Climate Change Education in the Formal K-12 Setting: Lessons Learned from Environmental Education

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Approximately twenty percent of the U.S. population – children, teachers, administrative staff – spend their days within the K-12 school system. We look to this system to prepare each generation for college, careers, and citizenship; it is through formal schooling that students learn the concepts and skills that will prepare them to be able to take on their responsibilities to address climate change impacts.

Given the strong relationship between student learning, instruction, and teacher preparation (Darling-Hammond, Bransford , LePage, Hammerness, & Duffy 2007, Marzano, Pickering & Pollock 2001, Fortner, Corney & Mayer 2005), we must ensure that classroom teachers are both willing and able to provide effective climate change education. Addressing teacher competencies is not simple, however. Deficits related to teacher attitudes, pedagogical knowledge, and content knowledge have all been identified as internal barriers to successful instruction (Rule 2005, Summers, Kruger, & Childs 2000, Summers, Kruger, Childs, & Mant 2001, Ko & Lee 2003, Kim & Fortner 2006). In addition, external barriers such as lack of time and the need to meet curriculum standards also impact teacher willingness to include climate change instruction in the curriculum (Kim & Fortner 2006).

Ultimately, the ability of the elementary and secondary school systems to provide comprehensive climate literacy education will depend on the systematic availability of quality curriculum resources, impact of curriculum mandates such as state standards and assessment, and, importantly, the preparation of teachers.

For over forty years, environmental education as a field has faced, and continues to face, many of the same challenges as climate change education. To consider next steps and strategies, it may be useful to examine four specific issues related to the implementation of both environmental education and climate change education:

- Education, not Advocacy – The need to provide unbiased instruction
- The Environment is Interdisciplinary – The need to "fit" into a curriculum that is bounded by disciplines

- Environmentally Responsible Citizenship – The need to prepare students to make sound, evidence-based decisions and become independent, informed action takers
- Integrating Environmental Education into Teacher Education – The need to prepare those who prepare K-12 teachers

Education, not Advocacy

Early in the history of environmental education, it was recognized that a distinction between education and advocacy needed to be articulated. In his frequently quoted essay, John Hug (1977) argues that the "two hats" of environmentalism and environmental education are often blurred or mistaken for one another by practitioners and the public alike. He suggests that even though environmental educators might naturally wear the hat of an environmentalist as well, "They must scrupulously strive to get all the facts, examine and illuminate all the viewpoints, and keep from letting their own particular position (as an environmentalist) from mixing with their educator role." (Hug 1977) The "two hats" dilemma continues to dog environmental education; the field has been a frequent target of criticism focused primarily on issues related to bias, inaccuracy, and advocacy. (Sanera & Shaw 1996, Kwong 1995, Independent Commission on Environmental Education 1997, Solomon, 2000, Angle 2011). Jo Kwong (1995), in a report for the Center for the Study of American Business, described what she believes to be "unsettling trends," including the assertion that environmental education practice is often based on emotionalism and misinformation, focused on issues and not information, dedicated to activism and politics, and encourages an anti-anthropocentric philosophy.

Although most certainly there are instances of where individual environmental educators are guilty of participating in these "unsettling trends," the field itself has made strident efforts to distinguish education practice from environmental advocacy. Through the National Project for Excellence in Environmental Education, the North American Association for Environmental Education (NAAEE) has developed a series of *Guidelines for Excellence* that articulates the standards for high-quality environmental education (https://eelinked.naaee.net/n/guidelines). Each of these documents was developed using a national critique and consensus process involving literally thousands of educators. First published in 1996, *Environmental Education Materials: Guidelines for Excellence* (NAAEE 2009) provides a set of recommendations for developing and selecting environmental education materials. Three of the six key characteristics outlined in these guidelines are particularly apropos to the "education, not advocacy" discussion as they articulate the need for:

Fairness and Accuracy, including factual accuracy, balanced presentation of differing viewpoints and theories, fostering an openness to inquiry, and reflection of diversity (e.g., different cultures, races, genders, social groups, etc. are included with respect and equity). It should be noted that a balanced presentation does not necessarily mean giving equal time and space to every opinion or perspective, but treating major positions fairly. It also should be pointed out that the notion of balance suggests the need to consider multiple positions and not just token pro/con discussions.

