The design of an innovative teacher training course: environmental education for secondary school teachers

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THE DESIGN OF
AN INNOVATIVE TEACHER TRAINING COURSE:
ENVIRONMENTAL EDUCATION FOR SECONDARY SCHOOL TEACHERS

by
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B.S. Duke University, 1983

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[Signatures]
Chairperson
Dean, Graduate School

May 19, 1995
Date
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I. Introduction

This paper will explain the need for an innovative undergraduate course in environmental education (EE) for secondary education majors and in-service teachers and describe criteria for its effectiveness. The UNESCO-sponsored Tbilisi Conference of 1977 issued comprehensive goals and guidelines for EE for a variety of educational settings, including secondary schools. Subsequent research, including UNESCO's Moscow Congress of 1987, has identified several approaches to achieving these goals, including evaluation procedures and teacher training programs. However, several studies indicate that many secondary schools lack EE programs entirely, and that most existing secondary EE programs are not designed or implemented to achieve the goals necessary to properly care of natural environments.

I will do the following: 1) Summarize the most appropriate approaches, goals, and methodologies for EE provided by the U.N. conferences of 1977 and 1987, as well as by other research and education programs; 2) Use these mandates to describe criteria necessary to an adequate teacher training program in EE; 3) Survey existing teacher training programs, evaluations of those programs, and research on their effectiveness; 4) Establish the inadequacies of most existing programs based on various criteria; 5) Outline an innovative teacher training program that will fulfill the needs of EE more adequately than what I have found among existing programs.
II. Secondary School Programs

A. Theoretical Base

EE suffered an identity crisis in the early stages of its development, which focused primarily on content. The problem with the initial definition of EE was partly a matter of semantics. John F. Disinger notes that "conservation education," "nature study," and "outdoor education" were proposed at various times through the 1960s and 1970s, each an outgrowth of different phases of the conservation movement in the United States. While these and other related fields may each be considered a part of EE, or related to it, he finds that most professionals have ignored these definitions. Disinger suggests that the proponents of each movement have not seen eye to eye, or have failed to communicate. He suggests that people may be working too competitively to accept others' ideas, and also that some may feel that striving for a precise definition for EE is futile (Disinger 1985).

Another problem with early definitions of EE was a result of the deconstructionist nature of science (Orr 1989). The word "environment" today implies complexities of relationships and an interdependency of elements that was not generally acknowledged twenty-five years ago. Orr makes a seven-point list of the premises behind current approaches to solving environmental crises. These presumptions are that crises are discrete; that reductionist science is an appropriate tool for solving environmental crises; that the solutions are value-neutral; that they are top-down, originating with governments and passed on to the citizenry; that the public will act as sheep, accepting environmental policies without
understanding them; and that a technocratic society can support a humane culture.

Orr explains that the public needs to understand the interconnectedness of nature and society before appropriate solutions may be implemented. We must, therefore, alter our perception of education. "Conventional education, by and large, has been a celebration of all that is human to the exclusion of our dependence on nature." (Orr 1989, p. 52). Environmental education must not only acknowledge our connection to nature, it must be based upon that connection.

From an uncertain history some remarkable definitions of EE have arisen. In 1977, The World's First Intergovernmental Conference on Environmental Education, organized by the United Nations Educational, Scientific, and Cultural Organization (UNESCO), met in Tbilisi, Georgia, USSR. The conference formulated a declaration outlining the role, objectives, and characteristics of EE. This document was the first truly comprehensive statement of goals, objectives and guiding principles for EE, and its continuing usefulness and appropriateness is evidenced by its frequent citation in research on all aspects of EE. The efficiently written declaration is dense and meaty, and should be referred to in its entirety. Its great value lies in its premise that the purpose of EE is the care and sustenance of the environment, and that effective EE must therefore lead to appropriate values systems and resultant behaviors. In addition, the declaration recognizes the complex, interdisciplinary, nature of the field. Moral, aesthetic, and cultural factors are important to environmental principles and require a broader forum than a traditional science or social studies.
course (UNESCO-UNEP 1977). The declaration mandates the study of issues that are directly relevant to students' lives, but at the same time couched in a historical and a geographic perspective. Holistic perspectives, cooperative approaches to problem-solving, and challenges to traditional values systems are suggested that require alternatives to traditional teaching methodologies.

A second UNESCO conference ten years later (Moscow, 1987) summarized briefly the progress made world-wide in implementing the Tbilisi directives, and also provided outlines for the design of particular EE programs. The progress report focuses on programs at the international level. The paragraph relevant to this paper mentions a series of training seminars at international, regional, and sui®gional levels designed to foster awareness of the need for EE and the major obstacles to its implementation. These seminars mainly concern the development of pre-and in-service teacher training (UNESCO-UNEP 1988). The report emphasizes that despite these programs, the greatest shortage of qualified teachers exists in "intermediate formal instruction" and "general university education." (UNESCO-UNEP 1988, p. 17)

The report goes on to redefine some essential characteristics of EE, repeating various elements of the 1977 declaration. The Moscow report states:

"it falls to EE to supply...the means of perceiving and understanding the various biological, physical, social, economic and cultural factors which interact in time and space to shape the environment..."(UNESCO-UNEP 1988, p.9)

The Tbilisi report states:
A basic aim of environmental education is to succeed in making individuals and communities understand the complex nature of the natural and the built environments resulting from the interaction of their biological, physical, social, economic and cultural aspects... (UNESCO-UNEP 1977, p. 76)

Finally, the Moscow report gives brief suggestions for in-service and pre-service teacher training. The reason for their brevity may be the existence by 1985 of four UNESCO training modules in EE, each quite thorough and detailed (see Section IV.B. for a description of these modules).

