Toward Awakening Consciousness
A Response to EcoJustice Education and Science Education

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"Truth is One, but the sages speak of it by many names." The Rig Veda

"Compassion is the keen awareness of the interdependence of all things." – Thomas Merton

Introduction

In "EcoJustice Education for Science Educators", Rebecca Martusewicz, John Lupinacci, and Gary Schnakenberg, break new ground for the field of science education in relating long-known limits to our ability to understand the cosmos to those eternal mysteries they identify as the meaning of "sacred". Our fundamental unawareness was well understood by the medical researcher and gifted science writer Lewis Thomas who wrote that, "The only solid piece of scientific truth about which I feel totally confident is that we are profoundly ignorant of nature." (1974, p. 58) Beginning with the premise of our fundamental inability to ever fully know, Martusewicz, Lupinacci, and Schnakenberg argue that to achieve a sustainable society in proper relation to the ecosystem, science educators will have to rethink the curriculum and adopt a different approach to instruction.

They begin with the premise that "languaging" is a creative process that produces representations that diverge from the reality that intended to re-present it. In other words, as we reason through our language-culture filters, these filters influence our perspectives about reality, and those perspectives are necessarily flawed and limited. The authors note that humankind's 5,000 different languages are the bases of many different cultural systems. So, it's the old Blind Men and the Elephant wisdom story. Thus, as Michael Reiss (1993) has pointed out, every science is really an ethnoscience: "What is of significance for science education is that there can be no single, universal, acultural science." (24). What's more, science has to be reported in a language (mathematics also being a language), and all languages are human constructions. So the scientific enterprise has "incomplete ways of knowing by virtue of being embedded in a specific cultural (and thus symbolic/language) system." (Martusewicz, Lupinacci, and Schnakenberg, 2009). Note that the authors do not deny that science is the best process yet worked out by humankind for "knowing" – the authors only claim that we can never know everything via scientific processes. And I fully agree.

Taking this stance of epistemological pluralism, Martusewicz, Lupinacci, and Schnakenberg call on science educators to respect indigenous knowledges. Further, they recognize the great loss that occurs in the loss of a language or when a traditional society disappears. They also recognize that first-world science has played its part over the years in cultural imperialism and that as a result other species and cultural groups have suffered or gone extinct. Michael Mueller and I have written about these very matters (Mueller and Bentley, 2009).

Martusewicz, Lupinacci, and Schnakenberg also base their argument on the premise that we all live embedded in ecosystems and are fully dependent on natural services for survival. Absolutely true, but regularly taken for granted. From these premises, the authors introduce three major goals of an ecojustice framework, goals which involve deconstructing the dominating beliefs and behaviors of the first world societies, advocating a new epistemic stance, and revitalizing the cultural and ecological commons as the basis for sustainable societies.

To address the education of science teachers, Martusewicz, Lupinacci, and Schnakenberg recommend that teachers think about their roles and responsibilities using a deconstruction approach they identify as a

cultural-ecological analysis. In explaining this approach they draw on the work of Chet Bowers, a pioneer in identifying "root metaphors" that shape our thinking and behaviors. Through cultural-ecological analysis, teachers will come to understand how, "The words we use on a day- to-day basis help to maintain and recreate 'master narratives' that structure complex hierarchized systems of thought, identity, value, and material realities that create and recreate violent, destructive relationships and practices as if they are 'normal' or 'natural.'" (ibid.) Recognizing value in non-Western sciences, and through this process of cultural-ecological analysis, students gain a deeper perspective: "...exploring traditional science enables us to step outside our own cultural belief systems and more freely examine our hidden, capricious, and sometimes troublesome assumptions" (Corsiglia and Snively, 1995). Martusewicz, Lupinacci, and Schnakenberg go on to give examples of how this Western way of thinking is connected to the human-damaged environment in which we find ourselves living.

