

## Preparing Sustainability-Literate Teachers

by Victor Nolet – 2009

**Background/Context:** *This article explores sustainability as an emerging paradigm for preservice preparation of teachers. Sustainability education, which is rooted in Deweyan ideas about the fundamental social purposes of schooling, attends to the tensions created by the interconnectedness of environmental, economic, and social equity systems. Sustainability education extends but does not replace environmental education or education for sustainable development, although the latter is considered a problematic idea.*

**Purpose/ Focus of Study:** *Nine themes that occur frequently in the sustainability discourse are explored as the basis for sustainability literacy, a complex construct validated through collection of multiple sources of evidence. Specific strategies for integrating sustainability education into the preservice preparation of teachers are linked to a framework for teacher learning that addresses curricular vision, understandings about teaching, dispositions, and professional practices.*

**Research Design:** *The article is an analytic essay that examines existing literature in the area of sustainability education and maps this work onto current research pertaining to the preparation of beginning teachers.*

**Conclusions:** *Sustainability education represents a new paradigm for the preparation of teachers. It can help new teachers develop a curricular vision that addresses the fundamental social purposes of education in the context of an uncertain 21st century. Sustainability education also can stimulate a conversation about the role of teacher education in the creation and solution of global environmental and social justice challenges.*

*I am convinced that if we are to get on the right side of the world revolution, we as a nation must undergo a radical revolution of values. We must rapidly begin the shift from a "thing-oriented" society to a "person-oriented" society. When machines and computers, profit motives and property rights are considered more important than people, the giant triplets of racism, materialism, and militarism are incapable of being conquered.*

Martin Luther King Jr.  
April 4, 1967

A thought often attributed to Albert Einstein holds that we cannot solve a problem using the same kind of thinking that created it. Today, we face challenges that literally are planetary in magnitude and complexity, and it is becoming increasingly clear that our thinking *is* the problem. If we want to change the kind of thinking we are doing, we need to change the educational systems we are using to create that thinking (Orr, 2004). However, as Fullan (2006) lamented recently, our knowledge base in education has not moved from theory to action to bring about deep educational reforms. He suggested that those working in the field of educational change have not yet articulated a powerful enough agenda for change. Surely though, it is hard to imagine a more powerful or pressing agenda for educational change than can be found right outside one's front door.

Today, nearly two thirds of the natural systems that provide services for humans are in distress, on the verge of collapse, or past the point of retrieval (United Nations Statistics Division, 2005). Human activities have exceeded the Earth's biocapacity each year since 1961 (World Wildlife Fund for Nature, 2006), and after a mere two centuries of industrialization, humans have managed to bring the 4.5-billion-year-old Earth to a state of severe overshoot (Wackernagel et al., 2002). We have eliminated forests faster than they can regenerate, water supplies are at risk on every continent, and fisheries have collapsed worldwide (Brown, 2006). The loss of these vital systems is not the result of naturally occurring cycles but rather is the direct result of humans cutting down too many trees, taking too much water out of the ground, and removing too many fish from the oceans.

Human systems are in no better shape. Billions of people around the world experience crushing poverty and disease stemming from gross inequities in the distribution of resources such as food, shelter, and health care (United Nations Statistics Division, 2006). A global catastrophe is not inconceivable and indeed may be no longer even avoidable. Is this not a powerful enough agenda for deep educational reform?

We find ourselves in this situation because so many people in the industrialized areas of the world have come to believe that they are entitled to use more than their fair share of the planet's resources and that they are entitled to deposit the waste products of their privileged lives into the environment they share with the rest of the planet's inhabitants. Analyses conducted over the last several decades consistently have shown that the 20% of the Earth's population living in the wealthiest countries consume more than 80% of the Earth's nonrenewable resources and 50% of food products (United Nations, Department of Economic and Social Affairs, 1998). Indeed, if the rest of the world's inhabitants consumed resources at the rate of North Americans alone, it would take 2.5 Earths to support us all (Wackernagel et al., 2005; World Wildlife Fund for Nature, 2006).

As the recent Intergovernmental Panel on Climate Change fourth assessment report (Intergovernmental Panel on Climate Change [IPCC], 2007) made clear, there is little doubt among the credible scientific community about the reality of global climate change or the likelihood that humans are exacerbating if not causing it. Moreover, per-capita production of the greenhouse gas carbon dioxide (CO<sub>2</sub>) in the wealthiest countries is 6 times that in developing regions (United Nations Statistics Division, 2005), so those of us who live in the most industrialized regions of the world bear primary responsibility for the

impacts of climate change. Yet, most Americans perceive climate change as posing little immediate risk to themselves or their families and only a moderate risk to individuals and nonhuman species living in other regions of the world (Leiserowitz, 2005). Perhaps it is not surprising, then, that in the United States, educational leaders, particularly those concerned with the preparation of teachers, have yet to respond meaningfully to the issues of overconsumption, human-caused environmental damage, and the global and human catastrophe we are creating.

In fairness, the last few years have not been easy times for teacher education. In a recent special issue of the *Journal of Teacher Education* that focused on what beginning teachers need to know, Darling-Hammond (2006) suggested that teacher education as an enterprise lost its voice in recent years under pressure from opponents of teacher education. She noted that the work of the Holmes Group (1986, 1990) and the Carnegie Forum on Education and the Economy Task Force on Teaching as a Profession (1986) resulted in meaningful progress toward professionalizing teaching, but much of what was learned about building strong models of teaching was discounted or ignored during the last 6 years as the U.S. Department of Education sought to impose what has been characterized as a neoessentialist agenda (Imig & Imig, 2006) on the profession. In such a hostile political climate, teacher education may be in no mood to contemplate deep systemic reforms.

Furthermore, it may be difficult for some educators to look beyond the immediate and very real challenges created by poverty and inequity that exist in our society today to see the relevance of overconsumption and global climate change or to be concerned with impacts that may seem decades in the future. However, there is a growing recognition that climate change and environmental degradation are already exerting a devastating impact on economic and cultural well-being around the world and that those impacts are being experienced disproportionately by poor and indigenous people. People in poor communities have limited means to adapt to natural disasters and tend to be more dependent on resources directly affected by climate change, such as local water and food supplies (Bullard, Johnson & Torres, 2005; IPCC, 2007). The most immediately vulnerable people are those living areas where the effects of climate change are already evident, including coastal flood plains and low-lying islands such as can be found in Bangladesh and Indonesia; areas where changes in the length of growing seasons have affected crop yields, such as Sahelian Africa; and in Arctic regions, where hunting and travel have been adversely affected by loss of sea ice and permafrost (IPCC). Indeed, the Inter-America Commission on Human Rights recently agreed to hear a complaint filed by the Inuit Circumpolar Conference asserting that the world's leading producers of greenhouse gasses, typified by the United States, are directly responsible for the destruction of Inuit sea ice culture (Goldberg, 2007; Wagner, 2007; Watt-Cloutier, 2007). The complainants argue that a continuing increase in temperature in the Arctic region resulted in melting of permafrost, dramatic losses of sea ice, and outright destruction of entire villages. The complainants' case rests at least in part on failure of the United States to participate in international agreements such as the Kyoto Protocol on climate change.