Like the Tbilisi Declaration, the Moscow report provided general guidelines with scope, clarity, and simplicity, which were apparently ignored or implemented ineffectively. According to the second part of the Moscow report, "the actions undertaken to date have proved insufficient to counteract the steady deterioration in the quality of the environment" (p. 5). Subsequent papers tend to repeat points already set forth in 1977. For example, one guiding principle stated in the Tbilisi Declaration is that EE should "be interdisciplinary in its approach, drawing on the specific content of each discipline in making possible a holistic and balanced perspective" (UNESCO-UNEP 1977, p. 77). Twelve years later, David Orr finds it necessary to write "environmental issues are complex and cannot be understood through a single discipline or department" (Orr 1989, p. 49). Perhaps the process of defining EE must continue, however repetitive, until the basic tenets are put to use in a majority of formal educational settings.

Subsequent attempts to define EE may be somewhat repetitive, but they do serve to emphasize two important points. The concept of environmental literacy has been defined by Thiele (1988) and Orr (1989) for the purpose of evaluating the effectiveness of EE programs. Both authors describe literacy in terms of the characteristics of students who

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successfully complete a learning program. Two items that distinguish these sets of characteristics from those in other fields are 1) acknowledgment of the interrelatedness of elements in an environment, and 2) possession of an ethic. Thiele explains that interrelatedness is a significant concept in that it contrasts with the historically over-specialized and exclusive nature of most academic subjects. Many elements of environments (especially biophysical) were (and still are) studied independently of each other. The impact of a loss or change of any element was underrated. In addition, decisions affecting natural environments have not been based on a sound land ethic, a sense of our obligation to care for nature, a sense of right and wrong. Without knowledge of the interrelationships in nature, nor an ethical base for the treatment of nature, numerous environmentally destructive practices were begun and continue today (Leopold 1966). Therefore, an effective EE program should be defined as one that produces 1) understanding of the interrelatedness of environmental elements and 2) an environmental ethic in its students.

Thiele says we need to come to a consensus on a definition of EE; I suggest that the guidelines put forth in Tbilisi and Moscow, and refined by subsequent authors, are comprehensive. The primary problem has been a lack of strategies for implementation of these guidelines (Disinger 1986; UNESCO-UNEP 1987).

B. Existing Programs

The primary justification for an innovative teacher training course in EE is the lack of EE programs and of teacher training programs in the United States. In 1989, the Environmental Protection Agency Youth
Programs published a collection of notices from the offices of education in all fifty states plus the District of Columbia. Each notice is a one-paragraph summary of that state's policy towards and implementation of EE strategies (EPA 1989). An analysis of that document produces the following data:

<table>
<thead>
<tr>
<th>Aspect of State Program</th>
<th>Number of States Explicitly Noting this Aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model Programs Used (i.e., Project WILD)</td>
<td>3 6</td>
</tr>
<tr>
<td>Teacher Workshops Provided</td>
<td>1 6</td>
</tr>
<tr>
<td>EE Incorporated in All Grades</td>
<td>1 8</td>
</tr>
<tr>
<td>Curriculum Guidelines Provided by State</td>
<td>8</td>
</tr>
<tr>
<td>EE Included Primarily in Science Courses</td>
<td>1 1</td>
</tr>
<tr>
<td>EE Primarily in Science and Social Studies Courses</td>
<td>6</td>
</tr>
<tr>
<td>EE Incorporated Mainly at Secondary Level</td>
<td>2</td>
</tr>
<tr>
<td>EE Incorporated Across All Subjects</td>
<td>5</td>
</tr>
<tr>
<td>Broad Plans/Recommendations Formed by State</td>
<td>5</td>
</tr>
<tr>
<td>Community Projects Exist</td>
<td>5</td>
</tr>
<tr>
<td>Plans Inhibited by Lack of Funds</td>
<td>3</td>
</tr>
<tr>
<td>New Plans Were Funded by State</td>
<td>2</td>
</tr>
<tr>
<td>State is Considering Certification Program</td>
<td>1</td>
</tr>
<tr>
<td>Optional Certification in EE Exists</td>
<td>1</td>
</tr>
<tr>
<td>EE Certification Required in Several Areas</td>
<td>1</td>
</tr>
<tr>
<td>No State Requirements Exist for EE in Public Schools</td>
<td>1 2</td>
</tr>
</tbody>
</table>

Table 1. Environmental Protection Agency National Survey Data

Noteworthy among the states is Wisconsin, where "instruction in environmental education is required for...certification of all new teachers in early childhood, elementary, agriculture, sciences, and social studies education" (EPA 1989, p. 32). Indiana "has organized a higher education certification program for teachers in environmental subjects" (p. 11), and Pennsylvania "requires that every student at the secondary level receive 30 hours of instruction in environmental studies. Regular school visits are made every year to ensure compliance with this regulation" (p. 25).
However, Pennsylvania makes no note of how its secondary school teachers are prepared to provide this instruction. This information indicates that few states in the country have followed the directives of the Tbilisi or Moscow conferences in terms of implementation of EE in general, or teacher training requirements in particular.

Numerous model programs exist in the U.S., which teachers may use in part or in whole, as they see fit, to insert into their own curricula. Sometimes the inclusion of such programs is sponsored directly by the state. These include Project WILD, Project Learning Tree, Living Lightly in the City, and Sunship Earth, among others. Though these modules have successfully introduced many environmental concepts to teachers, their use in classrooms remains limited and oftentimes ineffective (Armstrong and Impara 1991). These programs' discontinuous natures and sometime irrelevance to student lives runs counter to research suggesting the need for comprehensive, continuous programs through all grades (Ioazzi 1989). Project WILD, for example, "is not comprehensive and was not designed to be a student's sole EE experience (Weilbacher 1991, p. 35). In a survey conducted for the Western Regional Environmental Education Council, teachers indicated that Project WILD was used primarily in elementary grades, and no more than 30% of respondents from any region (10% from Montana) used the curriculum in secondary grades (WREEC 1990). The study indicates that though a program may be generally valuable, its value will be limited by its low use in secondary grades and fields other than science.
Similar factors limit the effectiveness of other types of EE materials in secondary schools. Many programs consist only of paper and pencil desk-work, without significant outdoor or other hands-on experience, a fact that few researchers even address. Nature centers and environmental education centers, sometimes used for field trips by secondary teachers, usually claim to be teaching EE but do not include in the goal structures the mandates of the Tbilisi Declaration (Simmons 1991). Values education is now seen as critical to EE (I will discuss this further in section III.), but "few values education materials have been rigorously and objectively evaluated after publication" (Superka and Harms 1977, p. 3). Therefore, many EE programs are rendered ineffective due to inherent design flaws, inappropriate use, or lack of adequate evaluation.