Wisdom as a goal of schooling

The reference to Gregory Bateson's work in Martusewicz, Lupinacci, and Schnakenberg warmed my heart, as his work was formative for me when I discovered his work in the late 1970s and, later, that of his colleagues, Humberto Maturana and Francisco Varela. Bateson extended the concept of intelligence-Mind to outside the human sphere and thus Martusewicz, Lupinacci, and Schnakenberg conclude that, "wisdom" emerges from what Bateson called, "the ecology of mind", that is, "in the interactive and interdependent relationships within the whole complex system of life." This notion, inspired by Bateson, means that every day we continually negotiate our way with the world via messages that we receive from our surroundings.

Martusewicz, Lupinacci, and Schnakenberg then address the teaching-action component of the ecojustice education framework, arguing that education should lead to activities that "protect and revitalize their cultural and environmental Commons". This key concept of the *Commons* is from Bowers and is taken to be "the social practices, traditions, and languages, as well as relationships with the land necessary to the sustainability of their communities" (ibid.) What should happen in the classroom is that students, in their analysis of an issue, put the needs of communities first and come to see the consequences of different economic and political approaches to policy. Students *think globally and act locally*: local communities become the most important focus for sustainability efforts (just the opposite of what is enacted with national content standards and assessments).

According to Martusewicz, Lupinacci, and Schnakenberg, the purpose of ecojustice education is the attainment of "systemic wisdom where learning is oriented toward understanding of and acknowledging the ways in which we interact with, depend upon, and impact a larger system of intelligence." The ecological is viewed as being both human and more-than-human communities together, communities that interact at various levels. And thus, for science teachers, who should be knowledgeable of the assets of their local communities, it comes down to a series of questions,

> (how to) involve their students in work that is focused on protecting interdependent relationships that are part of intricate living systems. What aspects of the local commons support living systems, and which aspects work to undermine living systems?   What needs to be sustained? What needs to be limited or recognized as harmful and thus abolished?

Following these key questions, Martusewicz, Lupinacci, and Schnakenberg warn of the inevitable process of *enclosure*, a process also identified by Bowers. Enclosure is a process of exclusion that runs counter to collaborative interdependent relationships and helps create and maintain a status quo of hierarchies that protects elitist economic interests. Science, they note, has all too often contributed to cultural enclosures and several examples are cited, such as when "back in the day" science provided "data" to support white racial superiority. Teachers should help students to become aware of how enclosure works and how science has been used in the process.

Thus, to Martusewicz, Lupinacci, and Schnakenberg, science teaching from an ecojustice perspective should be *"situational, local, and supportive of living systems"*. They provide examples of students who are engaged in their own situational contexts and how these connect to larger social, political and economic contexts. These students are learning how to respond to problems in ways that sustain life. The authors also endorse an

interdisciplinary approach to teaching in which science is studied in combination with history, geography, art, literature, economics, and sociology.

A strong foundation for ecojustice education

"Study without desire spoils the memory, and it retains nothing that it takes in." --Leonardo Da Vinci

Martusewicz, Lupinacci, and Schnakenberg offer a compelling framework for ecojustice education based upon a sound epistemological foundation that should resonate with educators who are familiar with a constructivist epistemology (Bentley, Fleury, & Garrison, 2007). I offer a concept map in Figure 1 of this proposed framework for ecojustice education. The graphic illustrates the foundations of epistemology on the one corner of the triangle and of our situated ecosystem context on the other, both focused on the apex, the teaching-action component, which is the outcome of a cultural-ecological analysis process.