Depth, including an acknowledgement that feelings, experiences, and attitudes shape environmental perceptions and issues, the need to focus on concepts rather than a series of facts,

presentation of concepts in context, and attention to different scales. Depth argues for situating understandings within the real world and developing an understanding of systems, rather than a thin exposure to unrelated or disconnected concepts.

Emphasis on skills building, including the development of critical and creative thinking skills, opportunities for students to apply skills to issues, and basic skills needed to participate in resolving environmental issues.

Although these key characteristics and guidelines are geared toward the development of instructional materials, they were also written as a tool for teachers and others to use while *selecting* materials for use in the classroom. These same criteria are useful when applied to classroom instruction. Teachers need to use strategies to detect bias, and identify when their own teaching and the materials they use advocate a particular position or action. Although teachers may "understand that their commitment as environmental educators is to provide accurate, balanced, and effective instruction – not to promote a particular view about environmental conditions, issues, or actions," (NAAEE 2010b), they may not be skilled in recognizing bias in their own instruction. For example, in an observational study of teacher classroom behavior, Cotton (2006, p. 237) concluded that "…all of the teachers studied experienced great difficulty in implementing their beliefs about balance and neutrality, and the classroom data suggest that the influence of the teachers' own environmental attitudes was greater than they either intended or, in all probability, realized."

There is sufficient reason to believe that climate change education is similarly confronted by the need to distinguish between education and advocacy (Reardon 2011). Although there is considerable consensus behind much of the science of climate change (IPCC 2007a, IPCC 2007b), the politics of climate change and therefore climate change education are far from settled. Even if there was popular support in the United States for the IPCC conclusions on the causes of climate change, policy and individual behavior choices related to how best to address climate change remain.

Consequently, teachers must be prepared to select instructional materials and manage discussions of controversial issues in their classrooms appropriately. The following, drawn from guidance provided by the *Guidelines for Excellence* documents (NAAEE 2009, NAAEE 2010a; NAAEE 2010b), suggests that professional development should prepare teachers to:

- Critically analyze their own attitudes and beliefs related to the environment and climate change;
- Identify potential sources of bias, including the ability to identify logical errors and spurious statements, evaluate the completeness and reliability of information sources, identify misleading use of statistics, and evaluate the social, political, and economic context in which the information was created;
- Differentiate among instructional materials on the basis of their factual accuracy (e.g., determine if factual information is clearly referenced, data are drawn from current and identified sources, information comes from primary sources, a range of experts in the appropriate fields reviewed the materials or participated in their development in another way);

- Select and use materials that together present a range of differing viewpoints, ethical positions, and interpretations where there are differences of option or competing scientific explanations;
- Compensate for weaknesses found in instructional materials or information sources;
- Select materials and strategies that are developmentally appropriate for a designated age or level of knowledge, recognizing the need to consider emotional as well as cognitive development;
- Weigh evidence regarding environmental problems based on validity of data (e.g., from scientific societies or reputable journals);
- Identify and implement instructional techniques for presenting differing viewpoints and theories in a balanced manner; and
- Design and implement instructional strategies and techniques that encourage learners to explore different perspectives, form their own opinions, and explain their beliefs.

It must be recognized that no education is value free. The line between education and advocacy is often shaded, and there are few clear rules for finding an appropriate level of balance. However, by focusing on skills development, teachers and their students will be better able to detect bias. Further, by considering factual accuracy, reliability, and balance explicitly, teachers and their students begin to understand how to gauge the credibility of sources and to weigh evidence. Importantly, as they weigh evidence, they will confront the need to make decisions within uncertainty. Finally, creating a classroom environment that is open to inquiry encourages learners to explore and respect differing perspectives.

The Environment is Interdisciplinary

Understanding the environment and environmental issues is not bounded by disciplinary definitions, knowledge, or ways of knowing. Environmental education takes a broad view of the environment, "incorporating concepts such as systems, interdependence, and interactions among humans, other living organisms, the physical environment, and the built or designed environment." (NAAEE 2010b) A focus on systems requires an understanding of the relationships and interactions among the parts. Interdependence incorporates not only the concepts embodied in ecology, but the need to understand that human well-being is tied to environmental quality and that humans and the systems created by humans – societies, political systems, economies, religions, cultures, technologies – impact, and are impacted by, the total environment.