It would be unfair to say that little has been accomplished in establishing EE as a part of secondary school curricula. However, while a comprehensive theoretical base now exists for the development of EE, most secondary school programs now in existence do not nearly approach fulfilling the established goals. The shortcomings of EE may be traced through the actual programs and through the teacher training programs behind the scenes.

III. Failures of EE

There is little doubt among researchers that EE programs have not been successfully incorporated into public school curricula. As of 1978, EE in U.S. schools was not theoretical, systematic, or comprehensive; much energy was lost in discussions of problems, strategies, and methodology, and little energy remained for effective implementation of ideas (Childress
1978). By 1983, federal, state and local emphasis on EE had decreased (Sexton 1983). A 1988 review of studies indicated the existence of some, but infrequent, cognitive-focussed, hands-on EE and of a meager research base in this area (Lisowski and Disinger 1988). In 1990, Van Matre stated "In environmental education we never did the job we set out to do" (Van Matre 1990, p. 4). He indicates that most focused, sequential programs have been set aside and replaced by supplemental activities; even when teachers include an environmental unit or lesson, these do not adequately address the full spectrum of EE goals and objectives.

Some evidence points to the success of EE today: the number of educators and leaders working to implement EE, stories of student and adult activists confronting issues, and environmental law enforcement agencies' stories. (Hungerford and Volk 1990) However, other evidence indicates that EE has not been so successful after all. Hungerford and Volk cite reports on the actual condition of our natural environments that repeatedly indicate they are deteriorating. Second, they note that the U.S. has not spent the time and resources to develop systematic EE programs in public schools, so only a smattering of the population is receiving EE. Third, most EE programs are not designed to develop student ownership of an issue, nor do they develop the skills necessary for environmental activism. Their premise is that education must have as its primary goal the shaping of student behavior: EE programs have not resulted in environmentally responsible behavior, and therefore they have failed.
A. Lack of Values Education/Activism Skills

The importance of altering behavior, as well as the methodologies involved, constitutes the most critical new aspect of research in EE. Hungerford and Volk (1990) reveal one of the most pervasive and significant misconceptions about EE, which exists even in their 1984 paper: that awareness of an environmental problem and the possession of problem-solving skills engender the motivation to act. Altered behavior was assumed to follow automatically once a student grasped the immorality of a particular practice, and this assumption carried over into practice. Blosser and Helgeson (1985) and Bethel and Hord (1982) report on in-service teacher training programs that include field trips, lectures, demonstrations, labs, and discussions. No action skills are included in the programs. No explanation is offered for how attitudes are formed or changed, nor have the researchers attempted to find links between attitude and a change in behavior. Peyton and Hungerford (1980), in assessing teachers' abilities to identify, teach, and implement environmental action skills, found that both pre- and in-service teachers were poorly prepared in the activist skills examined in the study. Most of the population had limited experience in environmental activism, lacked confidence in their abilities as activists, and had incomplete plans or none at all for future environmental activism. In his 1992 study of seven high school EE classes in Illinois, Singletary (1992) found that "The courses and teachers emphasized the cognitive domain over the affective, and none of them made an overt attempt to alter student environmental behaviors ... teachers
apparently shared a notion that behavior arises from knowledge rather
than from beliefs and attitudes" (p. 39).

The Hungerford and Volk 1990 paper holds up the continuously
deteriorating environment and the perpetuation of irresponsible behavior
as evidence that EE, based solely on raising awareness and building
problem-solving skills, is not effective. Apparently, certain ideas about
humans' place in the world, and the role humans are privileged to play, and
the lifestyle to which humans are entitled, have remained the same.
Students may develop awareness of one issue in the classroom, but
"typically, issue awareness does not lead to behavior in the environmental
dimension" (p. 17). Hungerford and Volk synthesized three categories of
variables from recent research (esp. Hines et al. 1987) on behavior
modification, and used these to reconstruct a flow chart of behavior toward
the environment (Figure 1).

<table>
<thead>
<tr>
<th>Major variable</th>
<th>Major variables</th>
<th>Major variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental</td>
<td>In-depth knowledge about issues</td>
<td>Knowledge of and skill in using environmental action strategies</td>
</tr>
<tr>
<td>sensitivity</td>
<td>Personal investment in issues and the environment</td>
<td>Locus of control (expectancy of reinforcement)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intention to act</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minor variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge of ecology</td>
</tr>
<tr>
<td>Androgyny</td>
</tr>
<tr>
<td>Attitudes toward pollution, technology, and economics</td>
</tr>
<tr>
<td>Knowledge of the consequences of behavior—both positive and negative</td>
</tr>
<tr>
<td>A personal commitment to issue resolution</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minor variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-depth knowledge about issues</td>
</tr>
</tbody>
</table>

Figure 1. Behavior Flow Chart from Hungerford and Volk 1990

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The important point of their work is that many more factors inform our behavior than just knowledge of environmental problems (for example, attitudes toward technology, personal investment in issues, sense of empowerment to act). Unless these variables are addressed, EE cannot succeed in altering environmentally destructive behavior. This concept is supported by a number of studies.

A longitudinal survey of middle-schoolers in New York state found that students did not basically change regarding how concerned they were about environmental problems or about how much they felt they knew about problems in and [sic] environment. However, students did appear to change in how they perceive their chances of solving environmental problems. This change appears to be towards a slightly more pessimistic direction (Alaimo and Doran 1980, p. 318).

