure science. Calabrese Barton and Tan offer the example of the problematically decontextualized examination of water and the water cycle without discussing the role of power in community access to clean water. To present the water cycle without historic and political consideration of how water access is brokered within the system implies a divorce between the scientific and the social or political. It further implies a neutrality of science that has never existed (Calabrese Barton & Tan, 2020).

Historically, science has claimed an independence from community and political considerations. However, doing so belies a fundamental tenet of epistemologies of place (Nazar et al., 2019), in which communities' knowledge and practices can bring meaning to learning experiences in a way that connects formal learning opportunities to ways of understanding the world grounded in a continuity of people and locations integral to culture and identity (Bang & Medin, 2010; Natarajan, 2017). Thus, the notion of disciplinary purity or neutrality that devalues connection to context would require students to divorce their Indigenous selves and experiences from those within the classroom (Bang et al., 2018). Instead, the current study embraces the realities, complexities, and injustices science propagates on Hawaii and seeks to bring them into the classroom, making them a central focus of our collaboration with students.

Third, rightful presence in the classroom requires the active deconstruction and disruption of normative power processes that marginalize students (Calabrese Barton & Tan, 2020). This disruption of systematized and structural oppressions creates visibility, and it re-centers the weight of disruption from those directly impacted to the larger classroom community. Within classrooms, we see access and power structures intended to provide order enacted by teachers without reflection or thought. Typically, power is brokered through vehicles such as teacher-scheduled breaks, hall passes, discursive turn taking, and requiring permission to use the restroom. Within a rightfully present classroom, we expect such power structures to be critically examined and discussed as a community. By discussing and making visible the standard accepted power structures, inequities and oppressions can be articulated wherever they are felt. This process of making structures visible disrupts inequities by both shining light onto them and critically calling into question both their intent and purpose. It is this focus on a communal rejection of the forbearance of injustice that can re-center science towards community building and action.

### 2.2.1 | Culturally responsive community science to support rightful presence

By imagining spaces, curricula, and teaching experiences that anchor the notion of children as fully formed people with rich experiences and perspectives, rightful presence centers learning on the communities that fill classrooms. For authentic community science, students—as members of those communities—must experience rightful presence in which they hold the power to author their own identities as members of multiple possible overlapping communities and determine for themselves the issues within science that are important to them. Community-driven science becomes culturally responsive, because the learning opportunities are constructed with and shaped by issues and perspectives that youth participants bring forward as individuals and as members of their communities. In this way, it recognizes "the legitimacy and viability of ethnic-group cultures" (Gay, 2018, p. 32) as a vehicle for empowerment and emancipation within the scientific context.

Through this process, community-driven science can broaden notions of what science *is* and who "does" science. This openness creates a compelling context in which communities can engage science knowledge and processes for their own needs, goals, and desires. In doing so, communities become able to acknowledge and make visible the history of science (including the actions of scientists themselves) within that community and take an agentic role in science as an aspect of their community's future, becoming rightfully present and meaningfully engaged in the "doing" of science.

### 2.2.2 | Making as a tool to facilitate rightful presence in science learning

As a mode of "doing" science, Making, specifically inclusive making, offers a context that can support the development of *rightful presence* (Calabrese Barton & Tan, 2020; Peppler et al., 2016; Tan & Barton, 2017). The tools, materials and processes of making can disrupt stereotypes around who can and does engage in STEM by affording youth the opportunity to engage in projects and activities of their own design (Fields & King, 2014; Kafai et al., 2014).

Making can involve use of low-tech materials not typically associated with STEM, such as recyclable or craft materials, with higher tech materials such as actuators and microprocessors. This duality of materials can support a novel entry point for youth into STEM, as often young people already see themselves as capable in using crafting supplies (Kafai et al., 2014). This is especially true for individuals who already craft or have family members who craft (Searle & Kafai, 2015). Many making activities, such as electronic textiles (e-textiles), integrate handcrafts and cultural funds of knowledge not often engaged in school classrooms (Gonzalez et al., 2006). This has shown some promise in bringing historically marginalized or excluded communities into STEM (Kafai et al., 2014; Searle & Kafai, 2015). By engaging youth in STEM activities through making that support the sustained development of interest and personal belonging in STEM, further inroads may be made into redefining how youth perceive who does STEM (Aschbacher et al., 2010). Thus, from a materials perspective, making offers a compelling set of tools and a framework from which to develop youth rightful presence.

One approach that has shown promise for improving identity and interest markers for ethnically diverse students is culturally responsive making. Adopting a culturally responsive approach can improve academic performance for ethnically diverse students (Alaska Native Knowledge Network, 1998). Culturally responsive learning involves creating learning opportunities that reflect intuitive ways of understanding and knowing for specific cultural groups

(Klug & Whitfield, 2012). Such learning spaces and opportunities recognize and respect student identities and cultures as inherently valuable and work to create meaningful connections to them within the learning context (Klump & McNeir, 2005). Culturally responsive making does this by bringing new funds of knowledge into the learning space and creating greater pathways between the home and school worlds (Searle et al., 2019).

When classroom learning is devoid of contexts meaningful to learners, learning is stifled. It is through relevant and meaningful connections to both prior content knowledge and cultural contexts that knowledge becomes deeply held and retained by learners (Silseth & Erstad, 2018). By engaging strategies and practices that support rightful presence, teachers are able to create better alignment and connection, merging students' home funds of knowledge with their school funds of knowledge, reflecting a key goal of community-driven science endeavors (Phillips et al., 2019).

## 3 | METHODS

This study is part of a larger project examining teacher professional learning around making and computing. This single case qualitative analysis (Yin, 2013) was prompted by interactions between the researcher and a specific participant who was unusually articulate and outspoken in her perceptions of science as a disempowering force in the lives of her community of Indigenous Hawaiians. While her perspectives shared many similarities with other participants, her specific experiences and ability to convey them made her case particularly compelling. Leilani was purposely selected as the case for this study because of her efforts among the Mauna Kea land protectors and enrollment in the participating summer school class. Her case offers insights into the duality experienced by Indigenous Hawaiian youth who see science as divorced from their culture and community. I applied an interpretivist lens, focused on Leilani's lived experiences and constructed reality as she responded to the experience of being rightfully present within a science learning environment. Data collected included audio recordings of the 40 h of class, fieldnotes, interviews, photographs of artifacts, and instructor reflective memos.

### 3.1 | Community

Nestled on the mountainside of the Big Island, among farmland and ranches, are several small villages and towns that are home to many of Hawaii's rural communities. One such place, Nui Huna (translates to Big Secret), has roughly 10,000 residents across the entire county. It is the center of *paniolo* culture, the community of Hawaiian cowboys who emerged in Hawaii in the late 1790s after cattle were first brought to Hawaii as gifts for King Kamehameha. The local town at the center of the community is home to two major scientific endeavors focused on astronomy. Both the Mauna Kea TMT and the Canadian French Telescope projects are led from spaces rented in the town. Because of these projects, there has been an influx of predominately white scientists and their families moving to the town over the past 20 years. This is evidenced by the rapidly changing median income, which went from $51,150 in 2000 to $97,883 in 2019. While current poverty rates hover at just 10% of the town, that rate of poverty is not equally distributed or experienced. Indigenous Hawaiian townspeople, descended from Polynesian wayfinders who reached the Hawaiian Islands 1500 years ago, have typically lived there for many generations and experience an overall poverty rate four times higher than their white

counterparts, with nearly 25% of Indigenous Hawaiians in the area living well below the poverty line.[2]

It is also important to note the ongoing influence of colonialism on the island. While Hawaii was granted statehood decades ago, economically and socially, many of the islands experience highly colonial dynamics reminiscent of the early 20th century. In fact, some Indigenous Hawaiians are seeking national independence and an economic restructuring away from tourism with its inherently colonial structures that impact the daily lives of Hawaiians. For example, many Hawaiians took issue with water restrictions placed on them in 2022 in response to a higher than expected rate of tourism (McDonagh, 2022). While anti-colonialism is not the specific lens of this paper, the dynamic tension between Hawaiians and visitors fundamentally affects local community-driven science.

## 3.2 | Core community values

While not all Indigenous Hawaiians hold monolithic values, it is important that Indigenous Hawaiian community values are centered in making sense of working with Hawaiian youth. Central to many Indigenous Hawaiians within this specific community is a valuing of the community and the land. As a noted Indigenous Hawaiian leader and land advocate explains, "in Hawaiian culture, we focus on the group, the whole community, and the land. Conflict is not something we seek, because we recognize we return home to those we are in conflict with. So as a Hawaiian, my values of Ho'omau (preserve), kuleana (responsibility), and kokua (helping) are central in how we engage others" (P. Case, personal communication, March 1, 2022). Within and across Hawaiian communities, these notions of responsibility, helping, and preserving permeate conversations and perspectives on how to resolve problems and challenges across the communities. In centering the community and the land, there is a strong desire across generations for young people to remain on the island both for education and professional opportunities. This can cause challenges as the opportunities for both on the island are not as strong as in other spaces, such as Oahu (where Honolulu, the state capital, is located) and the mainland. Because of this community value for young people to remain on the island, for community science to be valued, engagement must offer perceived value to community members for a locally meaningful purpose, rather than as a tool for future degree or career interest.