Educators in the United States are beginning to recognize that the forces that create injustice and environmental degradation around the world are identical to those that create inequities here: racism, classism, and an irrational expectation of privilege (Gandin & Apple, 2004; Li, 2006; Light, 2002). Although this understanding is not yet widely

manifested in the professional standards, licensure requirements, or accreditation criteria for teacher preparation programs in the United States, work is under way elsewhere around the world in an education reform movement that has been steadily gaining momentum and credibility in the past two decades (Heselin & Goldstein, 2000; United Nations Education, Scientific, and Cultural Organization [UNESCO], 2004). This movement is coalescing around a constellation of ideas generally associated with the term *sustainability*.

## SUSTAINABILITY

Sustainability is a broad construct that usually refers to a concern for intergenerational equity, an idea that can be traced to a number of ancient cultures (Manuel-Navarrete, Kay, & Dolderman, 2004; Newton, 2003). The organizing premise is that when sustainability has been achieved, the current generation would be able to meet its needs without jeopardizing the ability of future generations to meet their needs. In the field of ecology, sustainability usually refers to the capacity of an ecosystem to sustain interdependent forms of life by balancing the rate of resource removal with the rate of resource regeneration. In the broader context in which the term is used today, sustainability often refers to a balance among various human systems that influence and are influenced by the natural environment. Ultimately, sustainability represents an ideal that will be achieved when human-caused environmental degradation has been reversed and overconsumption and gross economic injustices that deprive future generations of the ability to meet their needs are eliminated.

Our current conception of sustainability generally is attributed to the 1987 World Commission on Environment and Development report entitled *Our Common Future*. This report is commonly referred to as the *Brundtland Report* after Gro Harlem Brundtland, the commission's chairwoman. The Brundtland Report was the first international policy document to frame economic development, social justice, and environmental impacts as interconnected systems. According to the Brundtland Report, sustainable development considers social justice, which includes intergenerational equity, and the health of natural systems of equal importance with economic development. The report stated explicitly that critical global environmental problems were primarily the result of the enormous poverty in developing regions, primarily in the Southern Hemisphere, and nonsustainable patterns of consumption in the developed regions, primarily in the Northern Hemisphere.

The Brundtland Report called for "a vast campaign of education, debate, and public participation" and asserted that the "security, well being and very survival of the planet" depend on immediate action (World Commission on Environment and Development, 1987, p. 23). The report recommended redressing global inequities by redistributing resources toward poorer nations and at the same time encouraging economic development in those regions.

Today, the term *sustainability* often is used interchangeably with *sustainable development*, but the two terms represent quite different ideas that require some discussion. Subsequent to Brundtland, concern for the interconnectedness of environmental, economic, and social systems has become central to the idea of sustainability, but such an interactive systems approach has not always been associated

with the idea of development. Indeed, some consider the term *sustainable development* an oxymoron. A number of authors (Filho, 2000; Newton, 2003; Orr, 1992) have argued that sustainable development implies continual growth and therefore an increasing demand on resources that would eventually outstrip rates of renewal. A sustainable system is one in which resource use is in balance with resource regeneration, and at some point, growth slows or ceases. Therefore, unlimited growth is by definition unsustainable. Similarly, Palmer (1998) noted that the “problem of development” is inextricably linked to environmental impact. She summarized the relationship this way:

Rates of unsustainable consumption in developed countries continue to rise while poor countries fall further and further into debt to wealthy countries. Poor countries export more to acquire foreign currency to service their debt load. At the same time, poor countries often experience overpopulation, unmet basic human needs, and inadequate or misconceived government policies. Thus, the widening gap between rich and poor nations results in over use or misuse of natural resources and environmental degradation in developing regions. (p. 54)

The difficulty associated with the idea of sustainable development was framed cogently by Orr (1992), who contends that a focus on policy or technology approaches fails to account for a number of deeper and more complex problems having to do with the fundamental values underling modern civilization. According to Orr, those problems could include various social traps, such as the tragedy of the commons (Costanza, 1987; Platt, 1973); a flawed understanding of the relationship between economic growth and the Earth; Judeo-Christian beliefs in the divine right of humans to dominate nature; and the possibility that humans represent an evolutionary “wrong turn,” or an intrinsic perversity endemic to the state of being human. Orr distinguished between technological sustainability and ecological sustainability. The former is premised on the belief that every problem encountered by humans can be solved through technology and market solutions, whereas ecological sustainability relies on the overall moral improvement of society to bring human existence into balance with the rest of nature. According to Orr, sustainable development (i.e., technological sustainability) cannot succeed without the fundamental changes in values that would be associated with ecological sustainability.

The Brundtland Report has been transformative because it has helped shape the central ideas now associated with sustainability: intergenerational equity and the interrelatedness of environment, economy, and social justice. However, it was written against the backdrop of the then-prevailing vision of a benign 21st-century global marketplace in which a rising tide of economic prosperity would raise all boats. At that time, globalization was viewed as both inevitable and beneficial. Recall that the Brundtland Report predated, by several years, the U.S. Department of Labor Secretary’s Commission on Achieving Necessary Skills (SCANS) report (1991) calling for extensive school reforms aimed at preparing a technologically literate and highly flexible 21st-century workforce. With the hindsight that two decades afford, we now realize that the Brundtland Report was prescient in anticipating that the much-vaunted global economy would be accompanied by globalized hyperconsumerism, globalized poverty and disease, and environmental degradation that place the entire planet at risk. Today, the idea of sustainable development may seem naïve if not actually counterproductive to the goal of

achieving the vision of sustainability that Brundtland helped inspire.

Reaching consensus on a precise meaning for the term *sustainability* is further complicated by the wide use that it and the related term *sustainable* presently enjoy in the popular media and as a marketing tool. Often these uses align with Orr's (1992) technological sustainability and refer to specific practices such as use of materials, manufacturing, forestry, and agricultural or community planning that attempt to minimize environmental impacts (cf. Anderson, 1998; Bell & Morse, 2006; Birkeland, 2004; Hallsmith, 2003; McKenzie-Mohr & Smith, 1999; Toor & Havlick, 2004). Although not necessarily incompatible with the larger ideas associated with sustainability, narrower uses of the term *sustainable* to refer exclusively to environmental impacts underrepresents the broader perspective that sustainability entails.

A more comprehensive exploration of the meanings and interpretations currently associated with sustainability is beyond the reach of this article. However, several features mentioned in the foregoing discussion are particularly salient in the context of education and teacher preparation. To wit, sustainability is an emergent paradigm that considers environmental, economic, social, and political systems as interconnected systems rather than discrete entities; involves transformation of values and belief systems as well as technological, market, or policy approaches to problem solving; views social and economic justice and intergenerational equity as inextricable from environmental stewardship; cannot be achieved if current rates of consumption and environmental degradation remain unchanged; and emphasizes personal and collective practices consistent with responsible global citizenship.

