Citizen(s') Science

A Response to "The Future of Citizen Science"

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ABSTRACT

Citizen science is fundamentally about participation within and for communities. Attempts to merge citizen science with schooling must call not only for a democratization of schooling and science but also for the democratization of the ways in which science is taken up by, with, and for citizen participants. Using this stance, along with critical studies of place, I build on the criticisms of citizen science outlined in "The Future of Citizen Science" to argue for the centrality of place. Using a case of urban youths working toward transparency and cross-cultural dialogue regarding energy production in their community, I complicate the proposed immersion model to suggest a further reconstruction of citizen science in ways that account for youths' deep and critical connections to the geohistorical and sociocultural dimensions of place.

This article is a response to:

Mueller, M.P., Tippins, D., & Bryan, L.A. (2012). The future of citizen science. *Democracy & Education, 20*(1). Article 2. Available online at http://democracyeducationjournal.org/home/vol20/iss1/2/.

In my response to "The Future of Citizen Science" (Mueller, Tippens, & Bryan, 2012), I first point out two crucial lessons to be learned from the critical analysis of citizen science proffered in that article. I then use these lessons to push the authors on their proposed future directions for citizen science by suggesting that they overlooked a fundamental question of citizen science: that of place. I argue that citizen science is fundamentally about participation within and for communities and that attempts to merge citizen science with schooling must not call only for a democratization of schooling and science but also for the ways in which science is taken up by, with, and for citizen participants.

Repurposing Citizen Science

In their essay, Mueller, Tippins, and Bryan take on the history and practice of citizen science in order to build a case for a redirection in efforts. At issue in their framing is that the purposes for and the scope of participation in citizen science require radical redefinition if citizen science is to "democratize" science. Democratizing science, according to the authors, involves "include[ing] others who are marginalized in the community in more meaningful ways" (p. 7), such as through "fully explor[ing] multidimensional uncertainties that are implicit within science" (p. 8). Reminding readers that the history of science is replete with "androcentric philosophical science perspectives" (p.3) that have homogenized best practices in science while simultaneously shifting the locus of control to men, the authors call attention to how citizen science is, ideally, a multiperspectived and dialogic process for doing science.

In making their case, the authors use the example of teachers in the Philippines who fashion school science around community concerns. These teachers, acting as "teacher culturalists" and "teacher naturalists" (p. 10) by monitoring the health of a community and taking its pulse in relation to the environment play central roles in democratizing science by helping to create space for the authentic uptake of community knowledge in solving socioscientific issues. At the same time, teacher culturalists open up learning by expanding outcomes of learning through action-taking in their communities. This reflects an image of school science that stands in stark contrast to current practice, worldwide.

The authors powerfully laminate this empowering narrative of citizen participation reimagining science on top of the historical construction of citizen science; this illustrates how the traditional practice has fashioned citizens as mere laboratory grunts rather

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than as coconstructors. Citizen science, as a form of participation in science, has been conducted on scientists' terms. Citizen scientists are technicians rather than equals who "collaborate with scientists" (p. 3), disallowing opportunities for the democratization of scientific knowledge, tools, and resources. Such coexistence might indeed help to transform the scientists and their research. Even when citizens do the work of scientists, in ways prescribed by scientists, the outcomes are not always taken seriously within the worlds of science. Data are perceived of as less rigorous and margins of error as higher than that produced by or expected of those granted a science degree.

The authors implicitly acknowledge that the image of the laboratory grunt may be an unfair caricature of the citizen scientist across the entire historical domain of citizen science. As they note, one of the oldest ongoing citizen science projects, the Audubon's Christmas Bird Count, has for over a century involved the layperson in surveying birds, allowing for a rich repository of information on bird species worldwide. The project involves people from all walks of life and geographic locations and with a wide diversity of reasons for engaging in the survey of birds. In so doing, it has allowed a broad spectrum of questions to be asked about bird populations.

