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Grappling with wicked problems: Exploring photovoice as a decolonizing methodology in science education

Kristin Cook

Keywords photovoice · environmental sustainability · research methods

“...we can no longer afford to acknowledge the value of the ecology in sub-Saharan Africa but do little to facilitate its continuation through a method demonstrated to work in other contexts— authentic, democratic engagement of local communities” (Quigley et al. p.18)

In their work with teachers and community members in Kenya, Quigley et al. seek to localize the ‘wicked problems’ (Churchman 1967) of environmental sustainability through the use of decolonizing methods to challenge top-down approaches to solution-generation in the bountiful yet environmentally compromised Rift Valley. By contextualizing the study of sustainability in this way, science education research can assume the form of community engagement that is ultimately meaningful and maximally impactful to teachers, students, and to the local community. This type of engagement requires re-conceptualizing science knowledge, science practitioners, and science education, as well as moving from a focus on transmission of decontextualized knowledge toward activities embedded in particular places and in matters of local concern. Environmental issues, which at their heart are complex, contentious wicked problems, require a weighing in of multiple perspectives if attempts at resolution are to be sustained by the local community. In concert with Quigley et al.’s work with Kenyan

teachers and community members exploring notions of environmental sustainability, this article frames the decolonizing methodology of *photovoice* using Jürgen Habermas' theory of communicative action to expand on theoretical underpinnings for inclusive deliberation of wicked environmental problems.

Importance of decolonizing methodologies: Overcoming the scars of scientism

While over time western modern science has been stretched and flexed to renegotiate its boundaries, much of what makes it past the 'gate-keepers' and into textbooks and surrounding curricula rests heavily in the western world. The weighty emphasis on empirical evidence and objectivity promulgated by western modern science often precludes a deep consideration of other ways of knowing (Aikenhead and Jegede 1999). Perhaps we can hold the philosophy of empiricism to partial blame for the way the public too often views science as a body of facts, disconnected from other ways of knowing. This position implies that the only true knowledge is scientific knowledge—that is to say, western modern scientific knowledge, which can only come from positive affirmation of theories through strict science. In this view, the process of scientific inquiry has nothing to do with the social, cultural, or metaphysical realms of life. However, the value-free and amoral view historically advocated in science has done little to help learners navigate the assimilation of science with their worldviews.

Along with the intellectual movement of the Enlightenment, during which reason was advocated as the primary source and legitimacy for authority, came the high price of *scientism*. Scientism is a view that the natural sciences have authority over all other

interpretations of life, including philosophical, spiritual, or humanist explanations. Contentious debates over scientism continue today with Steven Pinker's (August 2013) recent *New Republic* essay entitled "Science Is Not Your Enemy: An impassioned plea to neglected novelists, embattled professors, and tenure-less historians" whereby Pinker dismisses scientism as nothing more than a 'boo-word' and argues that science actually poses and has posed no threat to humanities. The maelstrom of respondents would disagree and argue instead that science has a strong history of oppression and dominance over ways of knowing. As philosopher Jürgen Habermas (1984) articulated in his pivotal work *The Theory of Communicative Action, Volume I* "...modern western societies promote a distorted understanding of rationality that is fixed on cognitive-instrumental aspects and is to that extent particularistic" (p.66). It is this teleological and deterministic thinking that is central to science as an explanatory force. It is not surprising then given the dominance of western thought around the world that debates and resulting policies regarding environmental sustainability often take the form of top-down mandates rather than deliberation invoking perspectives of those most impacted by environmental change and degradation—such as been seen by the Maasai community among many others.

In science, an overarching asocial paradigm functions to streamline scientific endeavors. Thus, if all scientists operate under a given paradigm, then socio-political factors or cultural considerations, for example, do not need to be accounted for. With increasing complexity at the systems level of our global society (for example, division of labor and specialization of institutions), culture changes as well—including the culture within which scientists work. Within scientists' occupational cultures, structures exist to

streamline processes of reaching consensus between workers. As well, rationally organizing labor in factories so that the work completed by each person in an organized system gets the most profit for paid wages has also become a premium endeavor. As a result of this materialistic worldview, people have been treated as objects and have been subjected to the effects of instrumental rationality.

