

Environmental and Science Education in Developing Nations: A Ghanaian Approach to Renewing and Revitalizing the Local Community and Ecosystems

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ABSTRACT: Curriculum reform in environmental and science education now taking place in Ghana focuses on the community and ecosystems as the context of education. In Ghana, students conduct science investigations that include games, word searches, crossword puzzles, case studies, role play, debates, projects, and ecological profiles. This curriculum reflects an acknowledgement of the effect of conserving and protecting Ghanaian intergenerational knowledge and skills concerning the natural systems, including those of preserving ceremonies, personal expectations, narratives, beliefs, and values. The authors highlight these efforts to counter notions that Ghanaian education is still developing and to contrast the ideologies of seemingly developed educational landscapes in the United States. The authors argue that educational reform in the United States could benefit from an understanding of environmental and science education in seemingly developing nations.

KEYWORDS: cultural studies, curriculum, ecojustice, literacy, pluralism

In many places in the United States, a rapidly increasing human population and commercial and housing development stresses local wildlife habitat and agricultural land, which become less able to sustain life. When more people have access to fewer natural and agricultural

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resources, the specter of population collapse becomes more possible (Diamond, 2005). The general public has increasingly acknowledged a need to renew and revitalize cultures and to preserve environments, mostly because the environmental impacts of doing nothing are more visible each day. This situation does not mean we assume an ecological-crisis stance, which Mueller (in press) pervasively described as an imperative for action. Urban sprawl, acid rain, increasing deforestation, glacial melting, soil degradation, and the loss of biological diversity are some of the consequences of deemphasizing or ignoring anthropogenic stresses on natural systems. Teachers and youths examine these conditions through environmental studies, often without reducing them to crises, albeit in far fewer school settings than are now needed. A significant challenge for major U.S. school reforms (as one part of the larger educational domain) is that researchers and educators must prioritize standardization and high-stakes testing, which also directly influence prevailing cultural attitudes and associated behaviors toward the natural world. For example, the implicit and null curricula of schools may be responsible for promoting ideologies such as those of the superiority of reason, individualism, hyper-consumerism, and other cultural views that ideologically disconnect people and their environments (Bowers, 2001, 2006).

As Western influences have intensified abroad, and as teaching to the test has come to dominate public schooling in the United States, those people who have the most influence on school policy have moved the cultivation of ecological understandings and relationships to the backburner in U.S. classrooms (Bowers, 2006; Kozol, 2005; Mueller, 2008, in press; Mueller & Bentley, 2007; Noddings, 2006; Thayer-Bacon, 2003). However, on the front burner is measuring how well teachers prepare students to enter the workforce. The authors of the *National Science Education Standards* (National Research Council [NRC], 1996) also suggested this nod to corporate interests in that one of the four goals for school science is to increase economic productivity (e.g., NRC, 1996, p. 13). Although some researchers, educators, politicians, or others may argue that increasing economic productivity is necessary for the United States to be competitive in the global arena, this short-term goal is limited when one considers the U.S. impacts that have contributed to significant cultural and environmental vulnerabilities worldwide. More important, prioritizing financial success as a major goal of schooling leaves little incentive for teachers who are interested in environmental issues to foster human–nature relations that are needed for reducing our impacts and sustaining local ecosystems.

Since the early 1970s, environmental education (EE) has made strides in recognizing an ecosystem approach as the underlying structure for fostering biodiversity and ecological awareness and, in some cases, environmentalism. Typically part of the overarching framework of science education, EE in schools represents an inclusive and multidisciplinary means for developing ecological awareness and fostering relations between students and nature. Through EE, teachers encourage citizens (including youths) to participate more fully in local policymaking, in advocating for affected people and other species, and in protecting the integrity of the atmosphere, oceans, forests, and soil. But unfortunately, recent researchers of environmental literacy (Coyle, 2004, 2005) have concluded that U.S. public schools decreasingly emphasize EE, and when they do represent it, they seldom go beyond environmental catastrophes. As Kevin Coyle (2004) noted,

What passes for environmental education in America is usually environmental information. One might compare the situation to the difference between a full-course meal and a quick snack. True education nourishes a deeper understanding and an all important ability to apply knowledge, whereas information simply makes one aware of a topic and stops there. (p. 4)

A recent EPA report cited improvements in EE since the passage of the National Environmental Education Act of 1990 (1990), but in the spirit of the No Child Left Behind Act of 2001 (2002),

it emphasizes more assessment and accountability (National Environmental Education Advisory Council, 2005).