I see two crucial lessons to be learned from this critique and redirection. One of the lessons to be drawn from the authors' careful critique regards the purpose of citizen science. Citizen science, as a tool, historically has not been about democratizing science—about offering multiple perspectives or transforming a knowledge base or a set of tools or resources—but rather has been about getting more work done. I cannot help but think about this in light of the neoliberal agenda of corporate expansion. For example, the carefully constructed guidelines for participation in the Galaxy project, an open platform on which anyone can perform, reproduce, and share biomedical analyses, show clearly that the emphasis is on "getting it right" rather than on figuring out what multiple perspectives might yield or how to "do science better." The careful trading of "getting it better" for "getting it right" cements the capitalistic goals of the scientific enterprise rather than any sort of democratic goals.

A second lesson to be learned has to do with the philosophical bases of citizen science itself. To whom does citizen science belong? This question harkens back to feminist concerns regarding by whom science and knowledge are controlled and for whom they benefit (Harding, 1991). The models of citizen science outlined in the article to which I'm responding, in particular the stories of honeybee colony collapse, suggest that despite citizens' intentions for participation (i.e., caring for a community), citizen science in both scope and function is tightly mediated by those already with authority—those who set up the questions, the tools, and the resources for participation.

Citizens' Science with and of the Community

These two concerns regarding purpose and authority challenge the reader to think differently about citizen science and its relationship to community. In the community immersion model, the community matters as both a context for and a subject of investigation, accounting for both the physical spaces of the community (i.e., places where science can be done) and the interactions among people and place (e.g., why building a bridge might be an important topic). There are few examples in the science-education literature where local knowledge and practice are taken as a fundamental dimensions to doing science—not mere motivations for learning. However, in the spirit of working toward a more just world, I would like to push the article's authors further in their reconceptualization of citizen science. Drawing from critical studies of place, I wonder how the intersections among and the relationships within communities and the geohistorical and sociocultural dimensions of place (Gruenewald & Smith, 2008) might further redirect citizen science.

In the community immersion model, teachers travel to their host communities and interpret culture, using their content expertise to mediate dialogic interaction between local and scientific knowledge, such as when "physics majors designed a bamboo bridge to minimize the effects of the erosion" (p. 10). To what extent is the science work in the community immersion model with and of the community? If teachers name and lead community science efforts with their outside knowledge and expertise, then whose science is this?

Take, for example, the science work of youths in the community-based green energy program GET City around whether Lansing, Michigan, should build a new power plant (for a lengthier discussion, see Kissling & Calabrese Barton, 2012). In early January 2009, the city's electric company informed its customers (everyone in Lansing with a permanent address) that the city power plant, which provided the city with 69% of its electricity, was aging and that the cost to operate it would increase alongside the environmental challenges it posed. One plan to address this involved building a new hybrid power plant that would generate electricity from 70% coal and 30% biomass sources. A different plan was to buy electricity on the volatile open market. While both of these choices would mean increased electric bills in the future, the envisioned hike associated with the greener plant would cost one third that of the hike from the volatile open market.

Lansing's need for a new plant coincided with intensely challenging economic times, with unemployment rates at a historical high in the city and with a state economy ranked last in the nation. Many of the youths in GET City had families and friends who had faced foreclosure on their homes and lost jobs or endured budget cuts at work. It was not surprising that their responses to the plant were multifaceted, laden with economic as well as scientific concerns. As some of the youths stated (unpublished youth survey, April 16, 2009):

> *My mom doesn't really care about green power plants and global warming but she always says every dollar counts.*
>
> *[If costs go up] how are people going to feed their families because if they have no power, all their food will go bad. How they are going to work . . . . in the dark?*
>
> *It could still pollute the air because it would rely primarily on coal. Why you guys want to burn more coal than biomass? How come we can't just burn biomass instead of coal?*

The new plant would be a good step forward for all renewable energy. It would be a good step forward, and there will be more jobs needed to build it.