In articulating a conceptual framework for environmental literacy, NAAEE's *Excellence in Environmental Education: Guidelines for Learning (K-12)* (NAAEE 2010a) further delineates the knowledge and skills a comprehensive environmental education curriculum would encompass. Given the emphasis on systems, it may not be surprising that a key strand requires Knowledge of Environmental Processes and Systems (i.e., Earth as a physical system, the living environment, humans and their societies, and environment and society). Because environmental literacy depends on a citizenry that is not only knowledgeable of systems, but capable of taking individual action and making well-informed public policy decisions collectively, Skills for Understanding and Addressing Environmental Issues as well as the development of a sense of Personal and Civic Responsibility are also essential components of the framework.

These understandings and skills cut across the traditional school disciplines and can be aligned with the standards and expectations set by science, social science (e.g., civics and government, economics, geography, and history), arts, mathematics, and English Language arts (NAAEE 2010a). The explicit focus of environmental education on the integration of knowledge and skills is one of the primary distinguishing factors between it and a traditional view of curricular disciplines. Because environmental education is, by its very nature, interdisciplinary, the synthesis of learnings across subject material is a deliberate and essential outcome:

> An implicit assumption of disciplinary philosophies is that students will be able to perform their own synthesis when it becomes necessary to do so, by drawing as needed on their learnings from separate content areas. But rarely do students receive instruction or engage in guided practice in developing syntheses and drawing generalizations… Environmental education can provide a convenient and challenging mechanism for overcoming the shortcomings of monodisciplinary education, by using the interdisciplinary entity that is the environment as a focus for teaching and learning. (Disinger 1993)

As with environmental education, climate change education cuts across multiple science disciplines (i.e., biology, Earth system science, chemistry). The degree to which these disciplines are represented in the school system and in state standards may not, however, support robust climate change education. For example, an inventory of state science standards found that Earth system science education was under-represented and that there is "… a disconnect between the pressing need for an Earth system literate society and the current K-12 education system that is responsible for developing this capacity." (Hoffman & Barstow 2007) Although *Climate Literacy: The Essential Principles of Climate Sciences* "… focuses primarily on the physical and biological science aspects of climate and climate change," it recognizes the importance of integration of knowledge to informed decision-making and action. In particular, the guiding principles speak to "…an understanding of the complex interconnections among the physical and biological components of the Earth system as well as the consequences of such decisions on social, economic, and cultural systems." (USGCRP 2009)

In the best of all worlds, an integrated, systems approach towards environmental literacy and climate literacy would be customary and expected in K-12 schools. Unfortunately, along with the on-going barriers of time and budgets, the implementation of interdisciplinary curriculum is limited by teacher preparation and perceptions, and an instructional focus on content standards. Evidence suggests that elementary teachers have limited confidence in their ability to teach science (Powers 2004), possess narrow mental models of the environment (Mosely, Desjean-Perrotta, & Utley 2010), and lack a background in environmental issues (McKeown 2000, Forbes & Zint 2011). In a study of elementary school teachers, Forbes & Zint (2011) found that "…while many respondents reported that they had completed at least one environmental science or studies course as part of their postsecondary education and/or teacher education (60%), fewer reported having participated in professional development experiences focused on environmental issues (40%), and even fewer indicated that they had completed an environmental education methods course (20%)." Similarly, there is little evidence to suggest that secondary level teachers gain a broad preparation outside of their disciplinary area.

The current educational climate that focuses on standards and state mandated assessments effectively narrows the taught curriculum to those concepts and skills being tested. Consequently, if environmental education and climate change education are to be effectively included in K-12 schools, it must be facilitated. The barriers must be reduced and resource materials should be supplied that:

- Articulate a comprehensive and cohesive conceptual framework for teaching across disciplines and grade level bands. Although single activities or activity guides can be successfully dropped into the curriculum, the overall goals of environmental education and climate change education will be better served if they are connected to a cohesive conceptual framework supported by learning progressions;
- Provide guidance on how core concepts and skills articulate with state student standards (e.g., create crosswalks that align concepts and skills across the disciplines). Experience suggests that many of the core environmental education concepts and skills are found across multiple disciplinary standards. Crosswalks or other resources can illustrate how environmental education can be used to effectively and efficiently integrate a standards-based curriculum;
- Provide assistance in developing standards-based curriculum maps;
- Tie concepts and skills to widely recognized cross-disciplinary themes such as those addressed in the 21st Century Skills (i.e., environmental literacy, global awareness, civic literacy; health literacy, and financial, economic, business and entrepreneurial literacy)
- Are written using language and examples appropriate for a broad range of disciplines (i.e., avoid enabling the perception that environmental education or climate change education should only be considered the purview of science teachers);
- Provide sufficient background information so that teachers with little or no formal coursework in the climate sciences can understand key concepts and connections;
- Provide instructional materials that support teaching about complex systems, including social, cultural, economic, and political systems; and
- Include essays, lesson descriptions, and other informational materials for publications targeted at specific, non-science teacher audiences (e.g., National Council for the Social Studies, National Council for Geography Education, National Council of Teachers of English, Association of Childhood Education International).