Environmental philosophers such as C. A. Bowers (2006) have argued that the meaning of environmental education may be limited and inadvertently perpetuated by our preconceptions and assumptions. For example, the term *environment* has been historically defined in scientific documents “as needing to be brought under human control, as an economic resource to be exploited, as separate from culture, as an external phenomena that can be objectively observed and judged” (Bowers, p. 4). Although Bowers proposed a shift from the phrase *environmental education* to phrases such as *commons education* or *educating for the commons*, which he equates with *ecojustice education*, adequate conceptions of environmental studies already exist in other countries and clarify ecojustice theory, enhance and enlarge EE, and provide new directions for U.S. education (for a further description of educating for the commons, see Mueller, 2008, in press).

To make changes in people’s cultural attitudes toward nature, researchers and educators should address the cultural symptoms of environmental degradation. For example, historically, the traditions of Native Americans have been relegated to a lower status by scientists such as E. O. Wilson and Richard Dawkins who perpetuate the superiority of modernization and scientific thinking, which equates conserving traditional ecological wisdom with backwardness and oppression (Bowers, 2001). Although Wilson and Dawkins do not speak for all scientists, they are influential, and their books and articles impede emerging efforts to foster traditional ecological wisdom through environmental and science education. Today’s efforts to foster ecological relationships through environmental and science education embody a challenge to those who see ecological wisdom as backwards in relation to the industrial- or consumer-reliant ways of knowing and living that seemingly lead to progress. The presumption is that every cultural roadblock to industrial- or consumer-reliant ways of knowing and living leading to progress should be overcome, and these ideas of progress exemplify how certain words are currently being used in the multimedia to represent how a society advances (e.g., developed vs. underdeveloped societies). On the basis of this language, educators may judge ecological traditions that emphasize reducing consumerism, restoring ecosystems, or landscaping with native species—with few exceptions—as oppressive, backwards, illegitimate, or antiquated. This assumption is reinforced even further for those who do not have the opportunity to interact with people from other places beyond the us-versus-them mentality perpetuated by continuing to rely on this wording. The filter-down effect is that many teachers reinforce students’ increasing acceptance of rapid technological development and the so-called *greening* of corporations as opposed to living well with nature; that is, reducing human impacts by making personal and shared sacrifices.

But some environmental educators have already tried doing things in their classrooms (and agencies) to mediate the assumptions and attitudes of Western society, and these efforts are admirable. At the same time, the No Child Left Behind Act of 2001 (2002) reforms and high-stakes testing have led to a decline in EE in U.S. schools and an increase in tension for teachers who are pulled between higher test scores and the importance of EE. The more established field of science education does not embody the overarching multidisciplinary framework inherent in EE, and ironically, science education purports to foster an understanding of how scientific inquiry helps to make everyday choices, referred to as *scientific literacy*. It logically follows that there might not be a declining environmental literacy among citizens in the United States if the natural sciences were taught in a way that serves to elicit citizens’ fuller participation in choices that lessen human impacts on the world and contribute to sustaining everyday life. But science educators continue to wrestle with the latter direction in their classroom practice. For example, the headline for the lead article in the January 2008 issue of NSTA Reports reads, “U.S. Students’ Science Scores Lag Behind Other Developed Nations” (p. 1). This research shows how the assumptions of “developed nations” are implicitly conveyed as superior

to those of undeveloped nations. The research reports on the recent data from the Programme for International Student Assessment (PISA; 2007, as cited in NSTA Reports, 2008), an international assessment comparing students in 57 countries. Yet the reports only highlighted the results of the students in the developed countries. Again, the research emphasized economic superiority, which is evidenced by NSTA's warning, "If the United States does not remain competitive, Sheppach [head analyst for the Organization for Economic Cooperation and Development] predicts the country will feel the effects—lower wages and a reduced standard of living—within 15 years" (p. 5). Because the priorities of U.S. economic development have high costs and impacts on natural systems, why not acknowledge these issues?