The youths were frustrated with the lack of publicity about the plan as well as the dearth of information provided about why this plan might or might not be best. The youths set out to learn what they could about the new plant, and also about alternatives to the new plant. They wrote to local energy experts, asking them to assess the renewable, clean, and green qualities of energy sources such as coal, wind, solar, and biomass. They surveyed their peers and adults in the community at a range of locations, from Walmart to churches, about the plant proposal: Were people aware of it? How did they feel about it? They took trips to local places that were generating electricity from alternative sources, including a local solar panel array and a local wind turbine. Using small-scale wind and solar power experiments, the students simulated electrical production and recorded both quantitative and qualitative data about what they found. They wrote letters to the editor of the local newspaper about the topic.

What seemed to matter to the youths was not finding the right answer to the question of whether Lansing should build a new power plant. The youths, like the experts, could not come to consensus on an answer. What seemed to matter more to the students was engaging the community—including parents, peers, the electric company, and local environmental coalitions—in critical dialogue. They knew that their families could not afford higher electricity rates. But they also knew that the status quo could not continue. They knew that renewable energy sources were better for the environment, but they also knew that each form of alternative energy has its pros and cons. They synthesized their findings in digital stories, PowerPoint presentations, and posters, and invited the community to come together to discuss their findings.

In April 2009, the youths led a large community forum at a local Boys & Girls Club to educate the public on the city's plans and the reasons why some groups opposed it, the science behind the proposed design, and the possible alternative options that would provide for the city's energy needs while also attending to consumer budgets and environmental concerns. Leaders of the electric company and the local environmental coalitions debated the issues and answered further questions. When the forum concluded, leaders from both groups could be seen talking in a corner of the room, shaking hands. It was after this exchange that an electric company representative walked over to the members of GET City, who had just led the community forum, and made the following comment: "If it was not for the youth investigating the proposed design for a new power plant, we may have never talked to the environmental coalition" (personal communication at Community Forum, April 23, 2009).

This remark reveals the community impact of youth engagement with science. The students' research findings reflect a long struggle between city government and a vast coalition of environmental groups opposed to the city's plan to build a new power plant that was primarily reliant upon coal. They reflect families' struggles in difficult economic times. They reflect a community's desire to improve the quality of air and of life. At the same time, they offer a new and different space for moving forward.

Whose Science? For What Purpose?

As is seen in the power-plant debates, citizen science is not just about students doing science in the community or involving other community members in doing science of possible relevance to the community. While both of these elements matter, I believe doing science with, in, and for the community fundamentally involves a reconstruction of citizen science in ways that account for youths' deep and critical connections to their community—in other words, in ways that account for their sense of place. Such a stance on citizen science positions participants—in our case, youths—as community science experts, individuals with a collective expertise characterized by a deep connection to place, the capacity to use this connection to engage community members, and the knowledge of scientific processes to take action on local issues (Calabrese, Barton, and Tan 2010). Such a turn reframes *citizen science* as *citizens' science*, refiguring the importance and meanings of *community*, *science*, and *expertise*. As demonstrated by the power-plant story, youths' positions within their community—as youths who knew something about green energy, as members of families hard hit by the economy, as kids with asthma, as individuals who care about their community's survival—all mattered in how they took on the problem of the power plant and the science they took up in order to do so. Being experts meant negotiating a range of discourses—science, economic, health, and others—to foster conversation across difference. Such work is part and parcel of life within a community. It is citizens' science.

Is citizens' science an outcome worth striving for in schools? Is citizens' science even possible in schools? As expressed in Weinstein's response (2012) to Mueller, Tippins, and Bryan's original article, citizen science is unlikely to happen in schools for schools are fundamentally undemocratic places. Indeed, this response's own example, of the citizens' science regarding a power plant, takes place in a community setting, not in a school. Schools have sought out place*less*ness as a defining characteristic. In schools today, teachers and students are rarely asked to identify with place as a part of teaching and learning science. The very notion that place ought to serve as context for, subject of, and driving relationship framing the doing of science stands in stark contrast to the norm in science education that the focus is on standardization through testing and curriculum. Indeed, a push away from place has been the hallmark of reform over the past decade.