## 3.3 | School

Within Nui Huna town, there exist several schooling options that further deepen the community divides between Indigenous Hawaiians and white folk. The town, while rural and limited fiscally in many ways, is home to two private schools that serve specific swaths of the community. Both of these private schools boast roughly 10:1 student teacher ratios and tuition fees ranging from $25,000 to $50,000 per year. Conversely, the local free public middle school engaged in the partnership supporting the current study has a 25:1 student teacher ratio with 72% of youth qualifying for federal free and reduced lunch. Within the local private schools, there are very few Indigenous Hawaiian students, while the public school is 52% Indigenous Hawaiian.

As noted above, across the island of Hawaii there is much conflict around the use and engagement of the Mauna Kea for scientific purposes. Less than 40 miles from the summit of

Mauna Kea is Ke Ho'o, the local public charter school and site for the current analysis, whose student body is majority Indigenous Hawaiian and whose engagement with science is governed by the Next Generation Science Standards. Much of each school day is enmeshed in Hawaiian traditions, beginning with daily *piko*, a land-focused school morning meeting during which *Ike Hawai'i* is chanted in Hawaiian with the express purpose to connect everyone to the island, its geography, and their school *ohana* (family). Prior research at the school notes science instruction has long been taught in a culturally decontextualized way and the issues driving conflict around the expansion of the Mauna Kea observatory are intentionally not discussed (Tofel-Grehl, 2023).

## 3.4 | Participant

Ten middle school students of various cultural and social backgrounds from around the local town participated in the class. For this paper, I chose to focus on a single student, Leilani. She is a 12-year Indigenous Hawaiian young woman who attended the local public charter school, Ke ho'ouna Nei I Ke Aloha (Ke Ho'o), the year before the camp and was entering the 7th grade in the fall following the summer of data collection. Leilani has lived in the rural town that the school serves for her entire life. Generations of her extended family live in various towns across the island. In many ways, Leilani is a typical 12-year-old. She loves music, is very socially focused on peers in her classes, and spends her free time playing video games or on social media. In addition to this, she also spent many weeks over the past 2 years as a land protector of the Mauna Kea, sleeping on the mountain with her extended family to protect the land from further development and provide local support for continued protests. Leilani was selected for this case study due to her vocal engagement with the Mauna Kea land protectors. She was active in the local Indigenous community, often spending her weekends in Waipi'o Valley, another one of the island's sacred places and the social hub of the local Indigenous Hawaiian community.

On the one hand, Leilani's case is similar to her classmates, making her representative of her school community in a great many ways. Her connection to the local Indigenous community is the same as her classmates. Many youth in the class shared about their family connections to the sacred places we visited as a class. Leilani, like many of her peers, shared about her uncles and aunties, their gatherings, and culturally practices, making her wonderfully and ideally representative of the community on which this study focuses. Despite evident family valuing and centering of agency, Leilani did not come into the summer school class articulating any personal sense of agency.

While she had tremendous passion for local issues and shared her prior activism around these issues, she seemed resigned to the idea that within school she was to be seen, not heard. In fact, in conversation with the author on the first day when asked how she could change things she replied, "who am I to change it?" It is for this duality of experience and self-concept that makes Leilani an ideal case for exploring youth rightful presence within community science. In short, if the summer program was to have any impact on youth's sense of agency and feelings rightful presence, Leilani would be the most crucial person to see it in. Other students had stronger senses of agency and thus would be easier to scaffold and support stronger senses of rightful presence. Because Leilani felt no agency within science, she provided space for understanding the potential value of designing specifically for youth rightful presence in community science.

## 3.5 | Allies within the learning environment

Rightfully present spaces must include allies, as it is not the obligation of those excluded from systems of power to speak on and bring about change. Rightful presence calls for a dynamically tense form of allyship. Allies must be willing to name injustices and work to dismantle systemic oppression without becoming centered in the process themselves. If allies are centered, both space and agency are taken from those whose presence the allies seek to support. In short, the proverbial white savior cannot be an ally; even with the best of intentions, someone who centers their own feelings and perspectives over those of the community they seek to support would undermine rightful presence. Such self-centering is no less damaging for its potentially good intentions.

The design and teaching team reflected on what it meant to be allies within rightfully present spaces and established core values of allyship. Our allyship focused on three core values. First, we focused on centralizing Hawaiian cultural values and ways of knowing. Second, we sought to uplift and support youth voice and agency. Finally, we intentionally and critically named the marginalized spaces that Hawaiian Indigeneity was forced into through a colonial mindset. As allies, we tasked ourselves with deconstructing external power structures, implicit and explicit, within our classroom through the development of a classroom bill of rights.

We also recognized the inherently political nature of science on the island. As part of our design and process, we actively engaged youth in dialogue about the TMT, something students had never had the opportunity to discuss during school. While several members of the school community cautioned us against engaging any science around the Mauna Kea in order to centralize issues of community and scientific conflict, we chose to engage those topics head on.

Further, we actively sought out spaces where student voices were normally marginalized and engaged youth vigorously in driving those conversations. With this intent, the lead teacher and lead researcher (i.e., the author) acted as allies. Each stated their intention to interrogate collaboratively their practices before, during, and after class. The team found this professional vulnerability necessary to authentic allyship within our classroom space. This can be seen in the ways that our structured curriculum and projects were open to student direction and leadership, allowing youth to engage in conversations that we had not planned or anticipated (e.g., the enactment of Project 3, described below).

## 3.6 | Description of the summer class

As a result of the divide between science and Indigenous Hawaiian communities, science learning often exists solely as a classroom exercise, wholly devoid of connection to the lives of students, their community, and the socio-scientific issues that surround them. The consequences are multifaceted: when students do not experience science as something that can be part of their lives, they are unlikely to express interest in or curiosity about science as presented in school-linked discussion, and they do not see science-related careers as prospective career pathways.

The design team conceptualized science education as more than an isolated composition of knowledge, skills, and practices. These core elements of science must be lived and learned in service to the needs and realities of those in our classrooms. This means that science content, lessons, and projects cannot be devoid of the context of the world lived in by learners. Further, and perhaps more importantly, students' experiences and identities must be present in the

materials and the interactions that comprise their opportunities for learning in the science classroom. This embraces the concept of cultural responsiveness by empowering students within classrooms to occupy authoritative space during instruction that manifests in their scientific interrogation of ideas, applications of scientific principles, and purposing of scientific knowledge towards ends that they choose to value (Gay, 2018).

The class spanned 2 weeks during the summer of 2021. Class met for 4 h per day and included two place-based field trips to sacred sites on the island.

### 3.6.1 | Co-design

The class was co-designed with one of the school's teachers, who is national board certified in both science and social studies. As a middle school teacher, her focus was on finding ways to engage science and technology to support youth awareness and activism with Indigenous issues on the island. In this context, the design team introduced a set of culturally responsive science and computing lessons intended to help students develop an understanding of electricity and circuits, coding, and data representation and analysis through computational making with the goal of building bridges between students' school science experiences and their personal community identities.

It is important to note the limitations of student-led design within the curricular development process. This was something the design team thought about a great deal. It provided us with tremendous intellectual and emotional tension. In an ideal situation, free of time constraints, we would allow youth to entirely develop and co-design the curriculum. Unfortunately, because the summer school had a time frame and schedule this was not entirely possible. Thus, the curricular projects were developed prior to the start of the summer program. This allowed for time to do things like procure supplies, print 3D maps, and pilot projects to ensure they worked. While we saw this adult-led design process as necessary, we also recognized it as a potential limitation to youth rightful presence and the further centering of community science. Thus, we committed that during the summer school students were to have total free range within the projects developed and lessons enacted.

During enactment of the curriculum, we saw students enact their own design choices on their projects. Some students decreased the complexity of projects while others increased them. Often this was observed with students increasing or decreasing the number of sites/lights included. Another good example of this student ownership and agency was when students became angry that the software would not pronounce Hawaiian words correctly. This led to a two-day exploration and "hacking" of Hawaiian language where students dove into figuring out how to get the software to say Hawaiian words correctly.

### 3.6.2 | Disruption of standing power dynamics

In designing our space with youth and community rightful presence in mind, class was held in a neutral classroom outside of the normal space of the teacher involved in the class. Multiple times during the class she referenced her own discomfort at not being in *her* room. However, her discomfort made space for students to name the space themselves and create a classroom for themselves.