INSERT FIGURE 1: A graphic representing the ecojustice education framework.
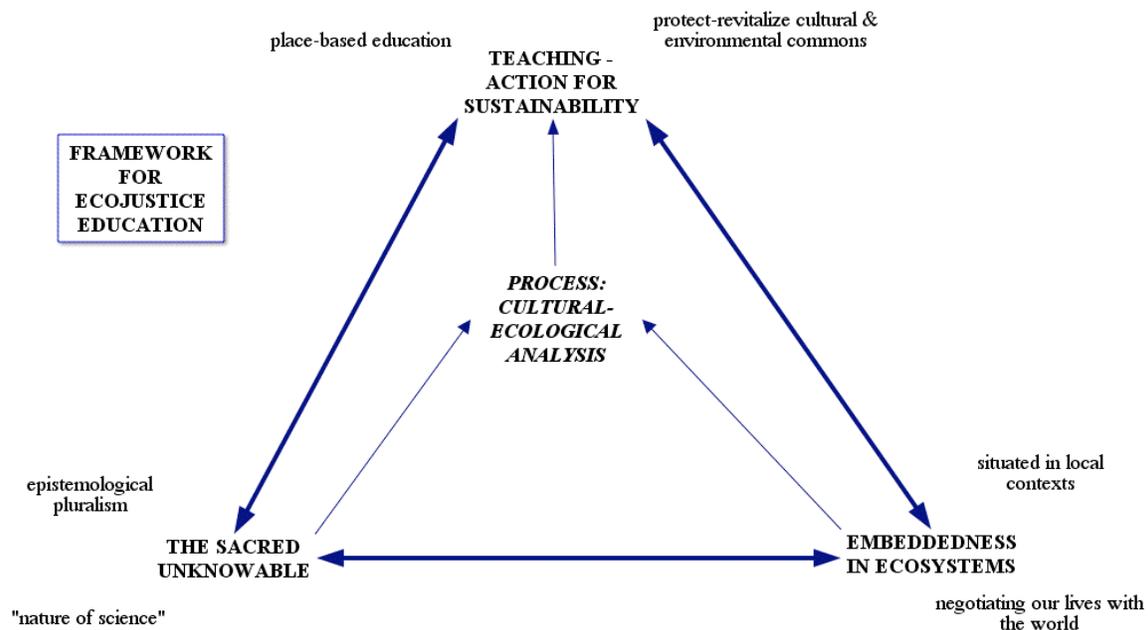
I have labeled the bottom left corner of the graphic "The Sacred Unknowable" because Martusewicz, Lupinacci, and Schnakenberg emphasize such a space in their argument that scientific knowledge will be incomplete. This corner could just has well have been labeled, "The Nature of Science" (NOS). The NOS, properly understood, includes the proposition that scientific knowledge is ultimately limited. An excellent resource about a post-modern view of the NOS is McComas (1998).

Epistemological support from modern science

Martusewicz, Lupinacci, and Schnakenberg don't draw upon science itself in their argument for the limits of science, but they well could have. In mathematics, they could have made reference to non-Euclidean geometry, which attests to multiple equally valid geometries, or they could have cited Kurt Godel's Incompleteness Theorem of the 1930s, which demonstrates that even mathematical proofs are not absolutely attainable. In physics they might have noted Quantum Theory, particularly Werner Heisenberg's 1927 theory of indeterminacy, also called

the Uncertainty Principle. They could also have referred to Non-linear Dynamics and Complexity Theory, more popularly known as Chaos Theory. From the latter we now know that the most common systems in nature are nonlinear systems, that is, not in equilibrium. Such systems are inherently unstable and thus limit predictability.

The point is that scientists themselves have recognized since the last century that while Western science may be foremost among ways to comprehend our universe, it isn't the only way, it isn't infallible, and it will always leave us with some uncertainty. This is important for students to know, since the impression that is conveyed by the massive science textbooks used in many schools is that science is a done deal and there is little left to be "discovered." These textbooks, by the way, typically treat the nature of science in the introductory chapter and usually promote the notion of a single "scientific method", which isn't surprising since few scientists have studied the philosophy of science and the assumptions underlying their own research (Glasson and Bentley, 2000).

Consistency with other trends in science education

For several decades now, much attention has been given in the field of science education to inductive teaching methods, usually called inquiry teaching. Inquiry teaching is not a new teaching method as inductivist approaches can be traced back to Dewey and even to even earlier object teaching. An inquiry approach is strongly promoted in the two major national science curriculum reform documents (National Research Council, 1996, and the American Association for the Advancement of Science, 1993).