Rather than seeking alternative descriptions of EE, however, we propose first seeking an understanding of what occurs in EE and science education in developing nations. As the phrase *developing nations* may be viewed as insulting and pejorative in Africa, for example, we use *economically marginalized nations* (recommended by a colleague with extensive work in African Countries such as Kenya). The emerging curriculum in Ghana and Africa as a whole brings together the dissident traditions associated with EE and science education, which is the key point of the present study. The synergy between EE and science education in Ghana is considered to be more developed. The overarching goal of the Ghanaian curriculum is to provide opportunities for teachers and students to participate in renewing and revitalizing cultural and environmental commons.

Environmental and Science Education in Ghana

The Western influences in economically marginalized countries such as Ghana, originally colonized by the British, create a serious disconnection between science and students' lives, which in turn influences the number of students who decide to embark on careers in the sciences (Entsua-Mensah, 2004). The result is Ghana's dependence on experts from other countries to investigate local environmental problems. Moreover, Ghanaian citizens may not be participating as fully in ecological decisions that sustain natural resources for the future. Also of concern in Ghana are increases in monoculture and terminal seeds that force farmers to buy seeds rather than save them. However, there is a movement in Africa to mediate previous Euro-Western colonization within social and cultural contexts (Entsua-Mensah, 2001, 2004; Jegede, 1995, 1997; Kroma, 1995). A significant part of this project is recognizing the high value of aboriginal knowledges (using a plural term) as a part of the basis for forming new curricula in environmental and science education that support students' identities, and yet also endorse the natural sciences as a way to make everyday choices and advocate for affected parties and Earth. Proponents of this movement recognize the need for a new perspective on scientific literacy: Environmental literacy and scientific literacy are essentially reciprocal. Common to both is knowledge regarding ecological relationships that strengthen the local community and ecosystems. Jegede (1995) pointed out that "some mistakenly think that to be educated means to be literate," and he offered examples of African villagers whose communication is exclusively oral and yet are regarded as highly educated (p. 169). Knowledge of the environment is not something new to people in economically marginalized countries, and although now increasingly relevant, the knowledge of peoples in economically marginalized countries is often considered as inferior or backwards thinking. Many people considered by Western standards to be illiterate are actually quite literate in terms of scientific understandings and environmental management. For example, a fisheries scientist who works closely with traditional fishing practices provided numerous examples of aboriginal or traditional practices of managing water resources and fisheries that continue to be effective in Ghana today (Entsua-Mensah, 2001).

Raising the status of ancestral knowledge and skills through environmental and science education is less difficult for people living in economically marginalized nations because they do not assume the ideologies that usually accompany a limitation of thinking and ignorance of traditional practices that have lesser human impacts on the natural world. The marginalization of traditional knowledges and skills is typical of education in supposedly developed countries because of increasing reliance on science and technology to address ecological concerns. Traditional ways of knowing and living are revered and actually should be considered to be more developed; that circumstance is an interesting difference between developed and economically marginalized nations. It follows that emerging environmental and science education in economically marginalized countries is better positioned now in terms of conserving and strengthening people and places for a sustainable future (or for sustaining interest in conservation and strengthening community). If resources become less available, human populations that learn to live within the limits of local ecosystems will have many more advantages over societies that have yet to learn such skills.

In Ghana, teachers are implementing an integrated, more culturally relevant and environmentally responsive curriculum in secondary science courses. *Science in Action: Student's Workbook* by Anamuah-Mensah, Savage, Quaye, and Towse (2005) enhances, supports, and supplements the received secondary science education. It is a teacher's resource book and a workbook with activities designed to help students "develop survey instruments, write memos and proposals, plan and carry out projects, and work in teams. The objective . . . is to encourage students to see science in its relationship with the society, the economy and the environment" (p. a). This curriculum incorporates local knowledges, thus providing opportunities for Ghana's teachers to make environmental and science education relevant to the country's students.