Students who do not initially express concern about environmental quality do not develop a favorable attitude toward altering their use of the environment (Richmond and Baumgart 1981). Even when citizens have expressed ecological concerns, they may not be prompted to act; provided only with knowledge of large-scale issues, or myths about possible solutions, they eagerly battle the wrongdoings of others. However, they do not understand their own role in the problem, or do not know how to change that role (Gigliotti 1990). Fear for personal consequences may increase the degree of verbal commitment and financial donations of adults to environmental problems, but they do not significantly increase the amount of time spent on the issue (Hine and Gifford 1991).

B. Insufficient Teacher Training

Since teachers are ultimately responsible for administering EE, adequate teacher training is obviously critical to the success of EE.
Adequate training is scarce in the U.S., though there are signs of improvement. For example, Champeau et al. found in 1980 that "most central Wisconsin teachers lack confidence in their training and resources and feel ill equipped to pursue state mandated goals. Recall that by 1989 EE instruction was required in Wisconsin for teachers in a number of subject areas, but teachers' attitudes and competencies had not improved by 1994 (Lane et al. 1994). No other states indicated this level of teacher training, and Champeau hypothesizes that the lack of confidence in training and resources could be applied to other states' teachers. In 1993, teachers in a special environmental school in Ontario, whose curriculum is supposed to include EE in all courses, reported that less than 20% of class time in any given department was devoted to EE (Samuel 1993). According to Samuel, two of the main reasons are teachers' conceptual difficulties with EE and poorly defined philosophy and goals for EE.

Stapp et al. (1981) list a number of constraints to the pre-service education of teachers in EE. First, many teachers are inexperienced in using community resources necessary to affecting environmental action. Second, few teachers have any training in values education, though values questions cannot be avoided in EE. Third, most teachers have not had the opportunity to apply problem-solving skills to community-oriented issues, which may be more complex and long-term than classroom projects. Fourth, EE advocates first-hand exposure of students to their environment, and because this is logistically and financially difficult (sometimes impossible), teacher training in this area is often quite limited. Fifth, EE is an interdisciplinary subject, but most teachers' college experiences do not
integrate subjects such as political science and biology, or ecology and philosophy. Finally, most teachers' academic experiences and achievements have been pursued on an individual basis, rather than on a group or team basis. EE requires teachers to use group work more than they have been trained to do themselves.

C. Lack of Context and Complexity

Successful EE must involve a variety of subject areas; students must deal not only with physical and biological elements of nature, but also with the ethical, social, cultural and economic dimensions of human interactions with nature. Problem-solving, development and questioning of values and attitudes, and participation in real, current issues are also integral parts of a strong EE program (UNESCO-UNEP 1977). By definition, EE is complex and multi-faceted. Many EE programs fail because they are too simplistic, and are limited by considerations of time and space. In reference to "Nature Scope," a curriculum supplement used for 8 weeks in K-7th grade classrooms, Armstrong and Impara (1991) never even expected tremendous changes in students' knowledge and attitudes. Under normal teaching circumstances, the numerous other demands on teacher and students dilute the EE module's effects considerably. Pretests and posttests produced few significant differences in environmental awareness, knowledge, and skills between groups exposed to the materials and the control groups.

A number of EE curricula are entirely contained within a science course. This fact alone puts limits on the scope of the program, but even in the context of a science course these programs are further handicapped by a lack of socio-cultural considerations. Martin (1987) points out that
science is a human enterprise and has an inescapable ethical dimension. Because it is a societal institution it has social and political dimensions. To leave the study of these to other disciplines is to sanction a philosophical silence on matters of great import (Martin 1987). Cherif (1992) notes that a gap exists between those who know how to do ecology and those who know how to teach it. Also, many teachers approach ecology from one particular (and incomplete) viewpoint, such as description, function, or evolution, and they address only the scientific aspect of ecology, and not the ethical, economic, political, aesthetic, religious view, etc.

These barriers are not exclusive to science or to EE; they reflect prevailing attitudes about education in general. Educators continue to emphasize general, cognitive, and rational learning over concrete, affective, and nonrational learning (Noddings and Shore 1984). Lessons in ethics, values systems, and first hand manipulation of components of a natural environment are limited by such priorities. Another difficulty arises from the tendency of most countries to separate fields like history, geography, and language skills into discrete courses. EE is generally incorporated into school curricula within the scope of science or social studies courses. When EE is offered as a separate course, it is "taken as 'just another subject' in the curriculum to be studied to satisfy examination requirements, thereby vitiating the purpose for which it was introduced" (UNESCO 1985, p. 129). Separation of subjects is perpetuated by the study of EE in teacher education colleges. Integration of separate subject areas is left to the discretion of individual student/teachers, without an example of how the integration may be accomplished (UNESCO 1981).
D. Feminist Commentary

Scholars in feminism and the history of science have argued that the destructive attitudes toward and treatment of nature in western culture stem from the patriarchal character of natural science (Keller 1985; Tuana 1989). Hierarchical attitudes toward nature and reductionist methodologies are at the root of this destruction. Scientists have traditionally removed context and subjectivity from their studies, formulating theories and laws based on unrealistic circumstances (Hubbard 1986). In addition, the objectivity claimed by most scientists rarely exists - science is invariably informed by the historical and social context within which it is performed (Kuhn 1970). We have not been seeing nature as an integrated whole, but as discrete, unassociated bits and pieces, and this has led, in part, to our spoiling the environment in the name of science and technology (McClintock in Keller 1983). Modern science is reductionist, by definition, and our reductionist philosophy of science must be changed before its applications to nature will change (Keller 1985).