Likewise, for decades science educators have been discussing methods of interdisciplinary teaching and the use of an "S-T-S" (science-technology-society) approach in teaching (Bybee, 1985, Yager, 1993). Ecojustice education is compatible with all of these movements.

Further, Martusewicz, Lupinacci, and Schnakenberg emphasize the importance of a curriculum that engages students in exploring their local environments and the complex ecosystems that they represent. In this regard they give a nod to the more recent movement in science education called *place-based education*, a movement that also can be traced back to Dewey and even to Rousseau (Gruenewald and Smith, 2007). One of the values of place-based education is that it tends to create a bond between the child and his/her environment (Sobel, 2004). Place-based education can be called community-connected education that taps into local people, workplaces, and cultural institutions (Bell, Lewenstein, Shouse, and Feder, 2009).

Ethics and urgency

Martusewicz, Lupinacci, and Schnakenberg provide an underlying ethic in their foundation for ecojustice education based upon the sacredness of the complex ecosystem upon which all life depends. The provision for ethics as an aspect of content in the science curriculum also was a concern of Dewey and has a long history in science education. In 1937, Dewey said, "The formation of the attitude... is the work and responsibility of the school more than of any other single institution." (1987, p. 254) This concern has particularly been a focus of feminist critiques (Zell, 1998). Certainly science education includes both cognitive and affective dimensions and we need to be more concerned about developing students' attitudes and motivations. In the words of Stephen Jay Gould (1994), "…we cannot win this battle to save species and environments without forging an emotional bond between ourselves and nature…for we will not fight to save what we do not love" (p. 4) An education that excludes an ethics foundation can lead to a self-centered, rudderless citizenry. According to the late Senator Gaylord Nelson (1997):

Ironically, an issue at least of equal importance to population is rarely noted or mentioned anywhere. Yet it is the key to our environmental future. The absence of a pervasive, guiding conservation ethic in our culture is the issue and the problem. Society's answer must be to focus its attention and energies on nurturing a conservation generation imbued with a conservation ethic. Without such a guiding cultural

ethic, society will not have the understanding, motivation, conviction or political will to persist in addressing the truly hard questions that will confront us in the decades to come. (38-39)

To develop an ethic of ecological sustainability science educators ought to become familiar with deep ecology, conservation biology, bioregionalism, ecofeminism, and socially critical analysis (Corcoran and Sievers, 1994). This task is all the more critical in our time as distress signals from one ecosystem after another become harder and harder to ignore. Croplands, forests, and grasslands, systems that support the world economy, are under varying degrees of stress and degradation in almost all places including the U.S. (Worldwatch Institute, 2009). NASA tells us that the ten warmest years on record all occur within the 12-year period 1997-2008 (Goddard, 2009). I'm not advocating that educators should teach from a crisis mode, but it is long past time to begin educating a generation of students on how to live in a world of ecological scarcity and to help them learn how to create a more sustainable society.

More examples of ecojustice education in practice

Martusewicz, Lupinacci, and Schnakenberg focus primarily on schooling, but learning is broader than schooling. Museums and other institutions of informal education could play a prominent role in ecojustice education, both for students and in professional development for teachers. Science learning in informal settings can complement classroom science goals and encourage connections with the local community (Bell, et al., 2009).

My colleague Claudia Melear's work with graduate students and pre-service science teachers on Ossabaw Island, Georgia's first Heritage Preserve, is an example of the kind of professional development that we need for teachers that facilitates a bonding with nature and the development of a conservation ethic. This work can be accessed at http://web.utk.edu/~ctmelear/ossabaw/.