Further, the design team designed a space of shared responsibilities where normal aspects of teacher power brokering were disrupted. For example, we decided that youth could

determine snack and bathroom break times rather than adults. This shared responsibility afforded our community opportunities to discuss the feelings around needing such permission. We engaged in uncomfortable conversations about the historic spaces in which humans have required permission from those in power for basic bodily functions. Our model of shared governance led to discussion of a classroom bill of rights that allowed anyone to use the bathroom without permission. This small but deliberate choice exemplifies the empowerment possible in a rightfully present classroom. The classroom bill of rights discussion, led by the researcher, stemmed from work they engaged in when they were a classroom teacher. Through group discussion, the community established core classroom rules that were not focused on what folks could not do (e.g., no running, no shouting) but rather focused on what rights each community member had (e.g., all people can move safely through spaces when they need to, all people can get help when they need it). This rights focus made explicit the practices and tenets of rightful presence and allowed youth to govern their own bodies with attention to their rights and those of others within the community space. Through this process we intentionally designed and made space for community and cultural values to be both present and enacted within the school context. By centering community cultural values, we sought to afford bidirectional spaces for mutual engagement between community and science in service to richer community science.

Central to the notion of rightful presence is that for youth to be afforded true rightful presence in any community, they must not be allowed rights. Rather, they must be afforded equal opportunity to determine what rights are within the community. This authorship of rights (Calabrese Barton & Tan, 2020) aligned well with our efforts at community-driven science as we allowed youth to consider what a classroom bill of rights, a rule list that governed the community, might look like. Within this rights-building structure, we negotiated community standards of behavior that were reflective of students' commonly held beliefs. For example, one belief that youth brought to their class's bill of rights was that within the classroom community, folks had the right to their pronouns and that members of community must honor them. Thus, the bill of rights helped to structure the discourse and codified empowerment of students in ways that permeated the milieu of the classroom activity and supported student autonomy as they engaged their projects, but it was not often referenced or linked to project activities explicitly.

## 3.7 | Author positionality

The author is a white-passing queer person from a religious minority, whose pronouns are she/they. For all intents and purposes, she is perceived—and thus treated as—a white, cisgender woman. This duality of experience and existence allows them to walk within and across spaces, often learning more about the privately held beliefs of communities she passes as part of. Aware of the privilege this affords, the author seeks to articulate and explicate the many truths and complex understandings around identity and community experienced by those they work in partnership with. Specifically, the author believes that research must be conducted with communities, not on communities. The author has worked in partnership with this community and school for the past 5 years. Additionally, the author was a lead classroom teacher for over 10 years and thus is well-versed in the progressive education practices and pedagogy needed to enact rightful presence within classrooms.

### 3.7.1 | Positionality as related to community and power

This paper focuses on several interrelated and overlapping communities as they impact the identity and experiences of Leilani. While a sole-authored paper, the author worked closely with the lead teacher to develop common understandings of rightful presence and community science to serve as the basis for collaboration. We conceptualized overlapping communities to which participating youth belonged. We saw youth engaging as geographic island community members, school community members, and indigenous Hawaiian community members. Not all youth felt present in all of these communities, and this list is by no means exhaustive. For example, one youth articulated connection with her paddling league community and her family community. However, the three communities listed here are ones that most youth had multiple connections to, if not complete overlap.

As educators and researchers, we were allies in youths' struggle, but our role was that of co-conspirators rather than leaders in this process. As allies, we worked to flip normative classroom power structures to create spaces of greater rightful presence for Leilani and her peers. As co-conspirators, we sought to follow her and others into conversations and spaces that engaged their multidimensional struggles directly. This meant we needed to leave behind our plans, intentions, and visions for what each day of summer school would bring. As carefully as we planned projects and curriculum with intent and a focus towards rightful presence, we also recognized that our plans were not the students' plans. If our work was to engage youth in deep community-driven science, we needed to cede our role as drivers in the classroom. As adult white women from the mainland, this meant recognizing both our privilege and cultural capital within the normative practices and discourses of science, but also our responsibility to cede, whenever possible, the spoken and unspoken power systemically granted us within the classroom space.

Within this work, we defined empowerment of youth as their ability to do three things: make suggestions, enact their own ideas and plans, and override adult authority. The right to do these things makes tangible the enactment of the first two tenets of rightful presence, in that they honor youths' right to have voice in the brokering of the rules by which the learning community operates and disrupt the normative power structure of formal learning spaces where student compliance to rules unilaterally imposed upon them is the norm. By making suggestions, youth were empowered to bring their voices to the space in which we worked together. It allowed them to share ideas, create a community of engaged thinkers, and be centered in the thought process. This sharing of ideas and making of suggestions is necessary preliminary evidence of youth empowerment. Further evidence of youth empowerment within our rightfully present space would be their ability to enact ideas and plans of their own creation. This ability to bring their suggestions to fruition was an important aspect of youth empowerment, as it allowed them to see things through to realization. However, for youth to be fully empowered, they must also exist in spaces where disagreement does not end in their ideas or plans being subservient to or lesser than adult ideas and plans. In other words, we sought a space of equality with youth, where capitulation to adults is not necessary for student success. We believe that youth could and should be able to override adult authority through classroom democratic processes in order to be fully empowered within their classroom space.

## 3.8 | Instructional context: Three projects

The curriculum was designed in the same vein. Working collaboratively with the teacher, culturally responsive making projects were designed to promote youth interest and center activity

around their home communities. The following paragraphs describe the three projects that students produced during the course.

### 3.8.1 | Project 1: Paper circuit name placard

On the first day of class, students were asked to make a rapid prototype light up name placard (see Figure 1). They were asked to put their name in the center and answer a different question in each corner. In the top left corner, they were asked to share an area of science that was of interest to them. In the top right corner, they were asked to share a place they wanted to visit. In the bottom right corner, they were asked to share a hobby or interest, and in the bottom left corner, they were asked to share a social or community issue they were passionate about.

### 3.8.2 | Project 2: 3D-printed volcano maps

On the second day of class, the group went on a field trip to the Waipio Valley to listen to and learn from the caretakers of the land. Our class heard about the ways that visitors disrespect the land, the people, and the rules. After taking notes and engaging with this trip, our class began the second project, programable 3D-printed volcanic maps of the island (see Figure 2). This project let students engage with both the geography and geology of the island. Students investigated through online sources topics such as which volcanoes on the island were older, active, or tallest. With this information in hand, students picked three volcanoes and determined how to visually represent the data they had on a single aspect of the geologic information gathered about their island's volcanoes.

### 3.8.3 | Project 3: Advocacy apps

During the 2-week class the team took students on two separate field trips. Building on the first field trip to Wai'pio Valley, in the second week students took a field trip to Pu'ukohola Heiau, a

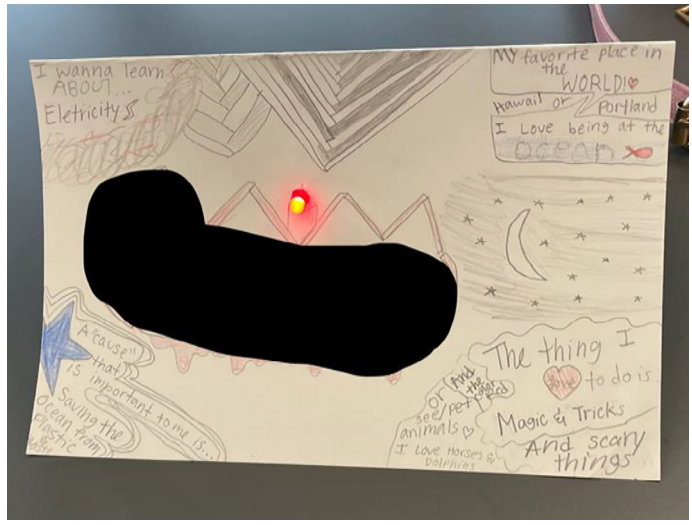


**FIGURE 1** Example of name placard.

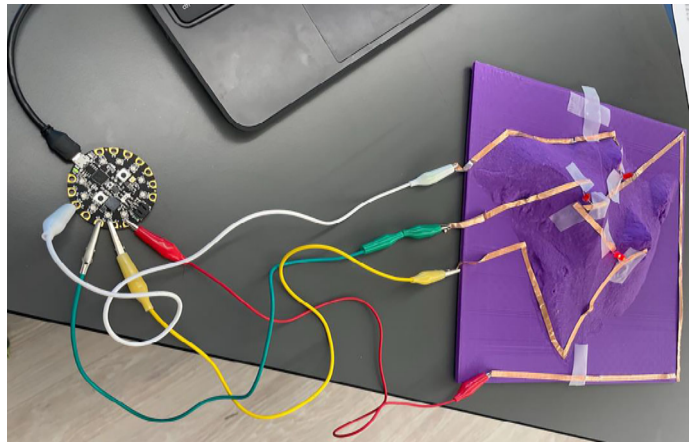

FIGURE 2 3D printed volcano mapping.

national historic site that marks the unification of the Hawaiian tribes under King Kamehameha in the 1700s. Heiaus are deeply religious sites to the Indigenous Hawaiian people and Pu'ukohola is still used for religious practice today. After this second field trip, youth were invited to reflect on the field trips taken and the importance of advocating for sacred spaces on Hawaii, especially given the recent uptick in vandalism and notable tourist disrespect plaguing the island (an issue so common it was covered on the local news the same night as the fieldtrip). To this end, youth designed, constructed, and coded apps to serve as guides for visitors regarding appropriate behavior on the island at its sacred spaces (see Figure 3). Youth were welcomed to pick from several sites island-wide.