Through games, word searches, crossword puzzles, case studies, role playing, debates, projects, and ecoprofiles, students conduct surprisingly elaborate science investigations. The students then learn through these investigations and become able to participate in governance and policymaking and advocate for other species. For example, Chapter 2.3 elicits students' participation in designing a bid to establish a gold mine (Anamuah-Mensah et al., 2005, p. 33). Students consider the terms, concepts, principles, and processes concerning the production of gold and investigate the solutions to pertinent environmental problems. They explore authentic Ghanaian problems with gold production, such as air pollution from sulfur oxide, mercury vapor, and dust; land pollution by arsenic oxide and degradation; and water pollution by sodium cyanide. Moreover, the students work through several case studies identifying the environmental effects of gold production on a local village as they prepare a report describing the advantages and disadvantages of proposed gold-mining activities and sites. Interestingly, students must work through the complicated interplay and trade-off dilemmas of people's livelihoods linked with gold production and declining ecological conditions. Because this environmental study gives no simple prescriptions, students are positioned as authentic stakeholders who need to become informed to participate more fully in evaluating decisions that affect the community and ecosystems. After studying the global factors on social life and the economy of the nation, students construct ecoprofiles that weigh the total impact of gold production including the use and disposal of gold, raw materials, energy requirements, and other environmental costs.

Beyond the authenticity of environmental cases, the Ghanaian module emphasizes relevant and aesthetic aspects of community life not found in the curricula of U.S. schools. For example, Ghanaian students read a chapter on beer production, which provides an opportunity to explore the enzyme responsible for malting, the process of fermentation, and different alcohol beverages produced from sorghum or maize and barley. There are follow-up puzzles to identify the concepts, principles, and processes of brewing beer. Beyond the local plants identified in beer production, the students analyze the ecological impacts of discharging beer waste into the environment and ways to

minimize those impacts. Students consider the consequences of importing rice into Ghana for beer production. They learn about an interesting beer product called *pito* that can be made from various plant sources, including bananas, mangoes, maize, sorghum, rice, millet, cassava, and yams. The students construct an ecoprofile to identify the relations among the production, use, and disposal of beer on raw materials, energy requirements, and other environmental costs.

Another example, found in Chapter 6.7, enables students to participate in a community research project regarding paint production (Anamuah-Mensah et al., 2005). The research project consists of surveys and interviews to “learn about some factors affecting poor quality paints on the Ghanaian market” (p. 81). In addition, students work through several case studies identifying “the factors associated with low quality paints or even with poor application of higher quality paints” in an investigation of a claim made by local businesses protesting the use of paint products that fade and deteriorate soon after use (p. 83). In the end, students construct an ecoprofile that assesses the total effect of paint production on raw materials, energy, and the environment. This example is interesting because students engage in environmental research with the local community, and that engagement fosters community relations and elicits people’s knowledge, beliefs, values, personal expectations, and narratives. Essentially, these emerging practices in Ghana are consonant with ecojustice ethics that emphasize the holistic relations between social justice and environmental justice (Bowers, 2001, 2006; Martusewicz, 2005; Mueller, 2008, in press). Ghanaian students are working to strengthen the local community and watersheds, or ecoregions, and protect them from greater vulnerability to threats by learning about everyday items such as paint.

A final example is in Chapter 19: the production of soap. Through case studies, students identify the socioeconomic conditions and importance of Ghanaian soap. Students design and carry out investigations that determine the quality and differences of soap, the environmental impacts due to increasing numbers of soap factories, and the cleansing power of soap. Moreover, students decipher the contents of a soap factory’s effluent, designing and testing a system for treating effluent and determining the efficiency of different detergents and soaps. Students also devise ways to improve the quality of traditionally made Ghanaian soaps, and they teach local people how to make these soaps instead of relying on the market for soap. In this regard, Ghanaian youth are developing understandings that transform into the renewal of cultural traditions that have a lesser human impact on the Earth’s biodiversity, which also fits ecojustice aims.