According to the Green Charter Schools Network (http://www.greencharterschools.org/) there are about 200 "green" schools across the U.S. that incorporate environmental education into the curriculum, with some of them receiving state grants. They include the Green School in Williamsburg, Brooklyn (http://www.thegreenschool.org/), the Growing Up Green Charter School in Long Island City, Queens (http://www.gugcs.org/), the Environmental Charter High School in Los Angeles (http://www.echsonline.org/), and the Urban Assembly School for Green Careers on Manhattan's Upper West Side (Navarro & Bhanoo, 2010)
There are also schools that emphasize social justice. The Parkway High School for Peace and Social Justice in Philadelphia is an example of a public school that transformed itself into a place that develops socially responsible young adults (Self, 2009). The school program emphasizes self-reflection "to enable students to build personal responsibility through exploring their own values and beliefs" and strives to provide students a critical understanding of local to global social justice issues. In their coursework, students analyze how media is used to influence viewers' perceptions and ideas. Projects are part of the program, as is community service.

In addition, I can speak to an example of appropriate K-12 schooling from my own experience as a parent. When we moved from Chicago to Virginia in 1996 we initially enrolled our daughter, a rising second-grader, into the local public schools. Sarah had previously been a student at the lab school attached to the university where I had taught. She had been accustomed to a personalized, Deweyan-type of schooling and came home from her new school crying every day for two weeks. As we learned, she was expected to sit at her desk for long periods of time and take notes from the chalkboard during the teacher's lectures. Our consultations with the school got nowhere and we soon realized that the school was primarily focused on drilling in content knowledge so that it could meet its goal of achieving the pass rate on the state's high-stakes tests. We moved Sarah to a private, not-for-profit school, founded in 1971 and known for a child-centered, experiential, hands-on instructional approach. At Community School (http://communityschool.net) Sarah's interest in learning began to thrive again. When our boys reached school age, they followed in Sarah's footsteps. Later I served on the board of the school and led several of its annual curriculum evaluations. Community School serves a diverse population of 140 students through middle school. Typically, over forty percent of Community School students receive financial aid. The school campus is located adjacent to Hollins University with which it has a cooperative relationship. Community School is a "peaceable school" with a peer-mediation program. It has a strong outdoor education program with many options and weekly field studies for most students. It is a school with separate full time staff

for teaching, drama, music, and fine art. The school's annual arts festival in the spring is a fantastic public display of all the arts – a feature of the curriculum Jerome Bruner (1996) called *Oeuvres* (cultural works), and said we needed more of.

Off and on over its history Community School had a secondary curriculum, but it had been in mothballs for some time when, in 1999, the board formed a high school committee to revive it. Our committee spent two years studying alternative schools and planned our new high school based upon a "museum school" model. The curriculum design built upon Community School's tradition of experiential education, characterized by:
* learner-centeredness
* community-connectedness
* low student to teacher ratio
* integration of social justice and environmental education in an interdisciplinary curriculum
* infusion of the visual arts, drama, movement, and music into the curriculum.

In starting up, we focused foremost on faculty selection, recognizing that unique teaching capabilities would be required for enacting the ambitious curriculum. As it turned out, this was our best decision. The school's program has evolved from the collaboration of students, faculty, and educators working in the museum/cultural community. According to Takahisa and Chaluisan (1995), formerly of the New York City Museum School,

> The Museum School necessarily involves a paradigm shift: requiring new organizational structures, new role definitions for teachers and museum personnel. Faculty (must have) a willingness to move in new professional directions, an interest in interdisciplinary learning, a commitment to urban education, a sense of themselves as learners, an openness to team teaching and collaborative modes of curriculum development, and a sensitivity to the school's diverse community of students and their families." (p. 24)

Community High School (CHS) (http://www.communityhigh.net) opened in 2002 and now has 60 students. CHS is located in downtown Roanoke in the heart of the museum and cultural community and now represents a unique local expression of the 'museum school' concept. Today, CHS offers a distinctive learning experience in an environment of free enquiry and respect for the individual. Its small student body is diverse and intellectually curious. While most students are college-bound, they nevertheless have a wide choice of challenging courses and can also pursue their own interests and can gain hands-on experience through museum and community internships. Since they are not locked into classes by age or level, students develop friendships throughout the student body and are able to work with others of various ages and both learn from and teach one another. The multiple curricular offerings and the nurturing environment of the school helps students gain self-confidence and respect for themselves, one another, their teachers, and the environment.