## 3.9 | Data collection

### 3.9.1 | Field notes

The researcher took field notes on key moments in the class that pertained to the research questions and appeared relevant to issues of youth engagement and rightful presence when she was not modeling instruction for the classroom teacher. Because students naturally self-selected to work at tables with peers, the researcher moved among separate tables as frequently as possible to make observations and notes on each group over time.

### 3.9.2 | Audio recordings and transcripts

In addition to the collection of qualitative fieldnotes, table microphones were used to collect audio recordings of the groups. A total of 40 h of class time was observed, recorded, and transcribed.

### 3.9.3 | Interviews

At times, youth were interviewed to follow up on conversations that emerged organically at tables. The conversations were recorded and transcribed.

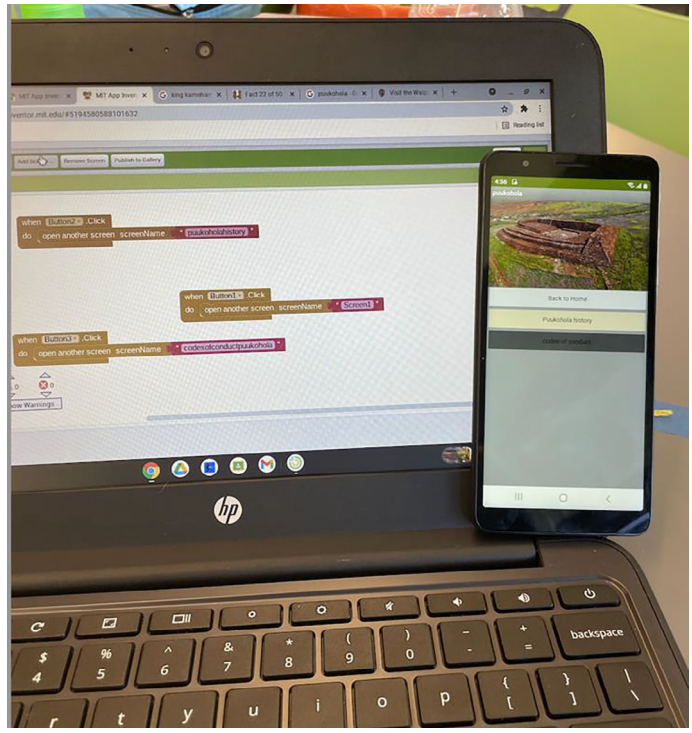


**FIGURE 3** Development of an advocacy app page for Pu'ukohola.

### 3.9.4 | Photographs of artifacts

Daily photographs were taken to capture the process of making and designing projects that reflected participants' identities. Of specific interest in tracking shifts in youth identity were localized projects focused on various places on the island.

### 3.9.5 | Researcher reflective memos

The lead researcher kept a journal of her reflections after each day of instruction. This allowed her to capture her thoughts and considerations on each camper as they engaged in the making process.

## 3.10 | Data analysis

Using a modified grounded theory approach (Charmaz, 2008) with *rightful presence* and *community science* as lenses, I engaged two modes of analysis to provide a deep and integrated look at the data. First, the data were examined temporally to understand the ways in which Leilani's perspective changed over the course of her experiences related to the summer class. Thus, data analysis focused on her articulated opinions of science held prior to the class as elicited through an initial interview, data collected during the summer class, and her reflections

on her experiences during an exit interview. Analysis of Leilani's articulated thoughts and experiences was especially sensitive to their manifestation of and compatibility with rightful presence within STEM endeavors—specifically, the tenets of rights reauthorship, visibility of her and her community's own wisdom and experiences in STEM spaces, and the disruption of normative power dynamics in the application of scientific knowledge.

Second, I explored emergent themes across times and spaces described by Leilani to understand Leilani's connections with and disconnections from science as both an individual and as a member of the Indigenous Hawaiian community. This analysis began with a *de novo* exploration of the data, leading to six discrete codes (e.g., disinterest in science, care of community). Additional examination of the data sought disconfirming evidence against the generated codes. Finally, code accretion occurred as themes emerged across codes and temporal spaces.

## 4 | FINDINGS

Broadly, the data indicate shifting engagement with and perceptions of community science on the part of Leilani. As she began the summer class, she clearly articulated valuing her community and the land, her perception that science and her Hawaiian identity are incongruous, and that scientists act without care for Hawaii. As she engaged in a science class designed to support rightful presence, her attitude towards science softened as she grappled with the question of what science could be for her. Specifically, her introduction to the notion that she could use STEM as a tool to advocate for and work on behalf of her community fostered this softening. As her community became central to the focus of her science learning, she began to contemplate community-driven science as a tool to meet her community's needs.

In this grappling with the role of science within and on behalf of her community, Leilani's growing sense of rightful presence shifted her perspective on community science. As Leilani's sense of ownership of her learning environment grew, she shaped it, allowing it to reflect more of Indigenous Hawaiian culture, values, and history. Because Leilani became more rightfully present, she was better able to see potential for community science. The following sections examine these shifts across projects temporally and through thematic analysis.

### 4.1 | Temporal findings

Throughout my time working with Leilani, she articulated complex thoughts and feelings about both science and science learning as related to her Hawaiian community. These conversations most often occurred during project construction times. Leilani's negative perspective on science was closely linked to her pride in and love of her Hawaiian community. Leilani articulated two specific beliefs about science and Hawaii/Hawaiians. First, she believed scientists were taking advantage of the Hawaiian community in general and the Mauna Kea specifically. In talking about science generally, Leilani clearly articulated her disgust for the discipline and those who practiced it in Hawaii. For Leilani, science was a destructive force that was harmful to her family and her community, making the notion of community science unthinkable. In one of our first chats together, Leilani talked about her family and the Mauna Kea and how the TMT project created division. She commented:

> All these people [the scientists who have come to work on the telescopes] come here and make so much money. But they take advantage of the land and our people. This is our mountain. My aunties cried when they announced the new telescope. My uncle was excited when he got a job there. But he had to quit it, because he would have had to destroy our land. It was a big deal, quitting. It was hard. He lost a lot of money. But they [the scientists] don't care, so they make a lot of money.

Here, we see Leilani's perspective on how science takes from her community rather than helping it. In this way, she saw herself and her family as disconnected from science. When asked about how she felt science related to her daily life she explicitly said, "it does not." When pressed, Leilani alluded to how the conflict over the TMT made it impossible for her to feel positively about science. She stated tersely, "science is not good for Hawaii."

From Leilani's starting perspective, community science was not possible, because science has been a violent external force that acted upon her community, not something that embraced or helped her community. Community science, to Leilani, was anathema. Her teacher confirmed this perspective and noted that the scientific companies in town often offered the schools money for science education, but that these monies were routinely declined by financially struggling schools. The school, the teacher reported, would rather continue to lack funding than take money from organizations associated with science on the island. As the teacher explained, money from science corporations would be considered "blood money." The teacher went on to explain that students, parents, and educators all believed that the offers of financial support were not intended to act as supportive gifts to the community, but rather as self-serving public relations efforts. With widely held beliefs that the science companies only helped the community for the purpose of helping themselves, Leilani's perspective was understandable. Thus, the notion of collaboration between science and her community was unimaginable to Leilani at the start of summer school.

Second, Leilani articulated a belief that science learning was not relevant to her in her life. In one conversation, I asked her if she and her family ever talked about her science schoolwork, and she said no. She said that she completed science assignments to do well in school, but she did not like it. When asked why, she said that it did not have anything to do with her life. She stated, "I live here. On the island, science is *pau* (Hawaiian slang for "done" or "over"). I do it, because I have to in school, not because I want to. It's just... *pau*." By using the word *pau*, Leilani put a division between science learning and herself. For Leilani, the content, standards, and lessons she received did not connect to her daily life as a member of the island community. This disconnect, coupled with the island-wide tensions between science and community, fostered Leilani's belief that science was not worthwhile to her as someone who lived on the island.