Professional development should prepare teachers to use these materials effectively, including the ability to select and implement teaching strategies that integrate content and skills from across disciplines. As Disinger (1993) suggests, synthesis of concepts and skills needs to be taught. The systems linkages of disaggregated content may well never be understood without explicit synthesis.

Environmentally Responsible Citizenship

As has been discussed, the ultimate goal of environmental education is the development of an environmentally literate citizenry who possess a sophisticated set of skills that allow them to solve novel environmental problems and determine the best set of actions – who have become thoughtful, skillful, and active citizens in a democracy.

The various documents in NAAEE's *Guidelines for Excellence* series speak, in one way or another, to the need for the development of citizenship skills and dispositions (NAAEE 2009, NAAEE 2010a, NAAEE 2010b). The guidelines for instructional materials (NAAEE 2009) recommend that, through environmental education, learners "should gain basic skills needed to participate in resolving environmental issues" and that "materials should promote civic responsibility, encouraging learners to use their knowledge, personal skills, and assessments of environmental problems and issues as a basis for environmental problem solving and action." The K-12 conceptual framework addresses the need for students to develop Skills for Understanding and Addressing Environmental Issues, and Personal and Civic Responsibility (NAAEE 2010a). Being able to plan and implement instruction for environmentally responsible citizenship is central to both the *Guidelines for the Preparation and Professional Development of Environmental Educators* (NAAEE 2010b) and the NCATE *Standards for the Initial Preparation of Environmental Educators* (NAAEE 2007).

Although instructional models geared toward the specific development of these skills have been published (e.g., Hungerford et al. 2003, Hammond 1997, Ramsey 1998, Stapp et al. 1996, Stevenson & Dillon 2010) and some strategies such as service learning that can address responsible citizenship are widely used, much of environmental education continues to stop at the water's edge. That is, environmental education materials and instruction tend to focus on awareness, appreciation and knowledge, without an accompanying focus on developing skills and commitment to action (Oulton et al. 2004, Simmons 2005). Similarly, a number of authors have found that pre-service environmental education programs tend to focus on teaching outdoors and nature education with little or no attention paid to helping beginning teachers learn how to implement instructional strategies that promote the development of citizenship skills. (see McKeown 2000, Powers 2004, Mastrilli 2005, Heimlich et al. 2004)

Climate change education shares with environmental education the need to ensure that environmental citizenship skills are included as an essential component of a comprehensive and cohesive instructional model. There is little reason to suggest that informed decision-making and action will occur with an *information only* approach to learning about climate change. Understanding climate systems is foundational, but not sufficient. However, without proper attention and preparation, the inclusion of investigation skills and action strategies can add to what is already considered by many to be a controversial topic. Evidence suggests that professional development should prepare teachers to:

- Understand and apply the skills of environmental literacy, including issue investigation skills and action strategies. Teachers will not be able to implement these skills and strategies in the classroom until they are themselves skilled. There is little evidence to suggest that teachers, on the whole, learn these skills or participate in citizenship education activities as part of their general education background;
- Articulate why teaching issues investigation and action skills are appropriate and important. If teaching about environmental issues in general is considered controversial and therefore to be avoided, teaching issue investigation skills and action strategies is less likely to be implemented. Teachers need to be able to articulate sound educational

arguments for the role of civic engagement and be able to describe the process thoroughly;
- Build community support for engaging students in environmental issue and action strategies;
- Select and implement age appropriate teaching materials and strategies that foster the development of issues investigation skills and action strategies in their own classrooms;
- Recognize that teaching toward civic engagement requires a sophisticated set of skills and that "environmental action" should not be simply added to the end of a series of activities without proper preparation. Similarly, they should understand that the end goal of environmental literacy is citizens who are willing and able to act on their own conclusions about what should be done to ensure environmental quality. Consequently, teacher should be willing and able to allow students the freedom to make their own evidence-based decisions;
- Model responsible, respectful, and reasoned behavior during instruction;
- Model the process of inquiry and application of environmental investigations in instruction; and
- Facilitate an open discussion of issues and provide opportunities for students to enhance their capacity for independent thinking and effective, responsible decision-making.