Rather than communicating a superficial portrayal of the natural world through textbooks, worksheets, and recipe-type labs, a Ghanaian, West African curriculum strives to embrace and value the students’ life spaces and ways of knowing. In relation to science, this curriculum promotes more student engagement and potential empowerment in decision-making options as students investigate the natural world. It recultivates cultural and environmental relations (i.e., ecological relations) that foster appreciation of, care for, and connection with nature. Ghanaian curriculum emphasizes that the Euro-Western cannon provides just one of multiple ways of knowing in the sciences. But the key point is that this curriculum is consonant with ecojustice ethics and efforts to shift EE to the foreground of what is relevant for schools. What one learns from African (and more specifically Ghanaian) science curricular reform movements has major implications for preparing environmental and science educators, curriculum developers, and researchers.

Critics may argue that these activities romanticize cultural ways of knowing and living, which are antiquated by today’s standards of knowing and living in places other than small pockets of the world’s modern societies. However, each chapter of the Ghanaian EE and science education curriculum emphasizes pollution and other environmental problems facing local communities. The reality of people’s lives in economically marginalized countries brings them up against constant

environmental problems, which are oppressive and difficult to resolve, considering their economic circumstances. Despite that, the loss of aboriginal knowledge and skills is taken very seriously. There is an effort to restore local production of goods rather than importing them from developed countries, which requires a shift to embrace and value a number of traditional technologies whose economic value had declined or that were historically downplayed (Anamuah-Mensah et al., 2005). For example, the Ghanaian curriculum points out that a substantial number of aboriginal industries using dependable ancestral technologies remain in villages and in large urban areas: "In the current knowledge economy, these technologies can continue to exist if they are improved upon and made competitive to those of developed countries through the application of science and technology" (p. 27).

Interestingly, Ghana is further developing scientific and industrial research organizations that use researchers to improve and make more visible the aboriginal knowledge. By recognizing the high value of ancestral technologies that leave a smaller ecological footprint (with few exceptions), these organizations recognize a wholistic interplay between traditional cultures and ecosystems. This is evident in an emerging Ghanaian curriculum that confronts cultural attitudes toward aboriginal knowledge and skills through science and EE. Ecojustice is an important part of the project to engage students in the competence of their cultures, local community, and ecosystems, identifying vulnerabilities and protecting them from restrictive ideological and ecosystem threats.

Educational Implications

Could Ghanaian educational reforms also work in the United States? Despite the challenges of standards-based curriculum and high-stakes testing priorities, interest in ecojustice and ecojustice education (sometimes referred to as *commons education*) as a method of teaching, redefining schooling, and promoting local communities and ecosystems has been growing (Bowers, 2001, 2004, 2006; Martusewicz, 2005; Martusewicz & Edmundson, 2005; Mueller, 2008, in press; Tippins & Mueller, 2009). Place-based education (Gruenewald, 2003a, 2003b; Smith, 2002a, 2002b, 2004; Sobel, 2005) is different, yet it corresponds with ecojustice education with respect to the goals of strengthening communities and environments through schools. Although not always represented as such, place-based education corresponds with ecojustice education, which

strengthens the ability of the world's diverse cultures to resist the environmentally destructive and culturally homogenizing forces that are now being globalized. This alternative approach to educational reform involves learning about (indeed, revitalizing) the traditions of the commons of these cultures that go back to the origins of humankind. (Bowers, 2004, p. 49)

Ecojustice and place-based education may or may not be compatible with standards-based educational reform. However, researchers might help to illuminate the short- and long-term outcomes of educational reforms that incorporate ecojustice ethics, such as those found in the Ghanaian curriculum. Moreover, researchers might determine whether this pedagogy cultivates student identity and affective development, more critical thinking, and the construction of science knowledge.