When asked, the classroom teacher noted that science learning was "from the mainland" and that most educational standards, assignments and tests were "at best from Oahu, but really just mainland stuff with no thought about kids on this island." The teacher's remarks distill widespread conceptions of science as being distant to the Big Island. The absenting of Hawaii, Hawaiian history, and Hawaiian culture from science learning made clear the lack of community presence or values within the classroom setting.

This lack of community centering reinforced Leilani's lack of rightful presence; if her community was to be absented from science learning then she absented herself as well. In a class discussion about STEM and why software cannot pronounce Hawaiian names, she commented that it was because "these aren't Hawaiian computers." This statement pointed to a lack of rightful presence within STEM that would be achieved by experiencing technology responsive

to the needs and experiences of being Hawaiian. In her closing interview, I asked Leilani to reflect on her earlier science classes and compare them with the one she had just completed. She noted that her earlier science classes "had nothing to do with me (indicating herself)." For Leilani, science learning was not part of her life, because her community was absented from the science presented to her.

Despite this strong preexisting negative association with science, during the 2 weeks of summer school, Leilani demonstrated strong engagement with the series of culturally responsive maker and computing projects described previously. The culturally responsive nature of the projects challenged her preexisting beliefs about the incompatibility of science and indigeneity. Below are her reflections and comments on those projects, culminating in her reflections on STEM in general and her relationship with it as a young Indigenous woman. From these reflections, we see the ways in which her developing sense of rightful presence and entre into community science help shift her understanding of what science is and in what ways science can be engaged for her and her communities.

### 4.1.1 | Project 1: Four corners placard

Leilani made a carefully and artistically drawn placard that showcased her name. She chose Disneyland as a place she wanted to visit, soccer as her favorite hobby, and the TMT on Mauna Kea as the social issue that she cared about. Of note, she did not put anything on her placard for science (see Figure 4, top left corner). When asked why she did this she said, "I don't really care about science. I just do it in school because I have to. But, like, scientists are attacking our land, so I don't like it." Just minutes into the start of the first day of class, we see evidence of how Leilani separated herself from any possible science identity, because she saw science at war with her Indigenous community.

This project was designed to allow youth to represent themselves, their interests, and their passions as a beginning step towards developing their own senses of rightful presence. By bringing youth's complex identities into the classroom, space was made to author themselves into the space and classroom community. Within that context, Leilani used this opportunity to draw space between her identity, her values, her voice, and science. This space was, in and of itself, an authoring opportunity that Leilani used to elevate her Hawaiian identity in school. By doing so within a classroom with an explicit bill of rights that protects her, she authored herself more fully into the classroom space without fear of disapproval or negativity. This evidences the beginnings of Leilani's developing sense of rightful presence and centering of her Hawaiian communities. At that moment, for Leilani, community science was not even a possibility, because she and her community were not rightfully present within the school where her first-hand exposure to science had taken place. As she began to author her own rightful presence into her school experience, she chose to bring her community into the classroom, functionally protecting it by refusing science space with it on her project. However, as she moved into the second project, an opportunity for her community and science to share space arose.

### 4.1.2 | Project 2: Modeling volcano ages and volatility

During our second project, Leilani opted to look at the activity status of three of the island's volcanoes, noting that Mauna Kea was not active (see Figure 5). When discussing her design

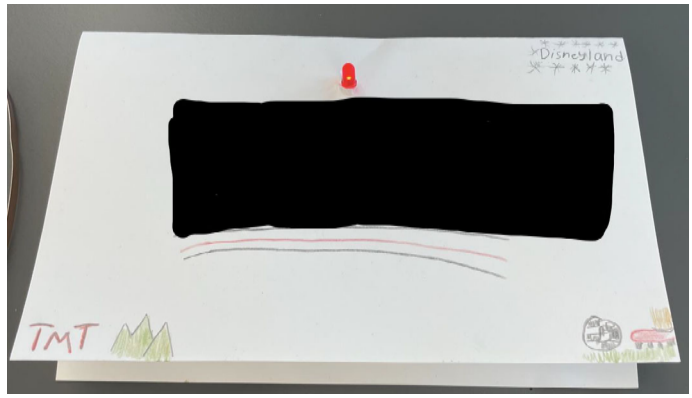


**FIGURE 4** Leilani's four corners placard.

choices during project during construction, Leilani told the origin story of Mauna Kea, talking about how it was interesting to learn that the volcano was dormant and that Kilauea was very active. She noted that this aligned with the history of the volcanoes within Hawaiian history, because Kamehameha only became king of the islands when Kilauea erupted and convinced Kamehameha's rival to surrender to the wishes of Pele, the goddess of fire. Leilani expressed her pleasure at the alignment of scientific understanding and her Hawaiian community's funds of knowledge and history. This alignment met with affirmation and gratitude to her for sharing from her classroom community, including the educators. In sharing with the class, Leilani rightfully presented Hawaiian community knowledge with equal validity to that of the geologic knowledge presentation. With science and Hawaiian community knowledge on equal footing within the classroom space, small shifts were observed. This was the first point in the class that we observed a softening in Leilani's tone towards science as she found a place where science and Hawaiian knowledge converged. When asked, she said "geology isn't so bad... This stuff is pretty interesting."

Here rightfulness of presence was established through Leilani's ability to engage the second tenet of rightful presence: "making visible the intersection... in the present while orienting towards new social futures." She was able to bring light to the ways that Hawaiian ways of knowing intersect and connect with western science; in doing so she created an interwoven future way of discussing geology within her classroom community. The third tenet of rightful presence was also enacted when she asserted the power and authority of Hawaiian knowledge as confirmatory of science knowledge, thereby flipping the traditional script that science is *fact* and Hawaiian knowledge is *myth*. While we are left to wonder what might have happened had these two ways of knowing not converged, their convergence created an opportunity for Leilani to grapple with the idea that science and community are not inherently opposed.

### 4.1.3 | Project 3: Advocacy apps

Leilani began her app design with a vision to engage multiple cultural sites, including the Mauna Kea. During the introductory lesson and scaffolded practice session in *App Inventor*, she and another student, Keila, noticed that *App Inventor* often did not pronounce Hawaiian words correctly. Leilani was furious, threw up her hands, and said "Of course " When questioned, she

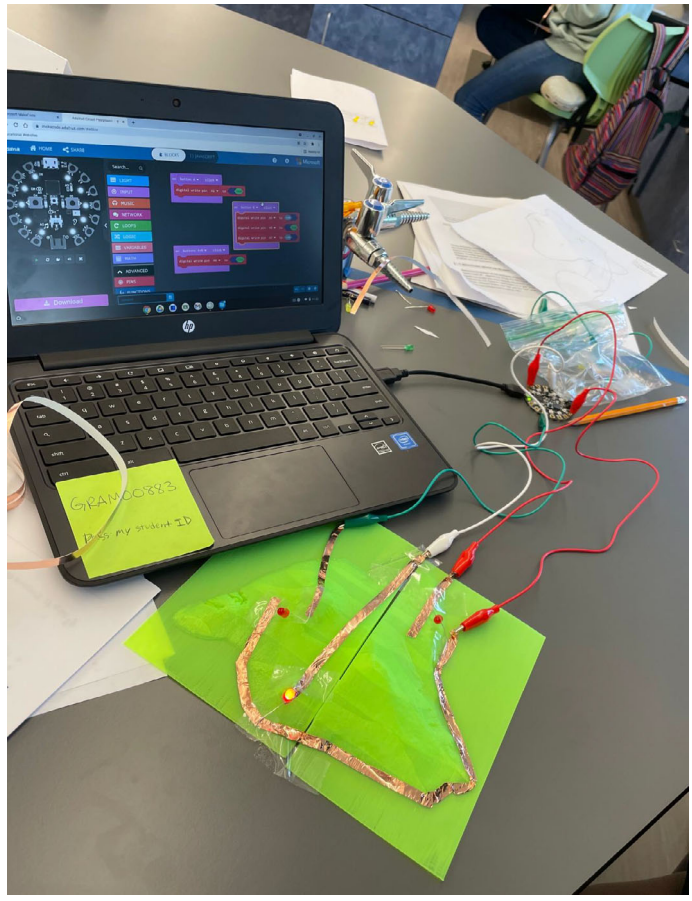


**FIGURE 5** Leilani's computational model of volcano ages.

expressed her frustration and lack of surprise that the technology could not pronounce Hawaiian words. As she said, "I am not surprised  You should hear *MapQuest*. It is ridiculous. It is like they did not even try." When pressed about who "they" were, she quipped, "the computer programmers. They are all white. Not Hawaiian."