As Immanuel Wallerstein (1974) describes, the core (in this case, European capitalist systems) benefits at the expense of peripheral economies resulting ultimately in large disparities among world residents. As such, skewed development impacts members of various economies differently. Such is the case with environmental regulation; as David Harvey outlines in his 2005 book *A Brief History of Neoliberalism*, government intervention is supported only when it benefits the economic elites. Thus, the free market should take its course to weed out inefficiencies *only* when said inefficiencies impact the elite. This leaves the non-elite to fend for themselves. In effect, capitalist systems themselves encourage a worldview in which scientism seems to make sense. Consequently, as long as scientific research is mainly tied to the economic system, what is chosen for research and the uses to which knowledge is put will both be heavily value-laden. In this lopsided worldview, objective validity claims are emphasized and normative-moral reasoning is devalued at the largest levels of social and system integration; though as we see in the debates surrounding indigenous knowledge systems, this type of thinking has brought about a great deal of critique in science education research.

As we strive to move away from the heritage of scientism, an emphasis on the human influence to science has set the stage for the constructivism of the postmodern era.

Habermas (1984) suggests, “Cognitive development signifies in general the decentration of an egocentric understanding of the world” (p.69), to exemplify that attempts to limit the self and all its values and biases allows for more freedom in interpreting the world. Current reform efforts in science education research recommend that science classrooms should allow a place for reflection on the social and cultural implications of scientific claims and innovations. As seen in the case with American dependence on coal despite the negative environmental impacts, Western thought has privileged notions of objectivity and consequently ignored very important parts of the socio-political influences on scientific processes, as well as the subjective and normative realms of scientific deliberation. Instead, many have argued science should be taught as a situated, relevant and socio-political discipline that is informed by and has implications in all learners’ lives (Hodson 2003). Constructivists have long attested to the perils of scientism and have illustrated how scientific practices have in fact never been outside of the socio-cultural realm. Scientific inquiry, constructivists argue, is not objective, value-free, nor without preconceptions with regard to what constitutes good or valuable science. On the contrary, it is a human enterprise practiced in the context of a larger culture- and scientists are the product of that culture.

Quigley et al.’s work speaks to the importance of decolonizing methodologies to bring forth voices of those impacted by and coping with the decisions of others regarding the environmental policies and management of their communal resources. In an effort to create a space whereby perspectives of community members may enter into the conversation about the meaning of conservation and thoughtful use of valuable resources, their work ultimately attempts to expand the dialogue concerning western modern science

and indigenous knowledge. Furthermore, it illuminates questions regarding the impact of such methodologies on the participants as well as the community of science at large.

What effect do decolonizing methods have on participants and/or on the practice of science? Will the Maasai community transform their relationships with their environment and ‘begin to enact sustainable alternatives to destructive environmental practices’ (p.3)?

What will the receivers of these perspectives do with them? Though the answers to these questions remains unexplored in Quigley et al.’s work, their use of decolonizing methodology has a noble aim in seeking to improve participants lives while also informing the field of science education about how to structure curricular reform efforts to be inclusive and impactful.

Theoretical underpinnings for emphasizing multiple voices in science education

If we agree that teachers and community members should be a part of the socio-scientific conversation regarding complex issues of environmental sustainability, it is here that Habermas’ theory of communicative action (1984) can be employed to disentangle validity claims and contributions made by learners of and participants in science. For Habermas, dialogue among and within worldviews is paramount.