When an influential scientist, such as Darwin, describes nature as hierarchical and competitive, he may be reflecting the capitalistic, industrial attitudes of his contemporaries in Victorian England (Hubbard 1979). Thus, modern attitudes toward nature may be influenced by a potentially destructive mindset. The hierarchical paradigm that permits us to place humans above other natural entities is a result of the "masculinity" of science and its reductionist tendencies (Martin 1988). These traits work at cross purposes with EE programs that seek to build closer ties between humans and nature.
Another gender-related difficulty with EE is the disparity in the number of men and women scientists at the professional level. Throughout the 1980's, the ratio of professional scientists who were women hovered around 13% (Dix 1987; McIlwee and Robinson 1992; Didion 1994). Of the most demanding governmental science positions, only 7.5% are held by women (Clemmet 1990). Role models are important in encouraging young women to enter scientific/ environmental fields. The secondary level is particularly important in this respect, since a large number of girls become discouraged with science at this time (Kahle 1983). Universal ecologic literacy depends on a balance of men and women as role models for students of EE (Kremer et al. 1991).

E. Inadequate evaluation and research

Research on the implications of gender bias on EE is scarce (Lisowski and Disinger 1988), as is research on most aspects of EE, particularly its effectiveness. Some attempts to evaluate EE have been inappropriate to this form of education. For example, tests requiring the recall of specific facts do not assess students' abilities to investigate local environmental issues (Robottom 1985). Other attempts have simply been inadequate. In 1977, Superka and Harms reported that there had been few systematic studies completed on reactions of educators to curriculum materials in EE. Though understandable as early as 1977, the shortage of feedback remains today; often results are compromised by poor instrument design and poor data analysis (Leeming 1993). Leeming's analysis shows that only 5 of 34 EE studies since 1974 attempted to examine changes in knowledge, attitudes, or behaviors.
One reason for the paucity of analytical research may have been that evaluation was not a high priority of educators (Bennett 1988-89). Bennett's report, written for the UNESCO Environmental Education Series, goes on to offer ideas for evaluating EE. It is this author's opinion that his report is extremely simplistic, with no in-depth treatment of any of the methods suggested, nor any indication of their appropriateness for particular types of EE curricula. Another example of a shallow investigation of problems with EE comes from Beutler (1988): "Achieving this promising outcome [of successful EE] will require some extra time and thought on the part of the faculty, and maybe a little money from the school district" (p. 4). This is the extent of Beutler's suggestions for improving the evaluation of EE; he trivializes the issue by grossly understating the time and effort necessary to successfully alter existing educational programs.

Possibly the strength of the recommendations in the Tbilisi Declaration eclipsed the perceived need for follow-up work. The declaration provided goals and objectives, but did not elaborate on how to implement them, nor on how to evaluate their implementation (Disinger 1986). Both skills must be an integral part of a good teacher training program in EE.

IV. Teacher Training Programs

A. Criteria Necessary for Success

To a large extent, the criteria for a successful teacher training program in EE are based on the directives and difficulties listed above. The goals of EE should also be the goals of a teacher training program, since
each teacher trainee may be a potential trainer of future teachers (UNESCO-UNEP 1988).

The Tbilisi Declaration is undoubtedly one of the most important documents to the development of EE (Hungerford and Peyton 1980), and serves as part of the basis for the training program presented here. Stapp et al. (1981) provide one of the most thorough analyses of training programs, accompanied by a model for pre-service EE of teachers. Their analysis echoes each of the points made in the first sections of this paper. Their model is based on four factors necessary to produce competent teachers: 1) basic competencies in natural and behavioral sciences; 2) understanding of interrelationships between humans and ecosystems; 3) understanding of educational theory and teaching skills; 4) a teaching experience prior to certification.

To these models and goals, I add the five criteria for successful teacher training, each based on additional research, and grounded in a constructivist pedagogy. Constructivism, as it applies to education, has been defined by numerous authors (Wheatley 1991; Wadsworth 1992; Ertmer and Newby 1993); this passage is representative: Constructivism defines knowledge as temporary, developmental, socially and culturally mediated, and thus, non-objective. Learning from this perspective is understood as a self-regulated process of resolving inner cognitive conflicts that often become apparent through concrete experiences, collaborative discourse, and reflection (Fosnot’s preface in Grennon Brooks and Brooks 1993, p. vii)

One way of developing a constructivist curriculum is through inquiry-based instruction. Inquiry instruction uses strategies like problem-solving, logical and analytic reasoning, clarification of values, and
decision-making to help students acquire understanding of concepts (Sweiter and Anderson 1983). Thus, inquiry provides the vehicle for the collection of concrete experiences, discourse, and reflection that, in part, comprise constructivist learning. Constructivism, with inquiry-based methodology, serves as an appropriate unifying ideology for EE; both are reflected in the criteria below.

**Infusion.** Ramsey et al. (1992) define infusion as the inclusion of content and skills into existing courses in such a manner as to focus on that content and skills without jeopardizing the integrity of the courses. The importance of infusion lies in its capacity to provide all the facets - economic, cultural, social, communicative, etc. - that have been deemed necessary to and heretofore missing from EE. This multi-faceted approach is in keeping with the view of knowledge as a social and cultural construct. A curriculum highlighting different perspectives will provide a more inviting forum for experience-based discourse.

Suggestions for infusion possibilities may be easier to imagine in science and social studies courses and more difficult in, say, language courses (Ramsey et al. 1992), perhaps because of traditional views of what a language course should include. Language, however, is subjective, and temporary, and generally reflects the world view of a culture. Some cultures (i.e. some Amerindians) see all aspects of nature as interconnected and inseparable. Reflecting this difference, their languages employ unquantifiable "mass" nouns, as opposed to our discrete nouns (Chawla 1991). A study of other languages than English may offer alternative perspectives such as this on the interrelationship of humans and nature.
Thus, infusion of EE into more than just science and social studies courses would be beneficial to the field.