I pressed her to consider how she could handle this situation on behalf of her community. I asked her "what are you going to do to fix it? How can we support you in fixing this?" "Is it ok if I do something different?" she asked, referencing the curricular plan for the day. When the teacher confirmed that she could do as she wanted, Leilani quickly organized her classmates into an impromptu examination of which Hawaiian words the technology supported and which ones would need to be alternatively spelled to achieve correct pronunciation. Students created a list of words that *App Inventor* could pronounce if they were spelled slightly differently and some words that did not pronounce effectively (see Figure 6).

In discussion, the students noted that it makes learning the correct pronunciation harder when technology pronounces it incorrectly. Leilani commented:

> It isn't a Hawaiian computer...It was made and programmed by white people.... If I were to meet the people who made this, I would just, um, I don't know how to

> pronounce it from their technology...It isn't an issue of anger... It is just really frustrating to have to *englishize* everything I want it to say.

She went a step further and decided to see how many of the school's morning *piko* chant words were correctly pronounced by *App Inventor*. Her interest and focus on this aspect of inclusion indicated how important it was to her. Leilani spent approximately 2 h going word by word through *Malana Mai Ka'u*, one of the Indigenous Hawaiian school songs, and she found that approximately half of the words were not recognized by the software. Figure 7 shows the sheet where she highlighted the properly pronounced words in red and green. Through this effort, Leilani exhibits a strong sense of ownership, agency, and rightful presence in pursuing an issue of great importance to her community.

Within open class discussion about the pronunciation problem, students were provided the opportunity to write letters to or videoconference with programmers at some of the larger technology companies. However, students immediately declined this offer, stating that they did not believe that programmers and adults would listen to young people from a remote island state. This hesitancy shows that students, and Leilani in particular, still held reservations about their own ability to effect change on issues they encountered. As Leilani noted, those programmers were not likely to be Indigenous Hawaiian.

Here we see all three tenets of rightful presence enacted as Leilani engages the political nature of the struggle to have Hawaiian language represented correctly. Her engagement of her entire class, both Indigenous and native Hawaiian, demonstrates the sharing of the burden of knowledge across the empowered and the othered. Lastly, this instance is a communal act of

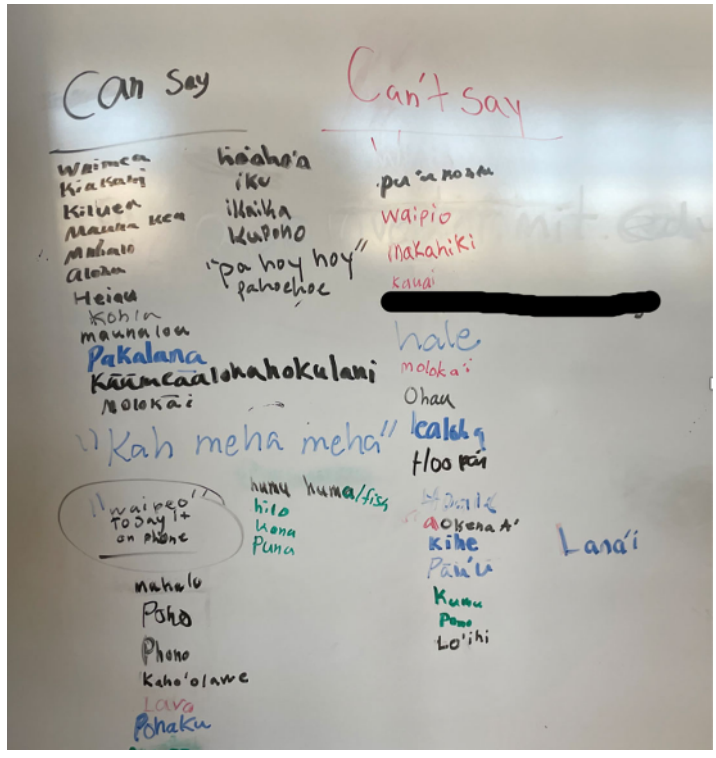


**FIGURE 6** Student generated list Hawaiian words app inventor cannot say.

disruption of an injustice, shared group wide, with the intent of building a better and more equitable future enactment. These efforts exemplifying the three tenets of rightful presence show the importance of having STEM be inclusive and in service to her communities. Through her agency and advocacy, Leilani drives home the central importance of engaging in community-driven science learning that is centered around the community in which she lives.

With the rich and unexpected class discussion exploring how the technology they would be working with did not fully embrace them, students began designing and building their apps. It was in this project that we began to see Leilani's biggest potential positive shifts towards STEM as her comments and thoughts around science move from the negative to neutral and then more positive. During the prior projects, she was diligent in completing her work but reflected very normal teenage behaviors of socializing and peer awareness. However, after her realization about the mispronunciation of Hawaiian words within the technology, she seemed determined to make an app that ensured all words were pronounced correctly and heritage sites were fully explained. Leilani embarked on 2 days of the most focused and intense effort observed from any of the students over the course of the entire 2-week class. Skipping recess, she worked straight through from when the classroom opened until students were boarding the bus home. Her app was not only well organized, but passionately written. Figure 8 shows the text of her app page focused on codes of conduct for the Pu'ukohala Heiu. Each of the behaviors she included were ones reflected in interviews and discussions with Pu'ukohala's caretakers.

Of note in her write up for the app was her ability to use both punctuation and brevity for emphasis. When asked why she wrote what she did, Leilani said, "Even a kid can read 'don't litter or 'don't poop It is really important that people do not do it." Upon completion of her app, Leilani shared it with the principal of the school and her entire class. During her presentation of her final product, Leilani drew praise from administration and her peers alike for her passion and clarity in presenting her work. As she was stepping away from the podium she commented, "Maybe we can change things." In a follow-up conversation seeking clarification

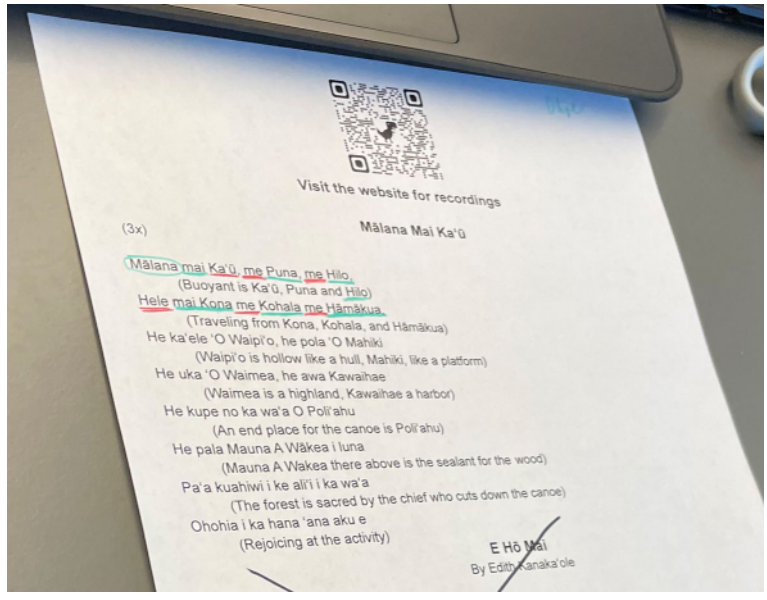


**FIGURE 7** Leilani's notes on AI pronunciation.

of her comment, she elaborated, "This was cool. Like maybe I can help my island and these circuits and computing projects could let me do something. Maybe."

While still articulating skepticism, Leilani began to find value and utility in the science content she was learning and ways in which it could be placed in service of the needs of her community. In her app, Leilani demonstrated all three tenets of being rightfully present through her willingness to engage the openly political nature of the island's struggle with tourists and her curt directives to visitors. No longer the quiet young woman she initially portrayed, her agency and sense of ownership within her classroom were also evident through her evolving presence and demeanor. While at the beginning of the class, Leilani spoke quietly and timidly, by the end of the class she spoke with confidence and purpose.

At the end of the 2-week class, I conducted a debrief interview with Leilani. The interview focused on the possible impact of the class and how I might improve it for future students. Leilani stated she did not expect to like the class. However, she noted that her mom thought of her as a "science kid," because she "used to do science experiments in [the] house and it would explode everywhere." As our conversation progressed, we discussed whether *App Inventor* and making based projects were "more science" or "more engineering." Leilani stated she felt that they were both; she said she needed to engage in learning science around electricity and geology but that the making things aspects were engineering.