Habermas’ idea of communicative action underscores the value of dialogue in scientific understanding and advancement. In an effort to advance science, the morals, values, and norms that are present in meaning can and should be untied from the objective claims made, and in a way that then allows us to examine relations between these claims in the learning and practice of science. He suggests:

The concept of communicative action presupposes language as the medium for a kind of reaching understanding, in the course of which participants, through relating to a world, reciprocally raise validity claims that can be accepted or rejected (p. 99). Even in western science, with objective claims often conflated as fact, it is in the claims that one can uncover differential perspectives and testable ideas. Current reform efforts in science education research recommend that science classrooms should allow a place for reflection on the social and cultural implications of scientific claims and innovations—and in doing so, qualitative research in science education should incorporate an examination of the beliefs held by the researchers and aim for *ideal speech situations* (Habermas 1984).

Habermas' theory asserts truth can never be determined by just one actor. The best way to reach a valid truth claim is through social integration in a democratic way. This implies that implicit and inherent in any attempt to reach mutual understanding is a presupposition that all voices involved in the dialogue can be reciprocally and equally voiced and attended to on their own grounds. This ideal serves as a standard for recognizing when our attempts to reach mutual understanding fall short in practice. The ideal speech situation necessarily involves intention and the presupposition to reach mutual understanding through communicative processes. This is especially crucial in laying the foundation for a study like Quigley et al.'s, which so heavily focuses on communicative acts between teachers and community members and ultimately with the scientific community.

Many would argue Habermas' ideal speech situation is not possible or at best limited in scope. For example, religious fundamentalists care not to reach mutual

understanding regarding evolutionary theory, but desire instead to impose their belief systems on others. I agree that this neglect of oppression and power differentials weakens Habermas' theory in the cases of epistemological absolutists. As Walter Parker (2003) asserts, the central idea of the ideal speech situation is reversibility—the ability for those in dialogue to change places with and take the perspective of the other. People with diverse perspectives need to first be at the table and then be willing to be changed by the deliberation. As Habermas (1990) has said, “nothing better prevents others from perspectively distorting one's own interests than actual participation” (p. 67). While it is certainly unlikely all people in all situations would have the capacity to attain the ideal speech situation, the potential to bring about fruitful multicultural exchange to examine public issues is worth the attempt.

Habermas argues it is possible to overthrow the dichotomy of subjectivity versus objectivity by proposing that there can instead be a scientific objectivism in which there is recognition of bias and values. Thus, it is possible to acknowledge that claims are socially situated, but also embrace the notion that there may be social situations that tend to generate more fore-grounded objective claims. Scientific research should incorporate an examination of the beliefs held by the researchers and aim for ideal speech situations, for it is by understanding different perspectives that we can arrive at a more accurate understanding of the truths of our world. For example, this type of research has been conducted in the field of ethnobotany, which draws upon indigenous knowledge as well as modern medicine to explore healing properties of plants. Incorporating as many voices and perspectives as possible helps to moderate the bias potential; it is for this reason that research that transcends geographical or race boundaries can serve to reduce the impacts

of only dominant voices being heard.

The voicing of multiple perspectives then is essential for science to make progress, for it is the process by which science corrects itself and holds true to its aim for improving people's lives. Habermas' asserts,

[The] same structures also simultaneously provide the critical means to penetrate a given context, to burst it open from within and to transcend it; the means, if need be, to push beyond a de facto established consensus, to revise errors, correct misunderstandings, and the like. The same structures that make it possible to reach an understanding also provide for the possibility of a reflective self-control of this process (p.120-1).

The physical sciences *foreground* a third person position but work within a larger holistic context, a paradigm, in which the performative position is crucial. A third person position makes use of constructs and theories specialized in objectivity, but these constructs and theories entail non-objective features that cannot be "tested" purely through experiments, measurements and the like. When they come into question, scientists have to debate theory at a level that becomes philosophical and cultural. So there is never a third person position that is free of a full set of cultural and/or lifeworld interpretative frameworks.

