

Designing STEM Classes for Hawaiian Youth's Rightful Presence

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Abstract: This paper shares the process of designing a summer school science and technology class focused on youth advocacy and the development of youth *rightful presence* (Calabrese Barton & Tan, 2019) for students in Hawaii. We examine students' changing perspectives and connections to STEM through their engagement in projects that center their own geography and life experiences. Findings indicate that youth sense of agency and autonomy were greatly improved by engaging in a space where science and technology were tools serving their own goals of protecting the island from further development and tourist abuse.

Introduction

Students entering the STEM workforce must be both trained and motivated to do so. However, the ability of school instruction to impart the necessary knowledge is largely dependent upon a solid foundation of motivation and prerequisite skills developed earlier (Akerson et al., 2011). Low levels of participation in STEM have been traced back to a lack of effective preparation and a lack of interest from students; without prior exposure and interest, students are unlikely to choose STEM as a focus of future pursuits (Hall et al., 2011). As such, it is essential that youths' skills and interest be developed prior to the secondary level. Minoritized communities and individuals have long found themselves excluded from legitimated access to STEM classrooms, careers, and communities. In order to support student STEM interest within the context of rural Hawaii, this research explores the development and design of a culturally responsive computing and making class specifically designed to support youth *rightful presence* in STEM (Calabrese-Barton & Tan, 2019).

Background

Making and specifically targeted inclusive maker activities offer a context that can support the development of *rightful presence* (Calabrese Barton & Tan, 2019). 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). The duality of low and high tech materials used in making can provide 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 (Tofel-Grehl et al, 2017). Many making activities, such as electronic textiles (e-textiles) have been shown to integrate handcrafts and cultural funds of knowledge not often engaged in school classrooms (González, Moll, & Amanti, 2005). This has shown some promise in bringing historically marginalized groups into STEM (Kafai et al., 2014). Further, e-textiles are highly personalizable, providing opportunities to express oneself and connect with others through STEM. For instance, youth may use e-textiles materials to tell a story about a meaningful moment in their life or to build something to address an issue in their community (Greenberg & Calabrese Barton, 2017). Research in culturally responsive computing has also shown that narrative and place-based approaches to making are especially promising for bringing historically marginalized or excluded groups into STEM (Searle et al., 2020). Therefore, by engaging youth in STEM activities through making rooted in a particular place and support the sustained development of interest and personal belonging in STEM, further inroads may be made into how youth perceive who does STEM.

Theoretical Framework and Research Questions

Our goal for this work was to support the development of better STEM identity and youth agency among Hawaiian youth. To that end, we engage Calabrese-Barton & Tan's *rightful presence* framework to guide this work. Rightful presence is "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" (Calabrese Barton & Tan, 2019, p. 618). Rightfulness of presence requires youth to fully occupy the disciplinary space within their classroom in such a way that they are able to restructure and reimagine their learning space for themselves. Rightful presence calls for a deconstruction of the power structures fundamental to schools in three core ways. First, the notion of a choice to extend rights to all parties inherently requires a brokering of power wherein those with power choose to extend rights to those without it. This structure makes the rights of some contingent upon

the benevolence of others—something that inherently undercuts rightful presence. Secondly, rightful presence requires the acknowledgement that science cannot be divorced from the political. Rightfully present spaces recognize and make visible the political struggle of minoritized individuals central to their history as related to science. Third, rightful presence requires the active deconstruction and disruption of normative power processes that marginalize students. This disruption of structural oppressions creates visibility, and recenters the responsibility on the beneficiaries of power. For youth in Hawaii a rightfully present STEM class centers around issues and questions of great importance to communities on the island, such as the impact of tourism.

With this framework and a design-based research approach in mind, we ask the following research questions:

- 1) How can educators design opportunities to support youth's sense of rightful presence?
- 2) Does youth's rightful presence manifest into action or agency within a classroom setting?

Methods

We engaged a phenomenographic lens for qualitative data collection and analysis during the course design and planning, the teacher professional development, and the ten day class sessions. Data collected include audio recordings of the class, curriculum design notes, fieldnotes, interviews, and photographs of artifacts.

Context & participants

Ten youth from around the local town enrolled in the middle school participated in the maker class, which met four hours a day for two-weeks. Youth were from various cultural and social backgrounds. The participating teacher is national board certified in science and social studies and has been teaching for over 20 years. She has been teaching at this public charter school for the past 8 years since moving from the mainland to Hawaii.

Description of the class

The class was co-designed in collaboration with the participating teacher. Her focus was on finding ways to engage science and technology to support youth awareness and activism with indigenous issues on the island. The class included two place-based field trips to sacred sites on the island. Youth engaged in three Hawaii focused maker projects. The first project tasked youth with engaging in making a paper circuit plaque that shared information about themselves and their passions (see figure 1). 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 want 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.



Figure 1. Example of Name Placard, 3D Printed Volcano Map, and Advocacy App

The second project (figure 1) saw youth using 3d printed topographical maps to build computational circuits that explored the geology and history of the island's volcanoes. This project let students engage with both the geography and geology of their island. Students investigated topics such as volcanic age, activity, or height. 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.