As Leilani and I pivoted to discussing social issues, she became visibly animated about the TMT. The Mauna Kea was personally important to her family, and they used to visit there quite often. During the height of the protests on the Mauna Kea, she said she and her family lived and camped there as part of the core group of land protectors. She noted that at one point, one

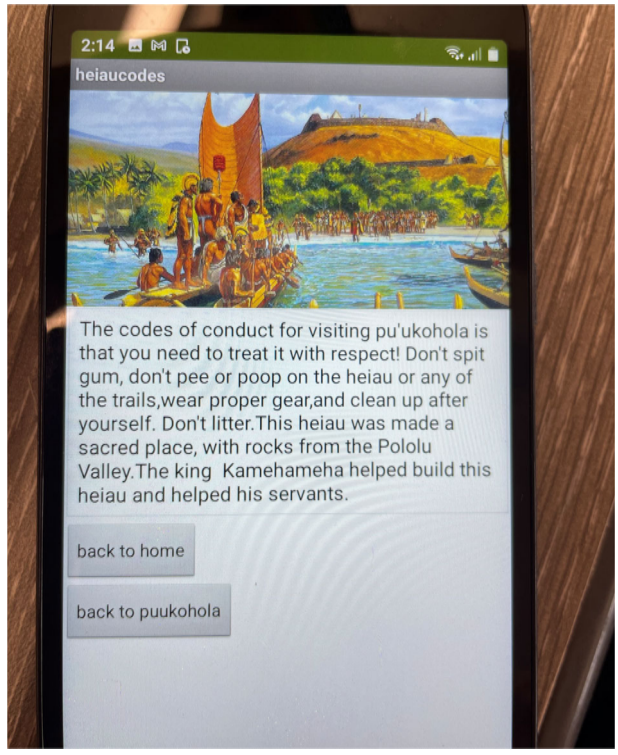


**FIGURE 8** Leilani's app.

of her uncles had been working on the telescope but ultimately quit the job because he felt conflicted about being Hawaiian and working on the telescope. Even at the age of 12, Leilani was able to articulate what a difficult decision it was for an Indigenous Hawaiian to leave such a lucrative job. She noted how engaged in her community she felt while living on the mountain, because every day the entire group would do *piko* together. As we talked, she noted how she could have used the e-textiles and maker technologies to make flags that lit up for the community. In reflecting on the *App Inventor* skills she learned, she said she felt that she could make an app to inform protestors about plans if the protests were still taking place. However, she noted that the pandemic changed the protest dynamics. In reflecting on the class, I asked Leilani to share how her feelings about technology and science might have changed, as she had indicated earlier that they had. She commented:

> I didn't really know what it was all about. I'll just be on my phone. I'll text time, but that was the only thing. And like, like text and *FaceTime* and stuff. I'll be on there too, but I wouldn't like go out of there and to like all of the different sites and stuff and search it up. But now I just found out that they're like more cool..... And we would actually make technology and then we would just before we would just be on technology instead of making it.... It feels fun and like, you can help other people too. It's not just for you, it's for other people.

When asked if this applied to science or only technology Leilani stated unequivocally "Oh, science too  You can't do technology without science. Not science like in school, but like we did here... science can help me protect it [Mauna Kea]."

Here, we see community-driven science as central to Leilani's valuing of science overall. By engaging in science with her own purpose as a Hawaiian woman, Leilani's growing attitudes and beliefs about science fostered her new bold sense of agency. She no longer saw science as something separate from her, but rather as central to her and her community. Furthermore, we see her "re-figure the world of science in ways that went beyond" the classroom (Gonsalves et al., 2013). Students' refigurings, as described by Gonsalves and colleagues, act as functional barrier-breakers between what youth conceive of as classroom science and other science. By refiguring science and its community-based meaning to her, Leilani engaged in the development of a permeable membrane between school and out-of-school science, actualizing a liminal space where the two form a richer, more complete space of what science can be for her.

## 4.2 | Thematic findings

Five codes emerged in the data from the summer class: disinterest in science, concern for community, disconnect between science and Indigeneity, care for land, and empowerment. Each of these codes is described briefly here and then in more detail under each emergent theme. First, Leilani articulated a disinterest or disconnect with science several times, referring to her own dutiful but joyless engagement with school science. She did not see STEM or science as things that impacted her life in positive ways. Secondly, Leilani expressed concerns for her community as related to science. She saw science as an external force that acted upon Hawaii and Indigenous Hawaiians. This externality of science caused her to have great concerns for her community when it came to the actions of scientists on the island. Thirdly, Leilani articulated a disconnect between science and indigeneity. For Leilani, a young person deeply focused on and

rooted in her community, science was not something she perceived as "for her." Because she saw science as an oppressive force in her community, there was no viable choice between science and indigeneity. If Indigenous Hawaiian community and values were not reflected in the science she saw around her, it was not an endeavor in which she wanted to engage. Fourth, beyond her care and concern for her community of Indigenous Hawaiians, Leilani articulated regular care and concern for the island itself. She often articulated her connection to the land in direct conjunction with her community. The land itself held value to her, as the *heiaus* (sacred temple spaces for traditional Hawaiian faith) and mountains were part of her identity and heritage. Finally, one of the concepts that evolved and recurred through the data was Leilani's growing sense of empowerment. As Leilani experienced science projects and lessons that focused on places important to Indigenous Hawaiian culture and made space for the inclusion of Hawaiian culture and values around those spaces, she grew stronger and more vocal in her role as advocate.

### 4.2.1 | Emergent themes

As these codes distilled into themes, Leilani's robust beliefs about the incommensurability of science with her Indigenous Hawaiian community and identity became clear. Leilani perceived the conflict between scientists on the island and Indigenous communities as one in which there was a right side and a wrong side. As such, she exited herself from engagement with science, noting that science was not for her and not for her community. The very lack of her community's visibility in science created for her a lack of rightful presence that barred her further engagement with science. In the descriptions of the emergent themes below, Leilani's growing sense of empowerment and agency facilitated greater engagement with science and specifically engendered an openness to community science. As her sense of rightful presence within science shifted her sense of science identity, she took on ownership and initiative of projects designed to engage her in rightfully present community-driven science.

Within the first theme, *shifting perspectives on science*, Leilani grappled with her own rightful presence as an eligible but disinterested student and participant in STEM activities. Second, she perceived a disconnect between her community and its ties to the land on the one hand and the larger science enterprise on the other. These themes are not mutually exclusive, as much of Leilani's individual positionality was clearly informed by her Indigenous identity and the personally meaningful ties to her community and its needs. Conversely, her lack of personal engagement within the science classroom reflected her perceived disregard for her community's voice within the scientific community.

In contemplating Leilani's perspectives on the potential of her personal engagement with STEM, she situates her disinterest in relation to her relative empowerment within science class and the larger scientific enterprise. In part, her initial disinterest is linked to a failure to see utility for science content in relation to her personal priorities, which entailed both her own envisioned future and her commitment to her role as a land activist and protector. However, this perspective was not simply a lack of value for what science can offer her as a student or future member of the workforce. It manifested a perception of STEM's rejection of her individuality, values, and identity as Indigenous Hawaiian. This rejection both mirrored the disregard for her (and her community's) activism to protect the Mauna as a scared space and the lack of intentional connection between the conventional delivery of science content in previous

educational experiences and opportunities for that content to be applied in personally meaningful ways even within a school focused on Hawaiian community.

As Leilani began to perceive her own interests and identity reflected within the summer science class, which fostered her own ability to author rights within that space, her stance of mutual rejection shifted to accommodate both useful aspects of content for advancing her own goals and an ability to envision herself as empowered to link science to her identity and community in multiple ways. In structuring the scientific space to support her rightful presence, direct engagement with establishing her own rights within the space afforded her the ability to perceive her engagement with science as legitimate and compatible with her personal identity. Specifically, STEM engagement opportunities directly recognized and engaged the historic and political oppression signified by the construction of the TMT and repurposed science knowledge and skills to facilitate and empower respect for her culture and its extensions to the land through the projects. Rather than seeking approval or engagement with the local science community, she used her projects and knowledge of circuitry and geology to both re-center science around Hawaiian knowledge and act as a disruptor of the assumed science power structure. This disrupted normative power structure facilitated deep enthusiastic engagement in community-driven science for Leilani, because the mechanisms of science could be harnessed on behalf of her community rather than having the resources of her community harnessed by science. Through these experiences, she began to conceptualize applications of STEM as something that could be driven by her community.

The second theme engages the dynamic tension Leilani perceives between science—and especially scien*tists*—and her land and community as a focus on *community rights*. On the island, science and Indigenous Hawaiians are at odds. Leilani expressed tremendous concerns for both her community's rights and for the land. These two codes came together under a larger understanding of her concerns for the rightful presence of her community. Her discord with science and the scientific community was driven by her community's discontent with being sidelined and ignored about issues deeply important to the community. Leilani had observed the lack of acknowledgement for intrinsic rights of Indigenous Hawaiians by the scientific community as related to sacred spaces like the Mauna Kea. As an Indigenous Hawaiian, she did not identify with the discipline she held accountable for denying her community its rights. As she stated, "they take advantage of the land and the people." Recognizing that rights cannot be given and that their withdrawal is a fundamental structure of oppression, Leilani's acts of science within the summer school class actively sought to disrupt the power structure of science on the island. In so doing, she saw room for her community, its culture, and its sacred lands to themselves be rightfully present within STEM by claiming and reclaiming the tools it offered in service of her own needs and priorities, opening the door for an alternative pathway for successful community-driven science.

