

Understanding, Redefining, and Designing for Broadening Participation

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Introduction

I study broadening participation. As a learning sciences researcher with a critical sociocultural stance to learning and development, I believe that our work is inextricably linked to questions of social justice, power, and cultural repertoires of practice. My research is oriented around two core beliefs—persons develop in structures of social practice and we can come to understand these structures by examining participants' cultural learning pathways (Bell, Tzou, Bricker & Baines, 2012). Given this stance to learning and development, I choose design-based research and ethnographic methods as my dominant approaches because they both privilege the experiences of participants. By leveraging ethnographic methods within the larger context of design-based research, two types of findings emerge from my work that pertain to design and theory: 1) design principles—findings about program design, curricula, pedagogies, mentorship, and implementation within communities and 2) broadening participation theory—findings about learning, Deep Hanging, deepening participation, and identity development for participants from non-dominant communities.

Design principles

Design-based research in STEM OST environments has been central to my research on broadening participation. From September 2010 - June 2015, I ran an out-of-school time (OST) chemical oceanography program called Project COOL (Chemical Oceanography Outside the Laboratory) that served middle school youth from mostly non-dominant communities. COOL was a design-based research and broadening participation initiative funded by the National Science Foundation and the LIFE Center. During years 3-6 of the program, we brought undergraduate and graduate students into COOL to serve as mentors and facilitators. Learning sciences researchers have paid much attention to OST environments as transformative spaces for youth participants. My interest in layered learning environments expands this to include the learning trajectories of adult participants within OST broadening participation programming.

Broadening participation

My research on broadening participation resists catastrophizing narratives of underrepresentation within STEM careers and learning environments while exploring experiences of participants from non-dominant communities. I explore the notion of broadening participation as a tension between the need to add more people from non-dominant groups to existing STEM disciplinary paradigms and transforming definitions of participation to include the experiences of STEM participants from non-dominant communities. What follows is an illustrative narrative in action from my data:

Angelica self-identified as Peruvian American and was a graduate student in Botany who came to graduate school with the goal of becoming like her undergraduate mentor, “the kind of person who could inspire students” (3/15/11). Angelica wanted to use her PhD to become an undergraduate professor. She wanted to create a program of Botany research that could also serve as a context for broadening STEM participation opportunities for students like herself. However, her dissertation committee's expectations of who and what she should become dominated any conversations she tried to have with them, “In my situation the expectation was just for me to primarily be a research student, and my training to be one for the person who would want to go into an R1 institution, though I'd never seen that to be what I wanted from the beginning. I got no help in how to develop myself as an educator” (3/15/11).

Settled expectations (Bang, Warren, Rosebery & Medin, 2012) constrained Angelica's available STEM participation pathways. When Angelica found COOL she viewed it as a pathway to creating her own educational theory and practice curriculum. She and other mentors from non-dominant groups explained in interviews that they saw the COOL program as a context within which they could resist settled expectations and redefine what counted to them as STEM participation.

As a sociocultural researcher with an equity-oriented frame, I take a critical stance towards understanding how individuals learn within structures of social practice (Bell et al., 2012; Dreier, 2009). I view

learning as deeply relational and situated. In my work, I define learning as the ways that participants deepen participation in complex activity systems (Bang & Vossoughi, 2016; Gutiérrez & Jurow, 2016), develop critical epistemic agency (Basu, Barton, Clairmont, Locke, 2009), develop identification within STEM disciplines (Carlone & Johnson, 2007), resist settled expectations (Bang et al., 2012), and develop science-linked identities (Nasir & Hand, 2008). I take a critical stance to understanding the affordances of out-of-school time (OST) learning environments and designing for broadening participation by considering powered relationships in STEM learning spaces. I am aiming towards a theoretical and practice-based understanding of the role OST learning environments can play in broadening STEM participation for people from non-dominant communities—Deep Hanging. This approach allows me to attend to both increasing participation in existing STEM paradigms and also redefining participation in learning spaces that honor participants and epistemologies from non-dominant communities which have historically been underrepresented in STEM.

Current work

I currently work on a project jointly funded by the National Science Foundation and Wellcome Trust—Learning and Environmental science Agency Research Network for Citizen Science (LEARN CitSci). Citizen Science is another space for broadening participation which positions the public to participate in contemporary science, learn scientific practices, and contribute to ongoing research. Citizen scientists ask their own questions, conduct their own analyses, and leverage the resources of science institutions to conduct research in their own communities. Ballard, Dixon, & Harris (2016) expanded upon Basu & Barton's (2009) notion of critical physics agency to define Environmental Science Agency (ESA)—youth enacting agency in environmental and citizen science contexts. Our goals in the LEARN CitSci project are to understand the ways that youth participate in environmental and citizen science programming facilitated by natural history museums and to characterize individual programs as designed environments which present affordances and constraints for youth engaging in ESA.

An emerging research agenda

I am interested in studying the affordances and constraints of designed learning environments in order to understand ways to maximize opportunities to redefine and broaden STEM participation. I introduce Deep Hanging as a theory of learning in practice. Deep Hanging entails authentic tasks in rich contexts, providing access, capitalizing on opportunity, and building interpersonal relationships which in turn strengthen identification with the discipline, facilitate learning, and redefine participation. I leverage my findings about non-dominant youth and adult participants' experiences to consider the affordances and constraints of designed-learning environments for broadening participation. These findings have coalesced into a set of design principles for layered learning environments- spaces that support mentor learning in broadening participation programming while supporting science learning and identity outcomes for youth. As my critical orientation continues to develop, I explore the narratives of participants from non-dominant communities in STEM, participatory design-based research (Bang & Vossoughi, 2017), and unsettled expectations (Bang et al., 2012) to reevaluate my theory building about youth and adult experiences within broadening participation programming. I resist narrow definitions of STEM participation by examining the limits of epistemic agency (Scipio, 2017b), pushing back against the metaphor of the Leaky Pipeline, and exploring pedagogies of joy in broadening participation learning environments (Scipio et al., 2017a).

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