Ecojustice ethics play a significant role in dispelling the notion that so-called *developing nations* represent inferior or underdeveloped ways of knowing and living. In some ways, the Ghanaian curriculum is more progressive than patterns of thinking and behaviors that contribute to the further vulnerabilities of Earth's ecosystems. The Ghanaian curriculum may represent a more developed curriculum, a synergy of EE and science education that can already be discerned in the literature at all levels. (It is worth noting that some science educators in colleges of education may still resist this emerging synergy, especially with respect to the acceptance of EE and its recognition

of spirituality, beliefs, and values, which are now part of a synergistic science education). This synergy involves the repositioning of the local community's knowledge, skills, beliefs, values, personal and shared expectations, and geographic specific narratives as part of the foundation for participation in the competence of communities and ecosystems. Cultural studies scholars are increasingly discussing examples of synergy that make it hard to ignore.

For example, Prakash and Stuchul (2004) wrote about issues associated with education and globalization relative to the goals of ecojustice. They related how education might break the Western mold of alleged development by means of learning and living that marginalize globalization and industrialization and regenerate the commons. Prakash and Stuchul pointed out the ways in which grassroots efforts in Mexico and elsewhere are reclaiming local cultural commons. They described how at the Universidad de la Tierra in Oaxaca, Mexico, teachers and students are celebrating the commons, local traditions, and cultural roots and questioning the structures of globalization. Professors and students are engaged in political and economic investigations, case studies, classroom debates, publications, workshops, reading circles, community apprenticeships, and studies of the language traditions of ancestral groups as part of the grassroots movements in Mexico to bring back to life the commons beyond the classroom walls. This international example is just one of many commons-strengthening activities occurring worldwide that revitalize the direction of science education.

Science and environmental educators working in parts of Canada, Ghana, Kenya, Malawi, and the Philippines, along with the United States, are beginning to replace generalized textbooks with instructional materials that recognize the importance of traditional knowledges and skills (Aikenhead, 2006; Entsua-Mensah, 2004; Glasson, Frykholm, Mhango, & Phiri, 2006; Jegede, 1995, 1997; Kroma, 1995; Nichols, Tippins, Morano, Bilbao, & Barcenal, 2006; Tippins, Handa, Bilbao, & Morano, 2006). Almost all of those works emphasize the community-centered knowledges and skills of local people in relation to diverse geographic places and the process of coconstructing understandings. This trend, which involves immersing teachers in the local cultures, communities, and ecosystems, invites people in the local community to share the responsibility for what occurs in their schools.

In the Philippines, teachers work with the community in soap-making livelihood projects, a de-worming campaign, coconut and mahogany reforestation projects, dental care, composting, herbal gardening, erosion control projects, waste segregation, and community history projects (Tippins et al., 2006). Consequently, teachers "rethink their ideas of relevance in terms of a more community-centered, rather than community-based approach," which is focused on "co-constructing curriculum with community members rather than abstracting it from their input," according to Tippins et al. (p. 2). Much as in Ghanaian reforms, schools in the Philippines are shifting toward a responsive curriculum for the nurturing of the community and Earth's ecosystems.

In the United States, ideas are developing about how to prepare environmental and science educators in ways that strengthen the community and nurture surrounding ecosystems. In Detroit, Michigan, Rebecca Martusewicz (2005) wrote about what people have faced during more than 50 years of economic, political, and cultural losses. Martusewicz described the grassroots efforts and community relationships cultivated through schools. Local citizens work to revitalize neighborhoods, use empty lots, restore church buildings, and create play areas and community gardens. People engage in grassroots environmentalism, ranging from high school girls testing soil and teaching residents how to decide if their soil is safe for planting, to people's participation in the self-sufficiency and moral reciprocity of teaching each other how to build and maintain compost bins, to exchanging seeds and seedlings, and to cultivating over 150 citywide gardens. These ecojustice activities may be considered part of what it means to engage in the curriculum of U.S. schools, but they are by no means a priority for schools that face the pressures of high-stakes testing. It is appropriate and

significant to say that these activities and relationships are now developing as ways to renegotiate and mediate dominant views of environmental and science education.