## 5 | DISCUSSION

Leilani's case offers a unique opportunity to reflect on the interrelated roles of community science and rightful presence. At the start of our work together, Leilani felt neither rightful presence nor agency within STEM. For her and those in her community, science was a net harm, not something positive. Through the arc of her story, she progressed from an antagonistic perception of science to one where she is the protagonist in her own science story. She engages science so science can serve her and her community's needs. It is through a deliberate process of

creating rightful presence within the STEM learning environment that Leilani finds spaces in which her community becomes present in her schooling. For Leilani and many others in Hawaii, the educational opportunities they receive—designed and built on the mainland—are experiences divorced from their lives, their concerns, and the core tenets of their identities. Through the inclusion of her community's struggles for justice within a STEM space Leilani found ways to harness science and technology as tools of empowerment for her community, rather than disciplines of injustice and oppression.

When communities do not hold or experience rightful presence in science, community-driven science cannot occur, because communities and their members absent themselves from oppressive science opportunities and dialogue. For community science to be possible, rightful presence must be supported at two levels. First, individuals, such as Leilani, must have a sense of their own rightful presence and perceive agency worthy of their engagement within spaces of science, including classrooms. Second, in order for community science to truly be for the community, there must also be notions of community rightful presence. This includes a reflection of community values within school, government, and political dialogues. This framing creates a reciprocal relationship. Improvement to the agency and rightful presence of individuals improves the ability of communities to be rightfully present in science and improvements to community rightful presence can improve individuals' sense of rightful presence to engage with scientific and socioscientific dialogue. Without reciprocal rightful presence, neither individuals nor the communities of which they are a part will fully engage in community science.

While school leaders and educators had good intentions when they suggested avoiding any discussion of the Mauna Kea due to the controversy, it was the explicit avoidance of conflict that reinforced the disengagement of their Hawaiian students and community from meaningful participation in science learning. Ultimately a policy of avoidant silence simply marginalized the conversation already occurring and served as an active hindrance to interest in and engagement with community science.

Within these silenced margins, students like Leilani formed their opinions and perspectives on the value of science and the scientific community. That their concerns could not be openly discussed, ultimately heightened tensions and moved educators further away from their goal of community engagement. While the goal may have been to avoid conflict, the result was the silencing of the community. However, when the veil of polite silence was lifted, as it was in our summer school class, rich opportunities arose for youth to discuss the political nature of science on the island and its relationship to their communities. By leaning into the tension through open discourse and acknowledgement, community science became possible in a space where the historic marginalization of the Indigenous community had previously made it impossible.

In the discord and dissonance felt, youth like Leilani, found the voice to engage the messy history and current events of science on their island. By making visible the struggle under which her local community suffers, the bidirectional ballasts of rightful presence and community science fostered rich engagement, burgeoning positive associations, and meaningful connection that centered varied funds of knowledge within the science classroom space. Being rightfully present allowed youth to bring their community openly into the curricular space of the school for the first time. It actualized the potential of science to work on behalf of the community, rather than in opposition to it. Thus, justice is served better by a fusion of rightful presence and community-driven science as the impact of the two together is greater than the sum of their individual contributions.

Future research should seek to understand more about the dynamic relationship between community science and rightful presence at multiple levels to operationalize and better

facilitate and support community-driven science. More than ever, community-driven science is needed. Climate change and infectious disease education are two scientific issues among many that require global engagement. While these issues are large, their impacts are felt locally and must be engaged as such.

Community-driven science lends itself to substantial, field-wide contributions by creating meaningful spaces of rightful presence for more communities to engage with science as it impacts and drives aspects of their daily lives. Further, the objectives and means of science must make sense within epistemologies of place held and constructed by communities (Nazar et al., 2019). Accordingly, establishing and fostering the rightful presence of individuals and communities within science is essential to attain meaningful engagement with science to meet community needs.

Community-driven science offers the possibility for a sense of rightful presence for youth who have not yet had the opportunity to see science as part of their lives. Leilani, in so many ways, is an entirely typical teenager. She loves soccer, socializing, and making *TikTok* videos. However, the context and community that shapes her life is not like that of her white mainland counterparts. She lives her life within her community and culture, creating for her a unique set of disconnects with science. Within her everyday science classroom, Leilani never felt a sense of rightful presence. Her role was that of passive science observer, subject to the mitigation of educators whose focus was not her engagement with science but her passage of state tests. Coupling that sense of passivity and disengagement towards science, Leilani lived a cultural disconnect from science and technology as her community watched in horror as the TMT project moved ahead despite lengthy and vocal community opposition. Her classroom teachers did not make her science classroom a space that made science any more welcoming.

As she said in my first conversation with her, "there is no room for me, for a Hawaiian, in science, so I don't care about it." Her relationship with science was divided and hostile. For Leilani, she chose her community every time. Within her summer experience, a science and technology class specifically designed to support youth's sense of rightful presence, that attitude shifted. By centering STEM learning on Hawaiian history, ways of knowing, and values, youth did not feel they needed to choose between community and science. Leilani instead took the opportunity to author technology that served her community's needs and disrupted the "normative knowledge/power relationalities" (Calabrese Barton & Tan, 2019, p. 437) of science that previously constrained her STEM engagement to satisfying the imposed requirements of the conventional science classroom.

The teaching of any content area topic, devoid of context and meaning to the people and communities being taught, treats youth as vessels to be filled with knowledge by educators who act as the holders and brokers of knowledge. It is an approach that inherently denies the rightful presence of many, because it assumes the learner is a *tabula rasa*, a blank slate. It also upholds the false assumption that knowledge itself is devoid of context and positionality. Leilani demonstrated this need not be the case through her repurposing of STEM knowledge and skills to make visible issues of community importance; by interrogating the normative aspects of STEM that constrained her and her community's "right to reauthor rights" (Calabrese Barton & Tan, 2019, p. 618) Leilani reclaimed STEM for herself as a Hawaiian community member. Initially, Leilani did not utilize STEM for her own purposes and felt that those who did participate in STEM endeavors did so to the exclusion and detriment of her community. However, when she established rightful presence within her STEM learning, she made meaning of and with STEM tools in conjunction with her community values and wisdoms. Her steps towards community science extended her notions of what science could be, moving

beyond the activities of scientists who have not previously recognized the legitimacy of her community's interests.

As members of communities, youth need to feel their connection to scientific knowledge. Their learning must serve them. Without connections, science remains something where students are mere receptacles of knowledge. Community-based science offers mechanisms to bring science into youth's lives for their own purposes and considerations. Community-based science education reconsiders the *why* behind the teaching of science and supports students from marginalized communities' rightful presence in science.

Through use of the tools, discourses, structures, and methods of the scientific world, community science seeks to center and engage communities in science for their own needs and goals. It attempts to forge a partnership between the scientific community and the community of focus. At its best, as showcased by Ottinger (2010) and Gonsalves et al. (2013), the partnership between the scientific community and community of focus creates a seamless merger of interests and goals through collaboration and mutual support. Centered in the work are the needs, perspectives, and ways of knowing of the community of focus.

Inherent to this approach to community science is an unspoken epistemic belief in the rightful presence of communities to preserve and integrate their own spaces and ways of knowing as centered within scientific endeavors. When community science does not engage in careful community centering, it can devolve into an inequitable partnership in which the values and objectives of science supersede the those of the community. In contrast, when community science truly centers communities and community ways of knowing, the rightful presence of community members establishes a space in which meaningful and transformative engagement can occur.

As a member of her community, Leilani could not see the value or benefit to her community of engaging with science or the scientific community. As her perspective shifted, she reflected an openness to science and a sense of empowerment to harness science for local needs that can come from rightful presence. For community-driven science to fully realize its potential, specific modes of outreach (e.g., vehicles for both formal and informal education) must center individual and community identity and honor the contexts from which those have developed. Only when youth are fully empowered can community and community-driven science enhance the value of science for communities.

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## ENDNOTES

[1] *Native Hawaiian* versus *Indigenous Hawaiian*. The term native Hawaiian has become politicized and an area of much disagreement between some white Hawaiians born on the islands and Hawaiians of descent from the Polynesian peoples who have lived there for centuries. Many white Hawaiians who have lived their whole lives on the island have appropriated the term "native Hawaiians" for themselves, as they believe they are native to the islands by right of being born there. Thus, to avoid confusion and focus our conversation on the peoples Indigenous and native to these islands for millennia, we use the term Indigenous Hawaiian rather than native Hawaiian to avoid both confusion and further appropriation of the term.

[2] Citation not provided intentionally to protect the anonymity of participating school and community.

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