## SUSTAINABILITY EDUCATION

As the complexity and scale of human-caused environmental damage and the intractability of the gross inequities between the rich and poor regions of the world have become better understood, so has the realization that technology, policy, and market-driven reforms will be insufficient to bring about the deep and lasting changes in human behavior that will be necessary to avert a planetary catastrophe. Today, education is considered an integral component of sustainability (Onwueme & Borasi, 2007), and the term *sustainability education* has emerged to refer to the broad category that overarches the various aspects of education associated with the sustainability discourse (Sterling, 2004).

David Orr's writing (1992, 2004) has been particularly influential in the evolution of sustainability education. In 1992, Orr described the "problem of sustainability" as the interaction of three looming catastrophes: the worldwide loss of arable land and food production capacity, which will coincide with an accelerating growth in population; the inevitable depletion of accessible petroleum; and the prospect of exceeding the limits of ecological thresholds and natural limits exemplified by, but not limited to, global climate change. Later, Orr (2004) made explicit the link between the "problem of sustainability" and "the problem of education," and he called for a rethinking of education to focus on issues of human survival in the 21st century. He wrote,

The crisis we face is first and foremost one of mind, perception, and values: hence, it is a challenge to those institutions presuming to shape minds,

perceptions and values. It is an educational challenge. More of the same kind of education can only make things worse. This is not an argument against education but rather an argument for the kind of education that prepares people for lives and livelihoods suited to a planet with a biosphere that operates by the laws of ecology and thermodynamics. (p. 27)

The idea of education for sustainability gained prominence following the Earth Summit, the 1992 United Nations Conference on Environment and Development in Rio de Janeiro. The report developed at that conference, titled Agenda 21 (United Nations, 1992), presented a plan that went beyond earlier recommendations aimed at achieving sustainable development and began to address the broader ideas associated with sustainability. At the same time, chapter 36 of Agenda 21 presented specific strategies and goals pertaining to education. Following Agenda 21, education has continued to be integral to the United Nations' conception of sustainability (United Nations, Department of Economic and Social Affairs, 2002), and this perspective was fully articulated with the passage of Resolution 57/254, which proclaimed the 10-year period from 2005 to 2014 as the United Nations Decade of Education for Sustainable Development (UNDESD; UNESCO, 2004).

The UNDESD represents a comprehensive framework for educational reform reminiscent of Dewey's (1897) pedagogic creed, with its emphasis on experiential learning, the moral and social context of schooling, and the expectation that education for sustainable development should be embedded in the larger curriculum. The framework for implementation of the UNDESD (UNESCO, 2005) includes recommendations that focus on all levels of education, including the preparation of teachers. The document specifies that

education for sustainable development will aim to demonstrate the following features:

- Interdisciplinary and holistic: learning for sustainable development embedded in the whole curriculum, not as a separate subject;
- Values-driven: it is critical that the assumed norms—the shared values and principles underpinning sustainable development—are made explicit so that that can be examined, debated, tested and applied;
- Critical thinking and problem solving: leading to confidence in addressing the dilemmas and challenges of sustainable development;
- Multi-method: word, art, drama, debate, experience, different pedagogies which model the processes. Teaching that is geared simply to passing on knowledge should be recast into an approach in which teachers and learners work together to acquire knowledge and play a role in shaping the environment of their educational institutions;
- Participatory decision-making: learners participate in decisions on how they are to learn;
- Locally relevant: addressing local as well as global issues, and using the

language(s) which learners most commonly use. Concepts of sustainable development must be carefully expressed in other languages—languages and cultures say things differently, and each language has creative ways of expressing new concepts. (p. 16)

Consistent with Orr (2004), and to some extent, the UNDES (UNESCO, 2004), Sterling (2004) argued for a change in the culture of education that goes beyond the traditions of environmental education and education for sustainable development. He suggested that sustainability education represents a new paradigm that conserves and transforms some elements of environmental education and education for sustainability but that represents a fundamental change in educational culture. According to Sterling, that new paradigm

- Implies a fundamental change of purpose or at least an additional key purpose for education.
- Implies embedding, embodying, and exploring the nature of sustainability as intrinsic to the learning process. This is education “as” sustainability—nurturing critical, systemic and reflective thinking; creativity; self organization; and adaptive management—rather than education “about” sustainability or education “for” particular sustainable development outcomes.
- Is not prescriptive but is indicative and purposeful.
- Affirms liberal humanist traditions in education but goes beyond them through synergy with systemic and sustainability core values, concepts and methodologies.
- Challenges the limiting effects of characteristics of the dominant mechanistic paradigm, such as top-down control, centralization, managerialism, instrumentalism, and the devaluing of the humanities and arts.
- Is based on “systemics” rather than “systematics”—that is the emphasis is on systemic learning as change, rather than systematic control in response to change. (pp. 56-57)

An underlying (as yet untested) assumption is that sustainability education will result in citizens who are more likely to engage in personal behaviors or contribute to public policy decisions in the best interest of the environmental commons and future generations. As Orr’s (1992, 2004) and Sterling’s (1996, 2004) work indicates, sustainability education is premised on the understanding that simply telling people about the negative impacts of their behaviors is not necessarily going to result in changes in those behaviors. Sustainability education recognizes the paradox that has vexed the environmental education and public health communities for decades: There often seems to be little or no relationship between knowledge of environmental or health issues and changes in behaviors (Corral-Verdugo & Frias-Armenta, 2006; Stevenson, 1987). According to Juker

(2002), there are several reasons for this awareness versus action gap:

- Structural barriers may impede individual sustainable behavior. For example work schedules and transportation infrastructure often favor use of private automobiles.
- Resistance to change. To move to patterns of behavior consistent with sustainability, individuals may need to disrupt deeply held personal belief and identity patterns. Sustainability related behavior may be perceived as lower status or less socially valued. For example, in the U.S., transportation in private automobiles is viewed as a higher status option than using a public transit system.
- Economic incentives foster unsustainable behaviors. For example, tax structures, utility pricing, transportation infrastructure, food production, and government subsidies often create price advantages for goods and services that result in greater environmental impact or rely on inequitable labor practices. (p. 263)

With such deep structural and psychological forces arrayed against it, one must entertain a degree of skepticism about the prospect that sustainability education will be any more successful than its most prominent predecessor, environmental education, in bringing about meaningful changes in patterns of overconsumption or environmental damage. However, Palmer (1998) summarized a number of studies investigating the impact of environmental education in schools and noted that environmental education has never been fully integrated into the larger context of schooling, and in fact the goals and methods of environmental education may actually be contradictory to the traditional purposes of school. In truth, environmental education has never enjoyed more than a peripheral presence in the larger education enterprise, whereas sustainability education implies a fundamental reorientation of all education systems. At the moment, because this is a nascent transformation, direct comparison of sustainability education with environmental education would be inappropriate.