If infusion is to be successfully implemented, teachers in all fields must understand how environmental issues pertain to their particular subject (Washington State 1986). Otherwise, EE is likely to fall through the cracks of a pre-existing course (Singletary 1992; Charif 1992). Teachers must be not only willing but competent to infuse EE, and this would be one result of a comprehensive training program (Hungerford et al. 1988). This is the reason for the Humanities facet of the innovative program I have designed. Since infusion in a variety of subjects is one central principle of EE (Simmons 1989), the inclusion of several subjects in a training course should facilitate infusion by teachers in the future.

Values Education. One reason for the innovative character of EE is the added political dimension brought about through infusion - students learn to become socially critical through the study of different languages, cultures, economies, issues, etc. (Robottom 1989). The alternative perspectives provided by infusing EE throughout a school curriculum lead naturally to another critical component of EE: values education. Values education may be defined as "helping students acquire a set of values and feeling of concern for the environment and the motivation and commitment to participate in environmental maintenance and improvement" (Ramsey et al. 1992, p. 36). Lucko et al. (1982) imply that attitudes, behaviors, and values ought to be parts of the environmental education domain (p.8).
A teacher training program must provide guidance in techniques appropriate to assisting students in questioning their values and behaviors (Stapp et al. 1981). These techniques are grounded in the psychology and sociology of social change; teachers should be equipped with this knowledge to better facilitate values education in their classrooms (UNESCO 1981; Caduto 1985). As noted in Hungerford and Volk (1990), a number of variables may influence a student's attitudes and values system, including personal investment in issues, expectancy of reinforcement from actions, and environmental sensitivity. However, the exact relationship between positive attitudes and values and the influence of EE and of socio-cultural factors remains unclear (Lozzi 1989).

EE is an effective vehicle for teaching values and attitudes (Lozzi 1989; Ramsey 1993), and a variety of teaching methods seem to work, depending on the circumstances (Caduto 1985). Pre-service training in team-teaching methods has improved teacher's values in European programs (UNESCO 1981). From his review of research in this area, Lozzi concludes that open-ended inquiry, interdisciplinary approaches, and guided discovery approaches were each effective methods of inducing long-term positive changes in attitudes. Simulations did not serve this purpose as effectively as traditional teaching methods. Finally, Lozzi states that outdoor education, particularly camping, promotes constructive changes in attitudes and values. Exposure to natural outdoor settings may need to occur over several years' time before students develop a sensitivity that will influence their behavior (Hungerford and Volk 1990), and should therefore be encouraged for teachers of all grade levels.
A more clearly defined guide to values education is provided by Wright and Williams (1977). Their model for analysis is in seven steps, and I paraphrase it here; to have a value, a student must:

A. Choose
   1) freely
   2) from alternatives
   3) after thoughtful consideration of the consequences of each alternative.

B. Prize
   4) cherishing, being happy with the choice,
   5) be willing to affirm the choice publicly;

C. Act
   6) doing something with the choice
   7) repeatedly, in some pattern of life.

Because this model offers discrete steps it may be useful as a guide to constructing lessons in values education, and also in evaluating the effects of those lessons on students.

Evaluation of EE is most effective when done by the classroom teacher, as opposed to a third party (Robottom 1985; Klein and Merritt 1994). Robottom says that EE is a socially critical form of education, which should provoke reflection upon one's own goals. The teacher must have examined the historical and social contexts of his/her EE goals, as well as that of the students, before introducing EE in the classroom. Therefore, states Robottom, the teacher should act as the researcher, questioning his/her own ideology and the EE goals that have been set within that context. Traditional, scientific methods of analysis by third parties tend not to scrutinize goals and intentions, but only how well those goals match the outcome (in the form of student behavior), according to Robottom.

Pankratius (1993) supports the view that a teacher education program must expose candidates' prior attitudes and beliefs to critical inquiry. In his study, constructivist inquiry and reflection resulted in one
woman's conclusion that Creationism was an inappropriate topic for a biology course. The teacher candidate, a devout Mormon, was neither alienated nor discouraged in her own personal beliefs, and is now equipped with the skills to guide her own students in similar inquiries.

To summarize the above contributions, constructivist EE is concerned not only with cognitive development, but with moral, or values, development (Wadsworth 1992). Values education lessons may be seen as somewhat flexible in design, with firm general goals that need clarification and adaptation to specific classrooms and subject areas. Evaluation of values education should be carried out by the teacher, in the classroom; based on his/her evaluations, the actual goals and objectives of an EE program may be changed.

Concrete Experience with Real Issues. Motivation to act must be accompanied with activism skills (Hungerford and Volk 1990; Hungerford, Peyton & Wilke 1980), taught by people who possess those skills themselves; without teacher training in activism skills, a school program can provide only mediocre EE (Washington State 1986). Many teachers report that EE materials are offered to them as if the materials themselves constituted the curriculum, yet these materials seldom give guidance for use with particular issues (Robottom 1985; Grennon Brooks and Brooks 1993). The teachers must have had some first-hand experience with an issue prior to dealing with activism in the classroom. The value of concrete, inquiry-based learning for education in general and science and EE in particular is supported by a large body of research.
Understanding of primary concepts is enhanced by manipulation of concrete objects; use of primary concepts to develop more complex ones is also enhanced (Novak 1987; Lisowski and Disinger 1991). Noddings and Shore (1984) note that an academic expert who teaches must realize that students new to the discipline will not benefit as much from learning the overarching structure of that discipline. There is not necessarily a correlation between the expert's view and the student's most advantageous view of the field. Rather, a student (especially a child) approaching a subject for the first time will enjoy greater comprehension and application skills if the initial learning experience was field-based, or concrete and manipulative.

Science programs, including ecology, tend themselves to "field" work, which in turn increases understanding and retention of new ideas (Lisowski and Disinger 1988). Constructivism in education has focussed on science (Keiny 1994), perhaps because the approach closely parallels empirical scientific methods (Gil-Perez 1994); however, it may be applied to other fields (Jaeger and Lauritzen 1992). Since EE consists of more than pure science, field experiences in EE should include more than science. An inductive approach is generally more effective when a curriculum is built of interrelated topics (Lott 1983). Peyton and Hungerford (1980) urge that both EE programs and EE teacher training include experience on real issues (i.e., reintroduction of wolves, logging control legislation). This work teaches competencies in team work and writing, as well as understanding of social and political factors, skills that must be developed if EE is to succeed. Teacher training programs should also include involvement in
actual environmental issues and inquiry-based problem-solving; possession of activism skills is a prerequisite to the ability to teach them to others (Sweiter and Anderson 1983).