To situate Quigley et al.'s work within the theory of communicative action further, dialoguing with participants and creating a space within which they have an active voice in *meaning-making* was paramount to their research process. Critical epistemology (Carspecken 1996) asserts dialogue is internal to action. How others interpret your speech, performance, or mental actions (and how you expect they might

interpret you) is also presupposed in the meaning of your speech, performance, or mental actions. Thus, meaning is shared and social even when internalized. The work of social constructivist researchers is to provide participants with the opportunity to describe their attitudes and feelings in their own words and metaphors. The goal is to focus on the range of constructions people create in making meaning of their experiences. This experience helped to construct local meanings of environmental sustainability for the Kenyan participants. For their words to be shared with the academic community of science educators—so begins the dialogue internal to action.

Speech acts are tied to our identity, so that as people create meaning, they also create or modify their identity. We as researchers must look at patterns or trends across the data to better grasp the identity claims people are making with their statements, as Quigley et al. did when they noted “participants place contextual, cultural and indigenous value on ideas of environment and sustainability with their photovoice pictures and narratives (p.14).” This definition of meaning, from the view of pragmatists, is subtle in that what we do can include not only speech actions or performative actions, but also mental actions. When we understand one’s words, we understand the implicit (or sometimes explicit) commitment of the action. One does not own the meaning of their words because meaning is simultaneously constructed with the listener. As such, when we misunderstand another, it is because we misunderstand the intention of the other. Meaning has a field property—a single statement, speech act, passage in a text will have multiple possible meanings with boundaries. As the pragmatist, George Herbert Mead (1934) claimed, acts are meaningful when they become interpretable from at least two positions. As in the case with a single person, that person is able to position-take an

‘others’ point of view and to assume both positions. It is within this process that a single intention is claimed or endorsed by an actor.

Thus, it is when we understand *position-taking* that we can understand ideology and cultural power, as well as human identities. Actors act within the presupposition that knowledge, or truth claims, have the potential to be agreed upon; that there is a potential for understanding and consensus. Therefore, truth itself is assumed to exist and possesses the capacity to be understood. So in effect, meaning is always uncertain, fallible, and based upon multiple perspectives; but at best, it is something that can be claimed or agreed upon. However, not all truth claims are of the same variety, nor can they be validated in the same ways. While quantitative research takes into consideration only the third person in an explicit and foregrounded way, qualitative researchers must concern themselves with in what ways knowledge is constructed from within the actor’s experiences.

Qualitative researchers highlight the process of social phenomenon, rather than analyzing causal relationships between constructs. In describing the process, they show how social experience is constructed and given meaning. By observing what people do, what they know, and what they say about their world, ethnographers seek to understand the socially constructed worldview of a community. The ethnographic research process involves methods of data collection that include in-depth and long-term fieldwork during which ethnographers spend time with the members of the community, listen to them, ask questions, and take part in their daily routines. Participant observation and prolonged engagement help researchers delve into individuals’ social experience and become familiar with the contexts in which these individuals develop and attribute meanings to

their experience. It is assumed that individuals' experience cannot be separated from their historical, social, and economic contexts and that the truthfulness of research claims depends on researchers' ability to integrate contextual factors into their interpretation.

This study incorporated the principles of Carspecken's (1996) critical ethnography. Carspecken provides a theoretical and methodological map to explore social actors' experience of the lifeworld and to analyze the relation of the lifeworld to the system. The term *lifeworld* refers to the coordination of communicative acts in everyday, face-to-face situations. Communicative acts constitute interpersonal events oriented towards understanding one another. When the lifeworld exceeds its capacity to coordinate face-to-face interactions, the system takes over in the form of tacit rules and norms that structure human relations and communication. Although Quigley et al.'s work illuminated the lifeworld of the participants; it stopped short of exploring the systemic influences surrounding it. The *system* in the most general sense is a relation between action consequences and new action conditions so that a process of reproducing and maintaining certain conditions is always going on and processes of a trend toward changes might be taking place through this same relationship. Every act has a variety of action consequences, which can be *internal to volition*, incorporating "orientations" such as values, identities, and norms- or *external to volition*, incorporating economic, legal, or political forces. With the next phase in their work in Kenya, which will aim to lead to action of "validating this knowledge as such that this community will be able to move this discussion towards enacting sustainable acts (p. 19)," the researchers will hopefully explore alongside their participants the ways in which their lifeworlds are impacted by systemic spheres. Actors need to be aware of

these system-level influences so they can critique and possibly work to change them.