Sterling's (2004) choice of the term *paradigm* seems appropriate to describe the current context for sustainability education. Indeed, we do find ourselves in a period of transition associated with what Kuhn (1996) described as a "paradigm in crisis" (p. 351). Such a transition is characterized by a reconstruction of fundamental theoretical generalizations to new modes for thinking about problems and solutions. According to Kuhn, when such a paradigm shift is complete, there is a decisive difference in methods, goals, and ways of viewing problems. The paradigm in crisis today is the one based on the belief that natural resources are inexhaustible and that humans somehow exist outside the laws of thermodynamics that govern the planet. Clearly, the sustainability discourse involves a very different set of ideas about the way humans should interact with the natural world and the purpose, goals, and methods of education.

Although not necessarily a complete instantiation of this new paradigm, the curriculum framework developed by the Commonwealth of Australia (2005) certainly is consistent

with its general principles. In Australia, sustainability education is included at all grade levels and in teacher education programs. Here are the goals established for all Australian students in the curriculum framework:

Understand and value the interdependence of social, cultural, economic and ecological dimensions at local, national and global levels; reflect critically upon how this interdependence affects communities, workplaces, families and individuals and be able to make appropriate decisions; develop attitudes and skills which are conducive to the achievement of a sustainable future; appreciate and respect the intrinsic value of the whole environment and a sense of the sacred; develop an ethic of personal responsibility and stewardship towards all aspects of the environment; and participate as active and involved citizens in building a sustainable future. (p. 8)

Similarly, in England, sustainability is a required component of science and geography classes at the secondary level. In a study examining the professional development preferences of British teachers, Gayford (2001) described a set of topics for sustainability education that is consistent with the themes found in the Australian framework:

(1) the interdependence of society, the economy and the natural world; (2) local activities and their possible global consequences; (3) citizens' rights and responsibilities, participation and co-operation; (4) the need to safeguard the future; (5) the importance of cultural, social, economic and biological diversity; (6) equity and justice; (7) change processes and development within the carrying capacity of the environment; (8) the impact of human communities on the environment; (9) the impact of poverty on environmental degradation; (10) the impact of technology on the environment and society; (11) the impact of personal action; (12) conservation and efficient use of resources; (13) the use of renewable and non-renewable resources; (14) the political dimension to aspects of sustainability; (15) the roles and responsibilities of government and businesses. (p. 324)

When the field of sustainability education is viewed in its entirety, it is quite possible to discern a coherent whole greater than its parts. Naturally, because it has roots in a number of domains, including public policy, social justice, economic development, and, of course, environmental education, sustainability education inherits from those fields a number of definitional, epistemological, and philosophical questions that have yet to be fully resolved. However, the core propositions of the field have begun to stabilize, and it is now feasible to discuss the characteristics of a literacy that would be associated with sustainability education (Bell & Morse, 2006; Byrne, 2000; Manderson, 2006).

## SUSTAINABILITY LITERACY

The idea of sustainability literacy originally was proposed by Orr (1992) as ecological literacy, which he conceived as including a variety of knowledge, thinking, and values dimensions primarily focused on environmental preservation and restoration. Orr's description of the components and aims of ecological literacy creates a contextual backdrop for the present discussion.

Sustainability literacy is construed generally here as the ability and disposition to engage in thinking, problem solving, decision making, and actions associated with achieving sustainability. Although it may be premature to refer to sustainability as a fully fledged epistemology, sustainability literacy certainly would involve knowledge, skills, and values that inform an individual's mental models and day-to-day behaviors. It entails more than simply knowing things about the environment, economics, or equity and justice issues, but rather involves a willingness and ability to engage intellectually and personally with the tensions that are created by the interconnectedness of these systems.

A number of policy and implementation frameworks developed in the last several years have converged on a set of themes, ideas, and processes that begin to form a content knowledge basis for sustainability literacy. Indeed, Edwards (2006) examined the policy documents and publications of 39 organizations generally associated with sustainable development or environmentalism and found that seven themes recurred frequently: stewardship, respect for limits, interdependence, economic restructuring, fair distribution, intergenerational perspective, and nature as model and teacher.

Edwards's (2006) themes are generally consistent with the conceptualizations of sustainability offered by a number of other authors in recent years, although two additional themes also seem to recur regularly: global citizenship and importance of local place (Barlett, 2005; Bell & Morse, 2006; Byrne, 2000; Federico, Cloud, Byrne, & Wheeler, 2002; Orr, 2004; Sobel, 2005; UNESCO, 2005; Wheeler, Wheeler, & Church, 2005). Using Edwards's list as a point of departure, following is a summary of nine themes that likely would form the basis for a sustainability literacy.

*Stewardship.* This theme emphasizes a human connection to the natural and physical world, and the importance of establishing an ecological ethic for managing, restoring, and preserving the biological integrity of ecosystems. It implies caring about, and therefore caring for, the environment. Related ideas pertain to the preservation of the health of resources such as water, air, soil, and species diversity. Similarly, the idea of stewardship involves what Orr (1992) described as "a commitment, pervading learning and research at all levels, to health, harmony, balance, wholeness, and diversity as those qualities apply to both human and natural systems" (p. 133). The term *stewardship* can have paternalistic connotations in the sense that a steward is one who manages the property of another. Certainly, given the history of what Gedicks (2005) described as developmental genocide that has occurred when native communities occupy land that contains valued natural resources, the notion of stewardship requires careful consideration. However, in the context of sustainability, the intent is to manage and preserve natural systems for future generations, so stewardship is meant to convey the antithesis of destruction or overconsumption. Stewardship in this context becomes a minimal requirement for intergenerational equity. Light's (2005) ideas pertaining to ecological citizenship also might pertain here: Good citizenship would involve attending to the environmental dimensions of a community and might be evinced by participating actively in some form of restoration or preservation ecology.

*Respect for limits.* This theme calls for living within nature's means by preventing waste, pollution, and, particularly, unsustainable resource depletion. This theme is concerned

with protection of biodiversity but focuses more directly on the extent to which life and nature are threatened by overconsumption in developed nations. The term *limits* here represents the threshold of living systems—the various limits that constrain unlimited growth. Overshoot occurs when the demands on a natural system exceed the sustainable yield of that system (Meadows, Randers, & Meadows, 2004). If demand and biocapacity are not brought back into balance, a system in a state of overshoot eventually collapses (Wackernagel et al., 2002). Overshoot indicators such as species extinction and global climate change are considered direct effects of the loss of respect for limits. The work of the Global Footprint Network (2006) directly addresses this theme. This organization promotes the use of ecological footprints analysis based on scientifically rigorous standards as a measure of the effects of human demands on the planet.

*Systems thinking and interdependence.* This theme covers not only the ecological relationships among species and nature but also the inextricable links among ecological, economic, and social systems. Interconnected systems include transportation and communication systems, food and energy production, financial transactions, and manufacturing networks. An understanding of any of these systems requires simultaneous consideration of environmental, economic, and societal impacts. At the same time, the notion of interdependence refers directly to nature's interdependent systems linking air, water, soil, and species survival.