**Feminist Approach.** Feminist scholars suggest that acknowledgement of the feminine aspect of humanity will encourage a more constructive environmental ethic than what has existed to this point - destroying environments would be unthinkable to graduates of successful EE (Noddings and Shore 1984; Keller 1983). Feeling for the subject matter, such as that described by geneticist Barbara McClintock, directs the formation of a behavioral ethic (Iozzi 1989; Noddings and Shore 1984). A feminist approach to nature would promote the examination of context and the acceptance of complex processes and interrelationships; feminist learning would be based at least as much in the affective domain as in the cognitive (Loughlin and Mott 1992). The addition of context and complexity would bring to light the political and cultural characteristics of science and scientists (Hubbard 1986), an aspect of EE included in the goals and objectives discussed above. In terms of the acknowledgement of context, and of the cultural and social nature of science, such a feminist approach is compatible with the constructivist ideology I have discussed. Constructivist education deals with the affective domain, as well as the cognitive (Wadsworth 1992), and students are encouraged to examine the source and motivation of their own and others' values (Geddis 1991; Pankratius 1993). Understanding rooted in personal reflection and experience has been described as both constructivist and feminist (Loughlin and Mott 1992).
The approach to EE discussed here is referred to as feminist because intimacy between the student (or teacher) and the subject matter has not traditionally been characteristic of masculine "objective" science (Rosser 1984). Rosser also notes that increases in the number of women in the social sciences and in biology have coincided with marked transformations in the philosophical bases of these fields. She suggests that this is not coincidental, but a result of the difference in perspectives and in approach of women scholars to their subject matter.

Gender bias extends beyond the sciences. Rosser's point is echoed by Kolodny (1975) in her examination of the oppressive attitudes toward natural environments promoted by patronizing metaphors in "classic" works of western literature, most written by men. Examinations of literature, language, politics, and all other facets of EE, in addition to science, could bring to light forms of gender bias; from these discoveries students might realize biases in their own attitudes and behavior of which they would otherwise have been unaware.

Appropriate Evaluation Methods. Many of the components of EE discussed thus far constitute challenges to basic premises of traditional education. It should be no surprise, then, that the evaluation of EE must also be based on a different epistemology than traditional methods of educational evaluation. Robertson (1994) presents an elaborate argument for research based on constructivist evaluation methods. He notes that the original approach to research in education was modelled after science research. This empirical approach requires observable facts or behaviors that may be analyzed statistically to form generalizable conclusions. The
traditional empirical method also depends on the separation of the object from its observer. Robertson reiterates the points I have made above: that EE involves changes in attitude, which are not necessarily observable or quantifiable; and that the socially critical nature of EE precludes a separation of object from observer, since the students and teacher must examine their own values. A constructivist approach to teaching consists of ongoing, subjective assessment of changes in teachers' and students' attitudes, values, knowledge, and behaviors (Klein & Merritt 1994).

B. Existing Teacher Training Programs

A survey of literature, college guides, and state programs reveals no single college-level course in EE for secondary school teachers that satisfies all the criteria discussed above. Following are those programs or modules that come closest.

UNESCO-UNEP has published modules - course outlines - in EE for pre- and inservice training of secondary school teachers (UNESCO-UNEP 1983; Muthoka & Rego 1985; Sinha et al. 1985; Hungerford, Volk & Ramsey 1989). The modules are for social science and science teachers. These guides are thorough, with sections on goals, content, curriculum design, classroom techniques, evaluation, and implementation strategies for schools and systems. The information and ideas is detailed, and each guide would be a valuable reference to a training program in these fields, or as a part of a program covering all academic fields. They have been included in the reading list for this course. None of these publications represents an existing course, however; they are merely guidebooks.
State requirements for teachers in EE were summarized in section II.B. Wisconsin's model is the most complete; it was written by the Wisconsin Supervisor for Environmental Education and contains detailed chapters on curriculum development, content, value development, classroom teaching methods, use of issues, and district-wide implementation. As with the UNESCO modules, this guide is a superb reference, but does not represent a specific training course.

As of 1983, only Ohio State University's Division of Environmental Education offered programs in environmental communications, education, and interpretation (Roth 1983). By 1992, several colleges and universities offered programs in EE, each of which fell into one of the following categories (Droege 1992):

1) Science/Policy-based environmental studies programs with little or no educational course or component;
2) Outdoor education programs with little educational theory;
3) Education programs providing degree-seeking students or inservice teachers with infusion-type, topical modules;
4) Environmental studies programs offering the pertinent elements of EE sprinkled through several different courses.

A 1995 survey of the 23 four-year colleges offering some form of EE in the United States (Peterson's Guides 1995) shows that no single course exists for secondary teacher candidates that satisfies all the criteria discussed in this paper; the above categories remain applicable. The advantage of programs from Category 4 is the depth of inquiry permitted in the time required to take several different courses. The disadvantage is that the time requirement is prohibitive to the participation of inservice teachers. For an institution with limited funding for new programs, a single course,
offered at a time when the greatest number of people are able to register, may be more likely to succeed and thus promote the growth of the program. Another disadvantage to courses offered during the regular school year is that outdoor time is limited by other courses and activities, both for instructors and for trainees.

To summarize, there are a number of valuable programs in EE for pre- and inservice teachers. When evaluated in light of the comprehensive criteria set forth by the Tbilisi conference and subsequent research, most of those programs come up short in one way or another. I outline below an EE course for secondary school teachers or secondary education majors. This course is innovative in that its goals, objectives and methodologies are in keeping with all criteria necessary to successful EE; in addition, as a single course offered during the summer, it is available to inservice teachers and can offer the maximum amount of time outdoors in natural settings.