Corporatocracy as the obstacle to better schools

> Education is not only about issues of work and economics–as important as these may be, but also about matters of justice, freedom, and the capacity for democratic agency, action, and change as well as the related issues of power, exclusion, and citizenship. Education at its best is about enabling students to take seriously questions about how they ought to live their lives, uphold the ideals of a just society, learn how to translate personal issues into public considerations, and act upon the promises of a strong democracy. Henry Giroux (2009)

With our high dropout rates some might contend that the U.S. has a failed public education system when compared to other industrialized nations. Teachers are often the scapegoats for those who hold this view, but a much more significant factor is our public schools' long history of resource deprivation. The "No Child Left Behind" (NCLB) program of the Bush administration (a bi-partisan project) has been an unfunded mandate, left to the states and localities to pay for and implement (Association of California School Administrators, 2008).

In fact, there is little evidence NCLB has improved American education: scores on standardized tests in the U.S. have shown no discernible change in student achievement for the past five decades, despite it (Baines, 2007, p. 100). With many accepting the view that "what can be measured matters," misconceptions are common about the status of U.S. student achievement as well as about how they stand among the world's children (Bracey, 2009).

Unfortunately, President Obama's new "Race-to-the Top" program is little more than an expansion on NCLB that would likely make matters worse, moving from state to national standards and linking teacher pay to the test performance of students. "Race-to-the Top" also compels state governments to shift funding from established public schools to charter schools.

The Obama "reform" adopts a corporatist ideology and identifies as its primary goal to create a more productive workforce. This perspective includes blaming the problems of public education on "bad" teachers. "Race-to-the Top" features a $4.3 billion "competition" among the states for federal grants that would be awarded to only a few states that implement these charter school and merit pay "innovations" ("Obama's Race", 2009). Schools whose students underperform on tests would have their principal and staff replaced or they would be turned into a charter school managed by a nonprofit agency and funded by parents and civic groups, possibly religious groups. "Race to the Top" will give money to states and school districts to "change the school culture" and encourages a punitive atmosphere in firing teachers and principals who fail to raise student test scores.

In the U.S., public school funding remains primarily based on local property taxes and thus our system is segregated by affluence: children who live in the suburbs and areas of wealth have well-equipped schools and well-paid teachers, while those in the inner cities and in many rural areas go to underfunded schools. Yet, instead of a program to equalize resources, Obama's plan continues to shift funding away from the most needy schools and thus further entrenches our class-based education system.

Obama's Secretary of Education, Arne Duncan, comes to the cabinet position with a business approach to education, as a proponent of expanding charter schools and of the corporate model for reform. Rich Gibson and E. Wayne Ross (2009) make a good case for the connection between this model of change, classism, and the current wars on "terrorism" – what they call the "core issue" of our time: "the interaction of rising inequality and mass, class-conscious, resistance." (p. 41) "Obama's education plan," they write, "is based on the same rhetoric (fear mongering) and reasoning that produced the educationally disastrous NCLB. …Like his predecessors, Obama misrepresents public education performance as a scare tactic and to open the door for the privatization (of public education)." (pp. 39-40).

With a concentration of power that enables the elite to pursue a global empire, America's "corporatocracy" – a term coined by Perkins (2004) to describe the form now taken by our ruling oligarchy – represents the biggest obstacle to creating schools that will further the goal of a democratic and sustainable society: "Rooted in the primacy of property rights over human rights, corporatocracy protects the rights of corporations as well as wealthy individuals to determine how resources will be used, by whom, and to what ends." (Sleeter, 2008, p. 139) Yet, given the recent collapse of the economy, replete with examples of unfettered greed and fraud, it would seem that the public might reject or at least question the business approach to education (Glickman, 2008). But the corporatocracy seems undaunted in its project of remaking schools in the image of business. The simplistic "one-size-fits-all" mentality of NCLB suits the corporate model because children are seen as both raw materials and products.