Manderson (2006) and others (Cortese, 2003; Hallsmith, 2003; James & Lahti, 2004) have argued for the use of *systems dynamics* as a strategy for representing complex human and environment interdependences and interrelationships. Systems dynamics is based on Forrester's work at the Massachusetts Institute of Technology (Forrester, 1968; Sterman, 2002) and considers interactive feedback and feed forward loops, and underlying causes and forces that result in change or equilibrium. This understanding relates to the way systems behave and change over time and the way different systems interrelate. Systems thinking provides strategies for considering environmental, economic, and social structures as interconnected systems that have cyclical patterns of behavior. Similarly, in the specific context of schools, Hargreaves and Fink (2006) and Fullan (2005, 2006) described systems thinking as a key attribute of a new kind of school leader who works intensively in a local school context while at the same time connecting with larger issues and contexts that have community and societal impacts.

In the past two decades, the interconnectedness of Earth systems, economic systems, and social systems has come to be more clearly understood. For example, thermohaline circulation (THC) transports warm water from the equatorial regions toward the poles and introduces cooler fresh water into the system through steady state ice melt at the poles (Rahmstorf, 2007). This system is essentially a set of interrelated feedback loops that helps moderate the temperature gradient between cool and warm regions of the planet. Paleoclimatic analyses and climate change modeling have shown that THC is quite sensitive to variation in air and surface temperatures and climatic levels of CO<sub>2</sub> (Bethke, Furevik, & Drange, 2006; Lucarini, Calamenti, & Artale, 2005). As surface temperatures warm, the THC seems to become less active or even shut down completely. Most atmospheric ocean general circulation models predict significant slowdown or complete shutdown of THC during this century, absent meaningful abatement of global warming

(O'Neill & Oppenheimer, 2004).

One of the outcomes of less or inactive THC seems to be an increase in the number of intense tropical storms and hurricanes (Wunsch & Ferrari, 2004). The 2005-2006 Atlantic hurricane season was one of the most active and intense on record, and graphic images from New Orleans and other areas affected by Hurricane Katrina helped illustrate clearly the complex interaction of social, economic, and environmental systems. Those placed at most risk by Katrina were those least able to get out of harm's way: the poor, elderly, and disabled.

Incidentally, much of the early attention on the impacts of global climate change focused on North Atlantic circulation systems, but recent analyses have indicated that the Pacific climate systems also appear to be quite susceptible to the effects of global warming (Pierrehumbert, 2006), and it is probable that the west coast of North America will experience severe weather on a more frequent basis. Tropical storms such as those experienced in the Gulf of Mexico might be unlikely, but the cumulative effect of record-breaking storms such as those experienced in the Pacific Northwest in the fall of 2006 would eventually be expected to have an economic and social impact.

*Economic restructuring.* This theme addresses the growing awareness that expansion of employment opportunities must not preclude safeguarding ecosystems. The underlying economic principle here is that traditionally, economists have treated the consumption of natural resources the same as human-made capital (Dresner, 2002). So-called *weak sustainability* is based on the assumption that new technology will always be available to substitute for the loss of natural resources, whereas *strong sustainability* assumes much less substitutability and treats natural and human-made capital separately (Neumayer, 1999). Designs for economic restructuring often have focused on strategies for strong sustainability and economic models that value cooperation and optimal efficiency to a greater degree than competition and waste. The premise of this work is that current economic systems depend on growth models that are untenably exploitive of people and the environment and that to achieve the goals of sustainability, new ways of thinking about economic success and prosperity must evolve. Ideas closely related to this theme include community-based social marketing (McKenzie-Mohr & Smith, 1999), natural capitalism (Hawkins, Lovins, & Lovins, 1999), and Genuine Progress Index (GPI; Ventoulis & Cobb, 2004). This theme is not necessarily "anticapitalist" but rather involves a reassessment of the underlying assumptions of current economic models and a movement toward what Henderson (2006) characterized as "green economy" and what McKibben (2007) described as "deep economy." Henderson described three areas in which a fundamental restructuring toward a more green economy already is occurring: (1) the lifestyles of health and sustainability (LOHAS) sector (which includes renewable energy and resources industries, recycling, remanufacturing industries, and industries involved with preventive and alternative health or organic agriculture); (2) the socially responsible investing sector; and (3) the area of corporate social responsibility. Another example of a move toward more green economic models is the GPI, which is a measure of national health premised on the assumption that traditional measures of our country's economic health, such as the gross national product, ignore much of what people value or that which fulfills basic needs (Cobb, Glickman, & Chaslog, 2001). The GPI and the gross domestic product (GDP) can be compared on the same scale because they are both

measured in monetary terms. The GPI begins with the computations of personal consumption but adjusts for costs ignored by the GDP, such as costs associated with crime, water pollution, or resource depletion. The GPI also adds in benefits ignored by the GDP, such as the value of house working and parenting, the value of volunteering, or the value of streets and highways.

*Social justice and fair distribution.* Social justice and equity are integral to current conceptions of sustainability and distinctly differentiate it from environmentalism and environmental education. The collective effort that is known as the “environmental movement” has been criticized in recent years because it has failed to address directly the human and social justice components of the environment. For example, Ageyman (2005) reported that an analysis of the mission statements of 30 environmental advocacy organizations showed that few mention social justice or equity as part of their core work. Sustainability considers social justice and equity as equal in importance to preservation of wilderness areas and biodiversity. Fair and equitable distribution of resources involves a shift in social values that may be facilitated through government policies such as tax changes or through socially responsible corporate practices. Innovative approaches to dealing with the shortcomings of current economic models might entail more local and community-based initiatives, and an attempt to more fully include all stakeholders in decision-making processes.

*Intergenerational perspective.* An intergenerational perspective implies that decision-making about critical choices facing society must be guided by a long-term rather than short-term view. This theme encourages consideration of the impact of actions on subsequent generations, as far out as 150-500 years into the future. Individuals, as well as organizations and governments, would prioritize decisions according to the likely impact on children’s, grandchildren’s, and great grandchildren’s lives. Clearly, the idea of intergenerational responsibility has particular relevance for teachers and teacher educators whose work is directly concerned with intergenerational responsibility already.

*Nature as model and teacher.* This theme suggests that humans have much to learn from the billions of years of evolution of the Earth’s living systems. The big idea here is that nature represents a significant source of “expertise.” This theme is concerned with advocacy for models and designs that are in accordance with the needs and cycles of the natural world. For example, materials scientists have for some time now been applying ideas of biomimicry in business and industrial applications (Anderson, 1998; Benyus, 1997), and the principles of green chemistry are being applied in a variety of industrial, educational, and research applications (Hjeresen, Schutt, & Boese, 2000). The integration of indigenous knowledge and Western scientific methods is gaining increasing acceptance and also maps onto this theme of nature as teacher. This work was summarized by Rist and Dahdhouh-Guebas (2006), who described a transdisciplinary approach to knowledge production that integrates ethnosciences—the set of concepts, propositions, and theories unique to each cultural group—with Western scientific approaches. These new ethnosciences include ethnobiology, ethnoecology, and ethnobotany, and they involve the study of the interactions among organisms and the physical, biological, and human factors to which they are related. Rist and Dahdhouh-Guebas provided examples of a number of successful sustainable development projects, such as application of local knowledge of woody vegetation in reforestation projects in Burkina Faso, Nigeria, and

Senegal; a language and culture-based erosion mitigation project in an Australian aboriginal community; and a successful economic development project in Kenya that resulted in preservation of a mangrove ecosystem through application of local botanical knowledge.