Engaging youths in citizens' science advances the goals of science education because it includes, but pushes beyond, the scope of knowledge and skill development. It positions youths as community science experts who, as mentioned earlier, work across disciplinary boundaries. It changes how we think define intended outcomes of science education from abstract mastery of discrete knowledge and skills to experience in appropriating knowledge and skills in multi-, inter-, and trans-disciplinary ways. It essentially changes what it means to develop expertise in science. It is no secret that people facing real-world situations do not isolate ways of knowing from each other. Allowing youths to leverage their sense

of place provides opportunities for them to engage with real-world situations of global importance and local relevance and demands this be essential to students developing expertise. However, in order for youths to leverage their critical connections to place, their knowledge and practices need to be seen as legitimate and places for multi-, inter-, and trans-disciplinary talk need to be a part of the ordinary curriculum and pedagogy of the classroom.

Citizens' science makes science broadly accessible in the community by allowing those most invested in problems to situate scientific talk and thinking within the daily lives of ordinary people and by orienting the doing of science toward those individuals taking personal responsibility and action. Part of making ideas accessible requires a localized knowledge of the scientific phenomenon at hand. For example, carbon cycling is a big idea (and an abstract idea) in science and yet, for the youths in GET City to be community science experts means that they could explain its value in terms that made sense scientifically as well as contextually to their schoolmates, families, and community members, with multiple and appropriate forms of evidence—such as one student stated, by "changing watts to dollars" (Interview with Jana, April 30, 2009).

The benefits of citizens' science to students and their communities are perhaps best expressed by one GET City youth describing video documentaries she made about an investigation she and her peers conducted on whether their city exhibited the urban heat island effect and its role in GET City's building securing a green roof (Calabrese, Barton, and Tan, 2010, p. 216):

> The movies were all about our research and what evidence we gathered . . . You have to show them [community leaders] somehow. Like, if we just wrote papers and stuff it would be just like school and stuff but I think that it was a fun way for [others] to learn so we need to do this for them.

Later the youth added, "No one listens [to us] in school" (unpublished interview, July 2009). This youth's comments suggest that she sees a fundamental difference between doing science for school and doing science with and for the community.

Making citizens' science a part of schooling is a daunting project, but not impossible. The basic tools needed to bring citizens' science to fruition in schools are already available—if we are creative and persistent. The nods toward the necessity of relevant and meaningful learning, in earlier calls for and repeated in the most recent frameworks for science literacy (American Association for the Advancement of Science,1989; The National Academies, 2011), ought to be called out directly and used to push toward citizens' science. Indeed, the new reform documents suggest that school science ought to be framed around relevant and meaningful problems—problems that are substantively valued in the discipline as well as compelling to teachers and students (Duschl, Schweingruber, & Shouse, 2007). While arguably such calls for relevant and meaningful learning in reform documents don't go far enough, calling merely for connections to be made among scientific concepts and practices of importance to people's everyday lives and interests, the calls are there. Their presence in the reform discourse can serve as a catalyst for opening discussions around more critical orientations toward relevance and meaningful learning.

Leveraging the language of reform documents is clearly not enough. We must allow students and their families—the citizens of citizens' science—and their critical connections to place to lead the way. In the case of the power plant, adult community leaders might not ever have known how the topic of energy transformations mattered to youths in profoundly personal ways if youths themselves had not brought their stories to the adults. Taking on citizens' science, therefore, requires a curricular and pedagogical approach that situates the work of schools within the community and that is attendant to youths' sense of place and how it shapes their engagement with knowledge pertaining to the social, economic, and political dimensions that are inherent in science.

Citizens' science ought to be part of the work of teaching and learning in schools. In many ways this is no different from what Dewey & Dewey (1915) argued for a century ago, the transformative possibilities in experience. We must heed Dewey's call for the transformative value of experience so that we do not make the "greatest mistake" of forgetting "that learning is a necessary incident of dealing with real situations" (p. 3). Citizen science, as described by Mueller, Tippins, and Bryan, offers an approach that may democratize both teaching and science. However, until schools become a part of community and teaching, learning, and science become emplaced (Lim, 2010), we may continue to be left asking, *Whose science? Whose knowledge?*

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