These conditions simultaneously resource and constrain action in ways that are external to an actor's volition. Participants' voices and experiences in the lifeworld impact the system of science and need to be heard.

In summary, critical research looks at the coordination of everyday, face-to-face interactions, and examines how the social system penetrates the lifeworld to organize its activities. It takes place in natural settings, and requires that investigators develop an insider perspective through immersion in the research environment, in order to gain deeper insights into participants' experience. In their study, Quigley et al. drew upon critical qualitative methodology in attempts toward the inclusion of learners in scientific processes of knowledge generation. They pose the question of whether their chosen method of photovoice, or any decolonizing method for that matter, is actually pure. How can any academic research truly be inclusive? Critical methodology includes a look at power relations and emphasizes not the control of social phenomena, but social justice and empowerment through dialogically egalitarian rational deliberations. Whether or not the participants were transformed in the process of writing narratives based on their photographs remains to be seen; however, as Susan Hughes (2000) asserts in her work on the exploration of multiple perspectives in socio-scientific curriculum,

The success of curriculum reform is influenced by hierarchical gender; it requires those involved to surrender abstract science as a body of privileged knowledge, to question scientists' positions as unique authorities, and to have a serious commitment to ending reproduction of gender and other inequalities that persist in education (p.438). Here, the involvement of these particular teachers and community members in

discussions about environmental and sustainable practices (or lack of practices) in this community in Kenya is a form of resistance to the dominant one-way transfer of knowledge that characterizes much of environmental policy and practices. The success of this research as a truly decolonizing approach, as Hughes states, depends on the degree to which the participants themselves internalize and critique the status quo. Therefore, Quigley et al.'s research methodology and the basis for it as described above attempts to meet the goals of critical theory in the two major ways: 1) an attempt was made to democratize the research process in that both the researchers and the researched are co-creators of meaning and interpretation; and 2) claims to truth were explored through the examination of power and consensus which operates to structure the lifeworld. This latter point needs further exploration in the following phases of their project to further illuminate the decolonizing nature to this endeavor.

As discussed, western thought has privileged a very instrumental set of notions of objectivity and consequently ignored very important parts of the socio-political influences on scientific processes, as well as the subjective and normative realms of scientific deliberation. For the above reason, it is essential that learners be brought into the conversations of science, rather than expected to be passive receivers of knowledge. As Bruno Latour argues (2004), by idealizing scientists as dispassionate, objective, and neutral voices, policy makers and environmentalists make it easy for skeptics to dismiss important scientific principles—as seen in contemporary and contentious debates about climate science. Latour asserts it is in the process of conversing about what constitutes worthy science that historical contingency, subjectivity of science, and the social forces that shape it lead to good science. From a

critical perspective, genuine consensus is a function of individuals' freedom from coercion, as oppression precludes participation in authentic and meaningful dialogues that are inclusive of diverse and multiple truth claims. Thus, criticalism is guided by the principles of democracy, justice, and the belief that the unequal distribution of privileges prevents all people to live life to its fullest potential (Carspecken 1996). As such, from a critical perspective, the concepts of objectivity and neutrality (when misappropriated) have served to conceal the role of science in the reproduction of social inequities. Therefore, critical research requires an evaluation of the social effects of its own discourse. It asks, then, whether it itself promotes change or supports the status quo.