*Global citizenship.* This theme relates to the interactive and interdependent nature of global political, economic, and social systems. Global citizenship involves civic engagement and a commitment to equity on the world stage and may be associated with a concern for a number of issues, such as peace, environmental justice, and economic equity. The Earth Charter (Earth Charter International Secretariat, 2000) exemplifies the perspective that would be associated with global citizenship. The Earth Charter represents a global ethic that sees all humans as citizens of the world, with shared values of social justice, economic justice, and sustainability that transcend culture, religion, and national identities. Global issues are transboundary and persistent, and underlie other events and require a new conception of citizenship that considers the interconnectedness of local decisions with outcomes on the opposite side of the world. Global citizenship is internationalist rather than nationalist in perspective and is based on a respect for human rights and self-determination that might transcend specific nationalism or regional agendas. Global citizenship attends to the accelerating nature of movement of people, goods, and ideas among countries and regions (Coatsworth, 2004). However, a critical dimension of an effective global citizen would reflect what Hannerz (1990) described as a cosmopolitan perspective: “an intellectual and aesthetic stance of openness toward divergent cultural experiences” (p. 239). Global citizenship also relates to the territory that is embraced by global change education. Global change involves the full range of global issues associated with human interactions with natural systems (Mortensen, 2000).

*Importance of local place.* Increasingly, our understanding of environmental, social, and political events also occurs in the context of place (Gruenwald, 2003; Sobel, 2005). For example, availability of nearby nature and green landscapes has a positive impact on personal health, as well as rates of community domestic violence and children’s school performance (Kaplan & Kaplan, 2005). Many people developed a deeper appreciation of the impact of Hurricane Katrina because it devastated New Orleans, a city with a strong place identity. Similarly, we understand the impact of loss of permafrost in the context of the inhabitants of Arctic regions that are directly affected but also in the context of our own “place.” When Arctic and sub-Arctic species such as snow buntings and snow geese regularly are observed far south of their range “out of place,” it becomes easier to appreciate that the human inhabitants of the Arctic regions also are needing to range farther and farther from home to reach hunting and fishing grounds. In the context of sustainability literacy, place pertains to an understanding of one’s bioregion, the distinct interrelated natural and social system where one lives, or foodshed, the system that describes the flow of food from the place where it was grown to the place where it is consumed (Kloppenborg, Hendrickson, & Stevenson, 1996).

## SUSTAINABILITY LITERACY AS A VALID CONSTRUCT

The foregoing list of nine themes is intended to be neither a definitive nor exhaustive description of sustainability literacy. Each of the themes includes some specific knowledge or skills component, and each also clearly includes a component that likely would be

characterized as disposition or belief. In addition, it is not known yet which of these themes might be “optional” or which would be considered “essential,” or how they relate to one another. When considered collectively, this set of ideas begins to frame sustainability literacy as a multidimensional construct.

Accordingly, following Messick’s (1989) conception of valid inference making, the inference that someone is “sustainability literate” would be developed on the strength of multiple forms of evidence collected in various contexts over time. That is, we could infer that a person is sustainability literate if he or she knows things associated with sustainability, if he or she is disposed to think or problem solve in ways associated with sustainability, and if he or she behaves in ways consistent with sustainability.

For example, an individual who understands the interconnected relationship among social justice and environmental and economic systems might be more highly motivated to purchase third-party-verified Fair Trade (TransFair USA, 2007) produce than produce from a distributor that practices unsustainable agriculture or exploitive labor practices. Furthermore, if the individual also understands that transportation of perishable produce often entails use of fossil fuels and a net CO<sub>2</sub> deposit in the environment, she or he might choose to buy locally grown organic seasonal produce instead of products grown outside the bioregion and shipped from thousands of miles away. Naturally, the third leg in a sustainability literacy validation triangle, behavior, would be highly contextual and, as noted earlier, susceptible to a number of variables that go beyond knowledge and disposition. For example, if local organic produce is unavailable or too expensive, a person disposed to sustainability might still purchase commercial produce shipped from thousands of miles away. Similarly, the evidentiary case for sustainability literacy might be weakened if a person persists in driving a fuel-inefficient single-occupant vehicle even though he or she knows about the impacts of CO<sub>2</sub> on global climate change, expresses a commitment to the causes of human rights and social justice, and has access to public transportation.

Conceptualizing sustainability literacy as a construct means that it would be viewed holistically, similar to the way we think of ideas like cultural competence or citizenship. Few would argue that we want teachers who are not culturally competent or who are not effective citizens, but these ideas are socially and individually constructed and contextually dependent. An individual might display cultural competence quite differently in different contexts, or two individuals might demonstrate effective citizenship in very different ways. Similarly, sustainability literacy will look different in different contexts or when enacted by different individuals, and there would be no single correct way to be sustainability literate. Along these lines, Onwueme and Bosari (2007) proposed a quantitative index that represents sustainability literacy as an asymptotic process in which no learner or system would ever achieve “perfect sustainability.” They envision sustainability education as a “gigantic literacy effort” that encompasses the classroom and the community under the guidance of well-prepared and committed teachers (p. 49).

It is important here to distinguish a construct validation approach from inference of a causal relationship. Construct validation involves a collection of multiple forms of evidence to support a judgment about the extent to which actual observations of a

particular phenomenon match patterns of theoretical predictions (Cronbach & Meehl, 1955; Messick, 1989). However, construct validation does not necessarily require observation of a causal relationship among variables. One implication here is that because there may not be a strong causal link between knowing more about sustainability and actually enacting sustainability, construct validation of sustainability literacy will require more robust assessment strategies than simple pre/post measures of sustainability knowledge.

An evidence-based strategy for assessing sustainability literacy offers a number of benefits, particularly in the context of the preparation of teachers. First, an evidence-based approach better represents the real complexity of the issues involved in sustainability, as well as the exquisitely fragile relationship among knowing, valuing, and doing. This approach assumes that multiple types of evidence will be necessary to capture the contextual nature of the deep learning and values transformation associated with the goals of sustainability education.