With the elevation of the subjects of reading and math above all other s in the K-12 curriculum, social studies and science have suffered, often sharing the same meager time slot at the end of the day (Brown and Bentley, 2004). Children who don't read or do math at the prescribed level and within the time limit are labeled "at risk," even if they might have other talents that would enable a future success in life. Once identified as "at risk" such children receive remedial instruction and may miss opportunities to develop other talents, such as in the arts. Worse, some children may see their own aspirations demeaned and lose their motivation to learn (Zhao, 2009).

In contrast, like Martusewicz, Lupinacci, and Schnakenberg, Deborah Meir (2008) and others have argued for more attention to curriculum goals other than that of producing a better workforce. To Meir, the primary goal of schooling should be to promote civil society and democratic values. With NCLB, she points out, "(t) focus is still unremittingly on preparing students to 'fit into' the future rather than to shape it." (p. 510) She warns of the over emphasis on "content knowledge" that we find in NCLB: "The "genius" of America, I would contend, has rested on its respect for playfulness, imagination, thinking outside the box, practical smarts, the taking apart and putting together of objects, exploring, and inventing." (p. 509)

Moreover, Larry Cuban (2008) has argued that Americans have always supported goals for its public schools that are not related to economic productivity, including goals related to citizenship, cultural unity, and improving social conditions. Obama's program of national standards would only continue the narrowing of the curriculum that began with compulsory state standards, and further lead to the deskilling of teachers who already are singularly focused on "test prep." Obama's program is likely to lead to a loss of instructional continuity for students from more curriculum fragmentation and more interventions uncoordinated with regular classroom instruction.

Beyond command and control

"For a school's curriculum is not only about subjects. The chief subject matter of school, viewed culturally, is school itself. That is how most students experience it, and it determines what meaning they make of it." (Bruner, 1996, p. 28)

We need to grow up and move beyond the command and control discourse that dominates government efforts to improve education. As a nation we should have learned by now that command and control is a losing strategy in the chaotic system of the classroom. Trying to apply chaos and complexity theory to organizations like schools, Dee Hock (2000) has coined the term "chaordic," by which he means chaos and order existing at the same time. Hock argues that the harmonious interplay of both is necessary for all vital, adaptable systems. He distinguishes between control and order: control is imposed, an attempt to eliminate chaos. Control stifles creativity and self-motivation. In contrast, *order* should arise naturally out of a shared purpose that engages students deep down and calls forth their best efforts. In an open letter to the current Secretary of Education, Herbert Kohl (2009) reminds us that,

It is possible to maintain high standards for all children, to help students learn how to speak thoughtfully, think through problems, and create imaginative representations of the world as it is and as it could be, without forcing them through a regime of high-stakes testing. Attention has to be paid to the richness of the curriculum itself and time has to be allocated to thoughtful exploration and experimentation. It is easy to ignore content when the sole focus is on test scores.

The Obama administration's educational program will be an obstacle rather than a segue to the implementation of Martusewicz, Lupinacci, and Schnakenberg's ecojustice education framework, but that doesn't mean that we science and social studies educators should fold our hands in resignation. There are those already-mentioned long-standing and respected movements in our field for us to draw upon – the "STS" (science-technology-society) approach, place-based education, experiential education. Even the National Science Education Standards make room for the goal of teaching "science in personal and social perspectives" and "the nature of science" (National Research Council, 1996). If it turns out that compulsory national standards for science and social studies education are enacted and then accompanied by high stakes tests, perhaps there will be some comfort in that these subject areas also will be assessed, even if by inappropriate and dubious means, so that they will still have a place in the curriculum.

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