Implementing research methods that empower dialogic meaning and truth claims

“...we chose to utilize a data collection method of photovoice that shaped a view from somewhere—in this case the view from the experiencer and to interrogate the ‘objective view from nowhere’ understanding of things” (Quigley et al. p.7)

In their research, Quigley et al. selected the process of photovoice with which to voice participants' perspectives about environmental issues impacting their lives. In an effort to democratize the conversation regarding environmental sustainability, photovoice acted to challenge the 'objective view from nowhere' by providing insider views on culture, values, and meaning related to the teacher and community members' sense of place. As stated above, critical research attempts to investigate how participants make

meaning of their own experiences. Ultimately, the goal of this research is to make explicit what is implicit with the primary goal of making the world a better place. The role of a researcher is to facilitate an environment that feels safe and supportive within which participants can talk about their personal experiences. Researchers are charged with helping participants explore their experiences using their own words, ideas, and, metaphors (Carspecken 1996). In Habermas' perspective of the purpose of such research, action oriented toward understanding is the primary objective:

Every action oriented to reaching understanding can be conceived as part of a cooperative process of interpretation aiming at situational definitions that are intersubjectively recognized (p.69-70).

Embracing the recognition of intersubjective definitions, researchers are able to gain knowledge about the larger social and cultural context of the lives of participants as well as the meaning they ascribe to environmental decisions in their place made for better or for worse by others.

Photovoice has roots in critical theory by attempting to make explicit insider's perspectives and critically reflect on them for the betterment of society through the use of dialogue. The photos offer a structure to that dialogue and can serve to advance social action as the community responds to the participants' perspective and locates it in solution- generation. Because participants take and have control over the interpretation of their own pictures, photovoice places the power into the hands of the photographer and out of the hands of those who hold the dominant view. Those in positions of power to change the community may not reflect what change is most desired by participants. Ultimately, then, the

Kenyan teachers and community members in this study are able to participate in a process that may lead to unforeseen social change.

Photovoice has received attention for engaging participants in the research process. Developed by Wang and Burris (1994), photovoice is a method by which researchers provide cameras for participants, whose voices are often ignored in policy-making, so that they may document issues important to them through the use of photography. Participants collaborate on the reasons for and use of their pictures and reflections to showcase relevant issues and ultimately generate dialogue with community members and policy makers who may be in a position to mobilize change. The researchers' role in photovoice is to facilitate conversation, story telling, and reflection on pictures taken by the participants, and then attempt to codify the emergent themes that are generated by collective discussion. Oppressive relationships characterize the social structure within science and limit the possibilities of action by the oppressed. Exploring participants' discourse "is not a straightforward matter since the identities, the forms of thinking, and the beliefs of people are all ensnared within oppressive relations" (Carspecken p. 8).

Furthermore, empowerment of participants is one of the key goals of the use of photovoice as a research tool:

To enable the recording of and reflecting on problems of a group or community, promote critical discussion of these problems, generate collective knowledge of the problems through discussion of the photographs, and finally to take action to change the problems by reaching out to those who influence or make policy (Wang 2005).

Photovoice puts cameras into the hands of students in order to address issues from their position and point-of-view. It offers an insightful insider perspective into the lives of students. Photography also offers participants new and reflective ways to perceive their own world and offers researchers new insights and perspectives. Researchers should structure photovoice projects to maintain a life of their own once so that the work continues to evolve. As Quigley et al. noted in their description of their future plans for ongoing involvement with this community of participants, opportunities for continued dialogue (i.e. perhaps in community art galleries, local sustainability task force meetings, or public media) among community members should remain after the exiting of researchers.

Outside of science education, the process of photovoice has been used in public health education and community development to connect participants to the community in an effort to inspire change. Downey et al. (2009) used photovoice to explore rural Appalachia residents' understanding of and barriers to public health in an effort to improve the access to resources in the community. Researchers found that although debate was an important part of the experience with photovoice, opportunities to deliberate empowered participants as active members in the community. Another study by Morgan et al. (2010) explored female Nicaraguan immigrants in rural Costa Rica through photovoice aiming to document, critique, and ultimately to improve life conditions for these residents. Findings indicated "the process empowered these women by affirming their community strengths and providing them with an avenue, through photographs and stories, for voicing their needs to policymakers and community leaders" (p.1). Photovoice is often used among marginalized people, and it is intended to

give insight into how they conceptualize their circumstances and their hopes for the future.