The final project engaged youth in the design and coding of "advocacy apps." During the place-based fieldtrips, youth were tasked with interviewing land caretakers about the behaviors and actions of tourists as they visited important places around the island. These interviews were used to generate class derived codes of conduct for sacred spaces. Youth then built apps to support tourists engaging in appropriate behaviors (see figure 1).

Data

A member of the research team took fieldnotes and kept daily reflections during and after class. In addition to the collection of qualitative fieldnotes, table microphones were used to collect audio recordings of the groups. A

total of 40 hours of class time were recorded and transcribed. At times youth were interviewed to follow up on conversations that emerged organically at tables. Daily photographs were taken to capture the process of making and youth engagement with designing projects that engaged their identities. Of specific interest in tracking shifts in youth identity were localized projects focused on various places on the island.

Findings

In seeking to develop youth's sense of agency and rightful presence the class needed to support youth in finding contexts and content that was both meaningful and applicable in their daily lives. With the rising resentment across the island towards tourist vandalism, the collaborating teacher felt that engaging youth in learning and thinking about how they could affect behavioral change on their island was essential to students on Hawaii.

The first project was designed as both an ice breaker and key point of contact for us to be able to collect information about what was of value to the youth in the class. Designed by the collaborating teacher, the activity asked youth to share their names, pronouns, and four facts. Students were asked to share a passion, a place they love, a hobby, and a science interest. As she conceptualized the activity, the teacher noted:

I like this name card activity because it lets us learn about the kids and what is important to them... If we combine it with the paper circuit, the kids can learn that part of the science while we learn what matters to them. When the kids can tell us what matters to them, they get a lot more into it.

By allowing youth to share their interests and passions, we were able to open up dialogues in the class with the specific goal of creating greater rightful presence for youth. For example, when one student, Leilani, shared her passion for protecting the Maunakea volcano from further development and destruction by scientists who were seeking to put up another large telescope, we pivoted the conversation to talk about why this conflict between Indigenous Hawaiians and scientists was important for all citizens of the island.



Figure 3. Leilani's name card showcasing her care for the Maunakea and disinterest in science.

With the conflict on the island having been the source of great angst for some students like Leilani, who spent her weekends with her family camped on the mountain seeking to stop impending bulldozers, other students made clear their lack of knowledge about the conflict. When Leilani explained the importance of the site, classmates began to discuss why it was important for everyone to help solve the problem. Marcus commented "Yesterday I did not even know about this. But now I can understand why Leilani is upset. I would be mad too if someone bulldozed my church. So, like, helping stop this is really important."

In Marcus we see the beginnings of an awareness at the injustices around him and the urge to help his friend make better a problem that was important. This marks the beginnings of a more rightfully present classroom as students uncover and address injustices, one of the core tenets of rightful presence. This dialogue continued as students engaged in their second project, the 3D printed volcano. After learning about the ages, activity, and relative heights of all the volcanos on the island, they selected three to create a computational circuit with actuators to model features of the volcanoes. Students programmed microprocessors to help tell the geologic story of their island. Tying the scientific information about the volcano into her display, Leilani shared some of her knowledge about how its great height was explained in Hawaiian culture because it was the child of the sun and earth. This bridging of scientific understanding with her Hawaiian epistemology brought Leilani to the idea that "geology isn't so bad." Her softening towards science was noteworthy because of her belief that science was at war with her people.

During the class students took two field trips to Hawaiian sacred sites. The first field trip took youth to the Wai'pio valley to interview and learn from the land's caretakers. The second field trip brought youth to the

Pu'ukohola Heiau, a national historic site and holy site to Indigenous Hawaiians. Through their conversations with the land caretakers students learned about the many problematic behaviors of the visitors to these sites. After these two field trips, the class began to brainstorm ways they could help people learn about the rules and regulations they needed to follow to have a respectful visit to these spaces. Youth engaged in a design and coding project entitled Advocacy Apps. Using MIT's App Inventor, a visual programming environment designed to facilitate app building for novice programmers, youth designed and built apps that explained the importance of respecting Hawaiian spaces and appropriate codes of conduct.

Students were eager participants in the design and coding processes for their apps. As one youth commented "These apps are good because I think people could really use them. They might work." The project marked a turning point for several youth in the class. Rather than observing and worrying about the injustices they discussed as a class, participants were able to engage with a problem and work to bring attention to the issue. In doing so, several youth commented on how they could see the value and applicability of the project. As Manzina said "I really like this because I feel like I can do something. In school I can't do anything with what I learn." Manzina's comment highlights precisely why designing for rightful presence in STEM is so important.

Conclusion and Discussion

Designing projects in support of youth rightful presence can be challenging but offers unique links between youth home identity and school identity. Making can provide youth a meaningful, culturally relevant way to engage with science learning around issues important to them. We see in this class experience that teachers are able to bring together content knowledge they need to teach with projects that engage student interest on a personal level. This integration of science into their daily lives and concerns creates a space in which science is personally and politically meaningful. Rightfully present science teaching not only makes science more accessible, but it also works to dismantle historic notions of what science is and who does the work of science. Culturally relevant making and rightfully present science go hand in hand to redefine what science is, who does science, and what science can bring to the lives and experiences of communities across the globe.

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