Second, an evidence-based approach to assessing sustainability literacy is consistent with current research about how people learn and, in particular, development of adaptive expertise (Bransford, Brown, & Cocking, 2000). This work has shown that experts in a domain are able to efficiently retrieve and apply knowledge to understand situations or solve problems. Individuals who have developed adaptive expertise are able to balance efficient knowledge retrieval and use with innovation—the ability to unlearn old ways of thinking and to tolerate the ambiguity involved in developing a new perspective (Bransford, Darling-Hammond, & LePage, 2005). The nine themes for sustainability literacy suggested in the previous discussion involve values and conditionalized knowledge that are highly contextualized. The process of becoming sustainability literate will involve more than simply learning facts about each of the themes. Acquisition of sustainability literacy would likely involve a long-term process of developing adaptive expertise displayed in a variety of ways and contexts over time.

Third, an evidence-based validation approach maps onto the use of indicator systems as a means for measuring the success of institutional sustainability efforts. Indicators are useful for comparing status or change in status of groups or complex systems against goals or standards (Jaeger, 1978; Shavelson, McDonnell, & Oaks, 1991). The process for using indicators systems to measure sustainability has been described extensively by Bell and Morse (2006). Currently the American Association for the Advancement of Sustainability in Higher Education (AASHE) is coordinating a process for development of indicators that college and university campuses can use to evaluate their progress in campuswide sustainability efforts (Glasser, Newport, Dautremont-Smith, & Walton, 2007). The draft AASHE rating system includes categories pertaining to social equity and justice and curriculum, as well as operations, governance, and fiscal and economic variables. Similarly, the U.S. Green Building Council (USGB) Leadership in Energy and Environmental Design (LEED) certification system rates buildings in areas pertaining to human and environmental health, water and energy efficiency, materials selection, and site development. The USGB Greening Schools initiative (Kats, 2007) is aimed at helping K-12 schools move to employ more environmentally friendly designs. An area that will require early investigation has to do with the concordance among evidence associated with a school's institutional sustainability and the sustainability literacy of individuals who work

and learn in that institution.

## INTEGRATING SUSTAINABILITY EDUCATION IN THE PRESERVICE PREPARATION OF TEACHERS

Today, sustainability education is almost nonexistent in the teacher education curriculum in the United States, although it is part of the preparation of new teachers in a variety of countries around the world (Fien & Maclean, 2000). However, signs have begun to appear that this situation is changing. A small number of college and university programs have begun offering course sequences or advanced degrees in sustainability education designed specifically for teachers or school administrators. Although these new programs seem to focus on the continuing professional development of experienced educators rather than on preservice preparation, and they tend to be located in schools where sustainability already is part of the larger philosophical mission (cf. Antioch University New England, 2007; Portland State University, 2007; Prescott College, 2007), they probably are harbingers of a broader movement in teacher education to engage with the sustainability discourse.

Recently, even more compelling evidence of a budding movement to integrate sustainability education into the preservice preparation emerged. In the state of Washington, the Professional Educator Standards Board, which has oversight of teacher licensure, recently passed a new program approval standard pertaining to teacher knowledge and skills (Professional Educator Standards Board, 2007). This new standard will require teacher preparation programs to provide evidence that their teacher candidates are able to prepare K-12 students “to be responsible citizens for an environmentally sustainable, globally interconnected, and diverse society.” Furthermore, according to the new standard, beginning teachers in Washington will be expected to “consider student learning in the context of social, political, environmental, and economic systems.” The new standard will apply to beginning teachers in all grade levels and disciplines. The 22 state-approved teacher education programs in Washington prepare approximately 3,600 new teachers each year (Office of Superintendent of Public Instruction, 2007), so the potential impact of the new approval standard will be significant when fully implemented in the next several years.

Integration of sustainability education into the preservice preparation need not entail development of new programs or courses, although this is an approach that some programs will choose, as the programs mentioned at the beginning of this section indicate. At the same time, sustainability education simply cannot add more content to an already overfull and often incoherent teacher education curriculum. If it is to be transformative, sustainability education must serve the broader purposes of the teaching profession and be fully integrated into the warp and weft of teacher preparation.

The framework for understanding teaching and learning described by Bransford et al. (2005) provides direction for situating sustainability education in a larger vision of preparing teachers for a changing world. That framework views teacher learning as occurring in a professional community in which new teachers develop a curricular vision, understandings about their subject area, dispositions about teaching and learning, professional practices, and practical tools (Hammerness et al., 2005). The remainder of this article addresses areas in which sustainability education maps directly onto this conceptual framework.

## A CURRICULAR VISION THAT INCLUDES SUSTAINABILITY

Part of the work of becoming a teacher involves development of an understanding of the larger context within which one's own teaching and learning is situated (Darling-Hammond et al., 2005). The nine sustainability literacy themes discussed earlier support a vision of teaching that addresses the fundamental social purposes for education in the 21st century. However, a more important aspect of the sustainability discourse, exemplified by the nine themes, is that it focuses on realistic solutions, often involving direct personal participation. Therefore, sustainability creates an accessible path to help new teachers link discipline and pedagogical content knowledge with real-world problems. When teacher learning is situated in the context of sustainability, beginning teachers have the opportunity to develop images of what is realistically possible (Hammerness, 2006) both in the immediate context of their own practice and in the context of the larger social purposes of education.

Because beginning teachers cannot be expected to simply conjure up images of enacted sustainability, they need to interact with tangible examples that support integration of sustainability into their own developing knowledge of practice. That is, English teachers must see sustainability as integral to the teaching of English; mathematics teachers must learn to view sustainability as part and parcel of mathematics teaching; and elementary education teachers must come to see sustainability education as part of the work of teaching young learners.

Access to exemplars of enacted sustainability literacy can be facilitated through wisely selected readings and assignments, and through hands-on experiences. Early in their development as teachers, candidates should interact with the big ideas associated with the broader sustainability discourse. Later, readings and assignment should focus on case studies and specific exemplars that show how sustainability education has been successfully implemented, with positive student outcomes. Specific examples of such material include *Ecological Literacy: Educating Our Children for a Sustainable World* (Stone & Barlow, 2005); *The Earth Charter: Toward a Sustainable World* (Blaze Corcoran, Vilela, & Roerink, 2005); *Place-Based Education: Connecting Classrooms and Communities* (Sobel, 2005); and various resources available through the Positive Futures Network (2007), including *Yes! Magazine*. In addition, descriptions and materials related to wide variety of school-based sustainability projects around the world can be found at various Web sites (cf. The Bioneers, 2007; The Edible Schoolyard, 2006; Center for Ecoliteracy, 2007). Materials such as these provide a number of access points that enable new teachers to make connections between the sustainability themes and their own pedagogical content knowledge.