For a final example that is particularly relevant to higher education in the United States, we point out that Carolyn Brandt (2004) at the University of New Mexico provided a 3-year description of her courses in ethnobiology. In these courses, members of local nations of Native Americans and the students themselves shared the responsibility of coinstruction. In one course, Native Americans and students discussed the central issues of water and water rights, including the subissue of government mismanagement of water resources, which deprives aboriginal communities of activities that define their cultural identity. For many students who embrace Western ideologies, Brandt noted that this course was an opportunity to reexamine the social and political contexts of science as it is promoted in higher education. This style of guiding learning at the university provides an opportunity for students to identify and generate multiple contexts for scientific knowledge. For students, their personal experiences “using traditional medicine, in practicing farming or gardening, and in collecting plants for basketry or other material uses” become largely meaningful in becoming literate in the community and nurturing surrounding ecosystems (p. 97).

If researchers and educators recognize the severity of cultural and ecological declines in different places of the world through appropriate and significant forms of science education and, in turn, recognize the potentially significant consequences for future generations (our students), then the emerging Ghanaian movement, ecojustice and ecojustice education, and other aforementioned examples of place-centered curricula in environmental and science education highlight a need to celebrate local life of the natural world in our schools. Perhaps our conceptions of developing nations are further dissolved by expanding and enhancing students’ ability to perceive the natural world through environmental and scientific literacy—so our children learn that they are not apart from it and that in taking care of it, they are acting in their own self-interest and taking care of themselves (cf. Hungerford, Volk, Ramsey, Litherland, & Peyton, 2003). The preceding examples illustrate the potential of an emerging Ghanaian approach to renewing and revitalizing the commons, as do the other educational efforts representing synergy between EE and science education that we have cited in this article. For this synergy to develop more fully, the significance of particular peoples’ contributions to the community, and ultimately, the increased sustainability of diverse environments should be more fully documented.

Conclusion

We began the present article by discussing Bowers’s (2001, 2006) ecojustice ethics to dispel ideas about the terms *developing* and *undeveloped*, and we highlighted the emerging curriculum in Ghana that has renegotiated and mediated Western influence by educating students in a way that embraces and values community and ecological contexts. We argued that renewing and revitalizing the commons should be a central purpose of education. EE and science education overlap and are essentially reciprocal in that the literacy of one entails the literacy of the other, and that reciprocity warrants their integration. Further, we provided examples from Ghana, an economically marginalized nation that uses science and technology to deal with environmental problems while maintaining the importance of local peoples’ knowledges and skills, beliefs and values, and personal and shared expectations and place-centered narratives. We showed how students are becoming informed of their natural environments and using this understanding to access environmental decision making. These students are preparing to protect their local cultures, communities, and ecosystems from vulnerabilities and potential threats that may result from economic and other national tensions. We offered several examples of activities occurring worldwide and in the United States to show that the Ghanaian cur-

riculum is significant and appropriate and that assumptions linked with so-called *developing nations* should be questioned. Although *economically marginalized* is the term used, the Ghanaian curriculum should not be viewed as an insignificant force for the conservation of cultures and community and the nurturing of Earth's ecosystems.

A Ghanaian approach to renewing and revitalizing the commons is not an unreasonable direction for EE and science education in the United States. What is likely to shift in U.S. educational reform is the status of multicultural and ecological perspectives. Students should have opportunities to bring their ways of knowing, beliefs and values, ceremonies, and personal expectations and narratives into the dialogue of the classroom. This is a shift toward recognizing and valuing the contexts that sustain all our existences. Perhaps so-called *developed* countries would benefit from an understanding of developing (i.e., using the term in the best possible way) Ghanaian curriculum and of the teachers and students who value diversity, develop identity, encourage community, and aim for the outcome of an ecoconscious lifestyle—particularly if society's goal is to reduce environmental impacts. For children throughout the world, we would like to see a more cooperative venture between EE and science education that seeks neither to colonize students' minds with assumptions that contribute to cultural and environmental declines nor to socialize students exclusively into globalization and Euro-Western cultural narratives of science. Instead, we would like to see EE and science education approached with humility that enables students to study science in their local community and ecosystem and that makes available to them the intellectual tools needed to live in concert with the natural world.

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