Integration of Environmental Education into Teacher Education

Teachers who participate in pre-service or in-service environmental education training are more likely than those who have not to: 1) believe that teaching environmental education is important, 2) feel confident in their abilities to teach environmental education, and 3) actually implement environmental education in their classrooms. (Forbes & Zint 2011, Plevyak et al. 2001) Professional development makes a difference. Unfortunately, policies that support teacher training in environmental education are limited. Although the number has grown over the last couple of years, few states have standards or requirements related directly to teacher training in environmental education (McKeown 2000, Mastrilli 2005). Wisconsin, Pennsylvania, Kentucky, and Washington are all notable exceptions. Consequently, when environmental education is included in teacher education, it is primarily because of the dedication of a few higher education faculty members. Studies suggests that pre-service environmental education is not institutionalized or systematic, its implementation varies tremendously across programs and institutions, elementary education pre-service teachers are more likely to be exposed to environmental education than secondary, and it is most often infused into an existing science methods course. (McKeown 2000, Powers 2004, Mastilli 2005)

The focus on standards and accountability that pervades K-12 education also drives much of teacher education, especially pre-service teacher education. Faculty who prepare teachers for licensure follow standards set by either a national accreditation organization (e.g., National Council for the Accreditation of Teacher Education (NCATE)) or by a state agency. These standards cover both content knowledge and pedagogy. The content knowledge standards are often derived from standards set by national level disciplinary societies (e.g., NSTA, NCSS) or the state level student content standards. Although there is some flexibility in how the standards are addressed, the program is held accountable for the outcome. More and more, programs must

provide evidence of their students', the pre-service or in-service teachers', competence in meeting these standards. As with K-12 classroom instruction, these standards effectively narrow the curriculum and encourage a disciplinary bias.

Recognizing that teacher education is crucial and that impacting teacher education institutions is critical, NAAEE became a member of NCATE in 2000. NCATE is responsible for the accreditation of over 60% of the teacher education programs in the United States. As a member organization of NCATE, NAAEE has the ability to influence the development of teacher standards for the other member fields (e.g., science teachers, elementary school teachers, social studies teachers). Furthermore, as a member of NCATE, NAAEE established *Standards for the Initial Preparation of Environmental Educators* (NAAEE 2007). These standards describe seven teacher competencies related to environmental education practices (e.g., environmental literacy, learning theories and knowledge of learners, instructional planning and practice, professional responsibilities). These standards have already impacted teacher education and higher education, providing credibility and a recognized framework for states interested in the development of endorsements and institutions of higher education interested in (re)designing teacher education programs.

It seems reasonable to assume that the barriers that limit infusion of environmental education and climate change education into the K-12 classroom are also exhibited in higher education (e.g., standards and accountability, teaching of controversial issues, interdisciplinary nature, lack of preparation to teach about citizenship behavior). If we are to move beyond the willing few, we must consciously work to meet the needs of teacher preparation faculty by ensuring the availability of materials and professional development that:

- Articulates the need and relevance of climate change education for their students. As with K-12 teachers, faculty members need to see the fit of climate change education within their disciplines or areas of teaching. Using appropriate disciplinary language and making materials available through a variety disciplinary organizations would assist in this effort;
- Increases the content and pedagogical expertise of elementary and secondary teacher preparation faculty across the disciplines (i.e., science education, social science education);
- Demonstrates how climate change education aligns with state level student content standards;
- Demonstrates how climate change education aligns with national and/or state teacher education standards and *how* it can be integrated into teacher preparation coursework;
- Provides awareness of and access to exemplary curriculum materials. Evidence suggests that teacher education faculty use a limit number of nationally available curriculum materials. In order to successfully integrate climate change education into programs, teacher educators will need to adopt a broader set of instructional materials that specifically address the climate change education conceptual framework; and
- Access to role models and mentors. Teacher educators need access to other teacher educators who have successfully integrated climate change education into their programs. Additionally, teacher educators need access to K-12 teachers who can serve as role models for their students.

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