## PRACTICAL TOOLS FOR INTEGRATING SUSTAINABILITY INTO TEACHING PRACTICE

Access to effective exemplars also can support development of specific tools for teaching practice. For example, materials developed by Facing the Future, a nonprofit organization that develops curriculum materials, teacher resource guides, and a variety of Web-based resources focusing on global issues and sustainability (Wheeler et al., 2005), can help beginning teachers better understand the various interconnected issues associated with

sustainability at the same time that they develop specific teaching practices. The Facing the Future materials are designed for use by students at the middle school and high school levels and include lesson plans that address the K-12 curriculum standards for a number of states. These materials are applicable in a variety of preinternship learning activities, including microteaching with effective feedback (Grossman, 2005), curriculum analyses, lesson planning, unit planning, and development of performance assessments. However, because curriculum materials such as the Facing the Future resources are not designed specifically for preservice teacher preparation, they need to be systematically integrated into preservice preparation. For example, the Facing the Future materials work well as the basis for unit plans developed using *Understanding by Design* (Wiggins & McTighe, 2006), which prompts teachers to clearly specify the big ideas, enduring understandings, and essential questions that structure what it is students are expected to learn as a result of instruction.

### ENACTED SUSTAINABILITY LITERACY IN FIELD SETTINGS

Field-based work prior to student teaching can play a vital role in helping new teachers develop a curricular vision and adaptive expertise that incorporates sustainability. This work can include clinical teaching practice in K-12 classroom settings or teaching in extraclassroom schools or community settings. A wide variety of field experiences could address sustainability themes, including participation in school gardening or recycling projects, work with students engaged in environmental restoration projects through their school, work with community poverty or hunger projects, or various local or international human rights-related activities in the school or community. Field-based work does not need to be identified as a sustainability project per se, but field experiences must be bolstered by in-class discussions, debriefing sessions, and written assignments that involve analyses of teaching and learning, as well as the interconnected sustainability themes.

Using teacher work samples is an effective strategy for collecting evidence of enacted sustainability literacy in preservice field settings. Teacher work samples are rich collections of evidence of teacher thinking, planning, and impact on student learning, which can be an effective, if not superior, proxy for classroom observations (Denner, Salzman, & Bangert, 2001). This methodology employs structured prompts that lead the teacher candidate to document actual teaching of a set of lessons. Prompts can ask for information about the candidate's planning for instruction, the design of the instructional sequence, assessment of student outcomes, and a reflection about the success of instruction. Prompts can be adjusted to a specific teaching and learning context and can address specific content or problem-solving aspects of the teaching, including issues related to sustainability and evidence of the candidate's impacts on student learning.

### LEARNING IN A PROFESSIONAL COMMUNITY

Sustainability education can provide effective models of enacted personal responsibility as part of the learning that beginning teachers pursue within professional communities of practice (Cochran-Smith & Lytle, 1999). Sustainability issues are particularly well suited for development of vibrant transdisciplinary and cross-age learning communities. For example, collaborative community-based and service learning projects can involve K-12 students, practicing teachers, preservice teachers, and faculty in the kind of giant

sustainability literacy project that Onwueme and Bosari (2007) proposed.

Part of the work of a professional community engaged in sustainability education is development of rich case studies. The process of developing case descriptions can help the community clarify shared values and norms of practice and provide a vehicle for systematically evaluating the outcomes of a sustainability effort. At the same time, use of case methods has been identified as an effective strategy for helping beginning teachers acquire thinking and problem solving associated with “thinking pedagogically” (Hammerness et al., 2005). Preservice teachers can analyze completed case examples and also participate in ongoing development of new case studies. This kind of work also is compatible with second-tier teacher licensure in many states and with development of portfolios for National Board Certification (Burroughs, Schwartz, & Hendricks-Lee, 2000).

The lens of sustainability provides an opportunity for teacher educators to reassess their own values and knowledge systems and to explore new ways to think about their own teaching and scholarship. Purposeful and collaborative work in the larger community context in which preparation programs are located also provides opportunities for teacher education faculty to make meaningful the service component of faculty growth and evaluation. As teacher education faculty explore their own sustainability literacy, they may also find that there are areas in which they want to update their own pedagogical knowledge. Therefore, faculty development may be an important early step for teacher education programs to undertake as they integrate sustainability education into the curriculum.

A successful model for faculty development in the area of sustainability was described by Chase and Rowland (2004) and Barlett (2005). The Ponderosa Project (Chase & Rowland) was begun in 1995 at Northern Arizona University as a way to involve faculty from a broad range of disciplines on campus in developing a greater curriculum focus on education for sustainability. The project invites faculty to infuse issues of sustainability into one liberal arts or general studies class over the course of an academic year. At the end of the year, the faculty participate in a workshop at which they present the results of their work. The project provided financial incentives in early years, but later, when grant resources were no longer available, the project continued with wide administrative and faculty support without external funds. The project also makes available technical assistance from local resource experts in various areas associated with sustainability. As Chase and Rowland emphasize, the modifications that faculty made in their courses balanced pedagogy with content, addressing how the courses were taught as much as what was taught in the courses.

The Piedmont Project at Emory University employs a similar approach to the one piloted in the Ponderosa Project (Barlett, 2005). Faculty participate in professional development seminars that prepare them to infuse issues of sustainability into their courses and curricula. Faculty from a wide range of disciplines have participated in the Piedmont Project and as a result have developed deeper understandings of their own connectedness to the natural environment. At same time, they have reported a reintegration of ethics and personal values into their professional lives (Barlett). The participants in the Piedmont Project emphasized that one of the most significant outcomes for faculty was that they

developed a deeper understanding of their own personal connection to place, as well as the importance of place as a key element of creating sustainable communities.

### UNASKED QUESTIONS

Sustainability education is a work in progress, but as this article has sought to demonstrate, it is a real phenomenon that merits the attention of the education community, particularly those engaged in the preparation of teachers. It is too early to tell if sustainability education is a stepping stone between the factory school paradigm of the last century and whatever comes next, or if sustainability education *is* what comes next. However, what is clear is that the sustainability discourse engages with challenges that are likely to dominate the 21st century.

Today, the solution path preferred by policy makers for addressing these challenges seems to be in the direction of weak sustainability. Our environmental policies tend to favor market approaches that treat human conditions as “externalities” and financial capital as substitutable for natural capital. National energy initiatives appear to be premised on the belief that new technologies “just around the corner” will replace petroleum. Our relations with others around the world seem to be predicated on the belief that prosperity lies in the direction of American-style free-market economic development. Unfortunately, the “facts on the ground” lead one to be less than sanguine about the prospect that weak sustainability approaches will result in more than marginal improvements if they don’t actually exacerbate the problems.

Strong sustainability involves deep transformations in values, new ways of thinking about problems, and fundamentally different approaches and a more central role for all education sectors. Today, few of our national policies seem directed toward strong sustainability, although in the long run, this probably represents a more viable solution path for dealing with the challenges that lie ahead. Of course, there may be a chicken-or-egg dilemma involved here. Perhaps it will take deep transformation of our education systems to create the kind of thinking necessary for strong sustainability approaches to occur. How to begin? The solution to this dilemma may depend on *if* and *how* the education community chooses to address two questions: (1) If our education systems resulted in the thinking that created the challenges we face today, do educators share responsibility for redressing those problems? (2) If, through reform of our education systems, it would be possible to effectively meet the tremendous challenges that lie ahead, wouldn’t education reform be a moral imperative?

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