In my own work using photovoice as a research tool in science education, the process has been impactful in the bridging of participants' background and interests with the environmental science topics of importance to the community. As well, because photovoice enables the participants to communicate with those in a position of knowledge and in some cases control over the issue in a way that democratized the dialogue, it inspires a deepened sense of care and interest in contributing to the community of science (Cook and Buck 2010). In effect, photovoice offers a tool for science educators at a time when a case is being made for politicizing citizens through issues-based, technology-oriented, and place-based curriculum aimed at social critique, values clarification, and preparation for socio-political action. Scientifically literate citizens should have the ability to assess the value of and critically evaluate knowledge in a particular context and to participate in the social negotiations that produce knowledge (Roth and Désautels 2004). Furthermore, scientific literacy in this sense can provide individuals with greater control over their lives by enabling them to make better-informed personal decisions; to participate in science-laden policy debates at local, national, and international scales (Hodson 2003). It is important to note, however, the power of political and economic ideology. In contemporary terms, we have seen recent examples of climate denialists who despite their strong education and science backgrounds, continue to deny the human contribution to climate change. To this end, we must tread cautiously about the promise of deliberation in science—noting limitations while aiming for potential emancipation.

Can science education research bring out such emancipatory and empowering processes of learning? Using photovoice simultaneously facilitates participants' to experience their stories and allows them to find spaces for expression and exploration, which may lead to their own insights and growth, or emancipation:

Inquiry that aspires to the name *critical* must be connected to an attempt to confront the injustice of a particular society or a sphere within society. Research thus becomes a transformative endeavor unembarrassed by the label 'political' and unafraid to consummate a relationship with an emancipatory consciousness (Kincheloe and McLaren 1998, p. 264).

The idea of emancipatory knowledge concerns the use of reflection of one to him or herself. This is in formal distinction from knowledge based on relations of the self to other selves and relations of the self to the material world and nature. Photovoice used in the exploration of environmental issues can offer ways to experience emancipation by providing opportunities for science to help impact our environment and be used in caring for the environment. Learning to care about nature rather than manipulate, exploit, and control nature could result in new ways of experiencing scientific investigations and inquiries. In effect, photovoice attempts to uncover lifeworld phenomena as participants make sense of their own experience. This knowledge, however, needs to be layered with system-level exploration as well. In doing so, taking the work done here into the community—and ultimately to those in a position of power regarding curricular reform—is essential. As Quigley et al. noted, "We recognize our work only represents the beginning of this conversation and are working towards engaging a wider-range of community members" (p.15).

Though Quigley et al.'s work here focused only on phase one of ongoing and multistep research project (the next phase of which will highlight the focus group interviews to develop emergent and co-constructed understanding of the key environmental terms), the foundations for active engagement of the participants with the community of science were laid. Such aims will require a much-needed dialogue among citizens, science educators, and those with institutional power to more directly affect policy. Irwin (1995) argued that local laypersons, or non-scientists, contribute unique and situated expertise and serve “not only in criticizing expert knowledge but also in *generating* forms of knowledge and understanding” (p. 112). Participation in local environmental action is also consistent with environmental education guidelines that emphasize knowledge and skills in both science and citizenship (NAAEE 2004). As Schusler and Krasny (2008) articulated,

This learning can increase people's ability to exert influence in public affairs through enabling them to play an informed and active role in the systems of power and decision-making to make choices rather than accepting the prescriptions of others (Freire 1973), to hold experts accountable, and to insert their own knowledge into the public discourse (Fischer 2000, p.280).

Thus, it is the grappling with environmental issues of consequence that aims to hone understandings of environmental science and accompanying systemic societal influences and constraints, skills in scientific inquiry, and civic engagement- elements that are crucial to participation in a democratic society, community building, and critical analysis (Battistoni 2002). It is here, within the exploration of environmental sustainability, that citizens can begin to critique as well as participate in socio-scientific

issues of personal relevance and impact.

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