V. Proposed Teacher Training Course
A. Course Description

*Environmental Education for Secondary School Teachers*

This college-level, undergraduate course in environmental education will be offered through both education and science departments, in keeping with the broad scope of the subject matter. It will be offered during the summer, to enable participation by inservice secondary school teachers as well as pre-service secondary education majors. The course will take place almost entirely outdoors, with some supplementary indoor laboratory work, as necessary. This will ensure opportunities for first-
hand experience with natural environments. Indoor areas for discussions and reading will be provided in the event of inclement weather. Indoor living facilities will also be provided, though camping should be incorporated into various sections of the course, at the discretion of each respective instructor.

The scientific component of the course will be interdisciplinary in nature, consisting of topics in geology, biology, and ecology. The course design will be based on daily field assignments outdoors. Students make observations, design projects and perform experiments, usually in small groups, and their results form the basis for discussions of the interrelated character of all natural processes. Thus the locus of control, the source of the data and the decisions based upon it, is "the students'. Students' understanding of science is shaped by the historical and cultural contexts in which it is developed. Students examine their own attitudes within such contexts in the values clarification sections of the course. Students also investigate current local environmental issues, including the value systems underlying those issues. Thus the course presents the elements and processes of nature as material from which students construct their own knowledge, values, and behaviors through inquiry-based methods of learning.

Because of the interdisciplinary nature of the course, instructors will be involved from different academic and professional fields, ideally one full-time instructor from geology, life sciences, and education. "Guest" instructors (used for a half day to 2 days) include representatives from local environmental organizations who can provide students with examples
of successful activism and opportunities to participate in current projects. There will be both male and female instructors (as close as possible to a 50/50 ratio) to provide role models for all students. Class size will be limited to 20-30 students to provide the maximum amount of interaction between students and instructors. Guest instructors should be given clear guidelines in the creation of their classes, so that they conform to an inquiry-based strategy.

The following syllabus is somewhat general, since specific lessons and issues should focus on the actual setting for the course. In other words, if the course is taught in the northern Rocky Mountains, issues concerning mainly slick-rock deserts would be inappropriate. The major topics for each week have been selected carefully to provide an experience in keeping with all five of the Section IV. criteria. Therefore, the topics should remain as guidelines for the instructors. Likewise, the reading list is meant to suggest possibilities; it should not be completely abandoned, though not every author need be used. When an entire book is listed, only portions might be assigned. Model lessons have been provided to highlight the application throughout the course of two of the Section IV criteria: Values Education and Concrete Experience with Real Issues.

Goals and Objectives

The goals and objectives for this course are those set forth in the Tbilisi Declaration of 1977, adapted and combined with the criteria described in section IV. above.
Goals:
- To foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural areas;
- To provide each trainee with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment;
- To create new patterns of behavior in trainees towards the environment;
- To provide knowledge and practice in teaching methodologies that will enable trainees to provide their respective students with similar learning experiences.

Objectives:
- To help trainees acquire an awareness and sensitivity to the total environment and its allied problems, and to the application of these problems to a variety of subject areas.
- To help trainees gain a variety of experience in, and acquire a basic understanding of, the local environment and its associated problems.
- To help trainees acquire a set of values and feelings of concern for the environment and the motivation for actively participating in environmental improvement and protection.
- To help trainees acquire the skills for identifying and solving local environmental problems, through first-hand experience with natural phenomena.
- To provide trainees with an opportunity to participate at all levels in working toward resolution of local environmental problems, and in designing secondary school curricula based on these problems and methods of resolution.
- To produce teachers who are confident and competent in their ability to provide these same experiences for future students, and who will continue to serve as appropriate role models in environmental activism.

Syllabus

Suggested time allotment: 8 weeks, 8 credits, 120 hours = 15 hours per week in class

Week 1-2: Ecosystems

Science:
Components of ecosystems - biotic and abiotic
Types of ecosystems
Interactions and interconnection
Energy flow
Cycles of matter

Humanities:
Science and nature - historical perspectives

Values Clarification:
Using the outdoors as a classroom
Description as a tool
Identifying patterns
Scientific methods
History of environmental education

**Week 3-4: Water**

Science:
- An agent of weathering and erosion
- A habitat
- A resource
- Human use and pollution of lakes, streams, oceans, and groundwater

Humanities:
- Attitudes toward nature in history, literature, culture

Values Clarification:
- Assessment of the success of environmental education to date
- Structure and goals of environmental education

**Week 5: Food**

Science:
- Energy transfer between trophic levels
- Availability and depletion of wildlife resources
- Soil
- Agricultural practices and problems - pesticides, irrigation, erosion
- World food production and distribution

Humanities:
- Sense of place and ethics

Values Clarification:
- Structure and goals of environmental education
- Changing values and behaviors

**Week 6-7: Evolution and Earth History**

Science:
- Cell processes, Gene flow
- Populations and stability, Humans
- Population responses to stress
- Plate tectonics
- Glaciation
- Geologic time table
- Stratigraphy
- Paleontology and the history of life on earth

Humanities:
- History of evolution - concept and use
- Competition vs. cooperation
- Biases and hierarchies in our views of nature

Values Clarification:
- Psychology of learning
- Developmental stages

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Week 8: Current Issues

Science:
- Local endangered species
- Timber management
- Public lands issues

Humanities:
- History of preservation, conservation, and environmentalism

Values Clarification:
- Obtaining resources for outdoor education
- Public agencies as resources
- Designing a field trip
- Designing a case study

Model Lessons

For each of the five units of the course I have provided a model lesson and assignment designed around two of my criteria for a successful EE course: 1) concrete experience with real issues, and 2) values education. Provisions for concrete experience lie in hands-on, self-directed investigations of tangible environmental elements (rocks, bugs, etc.) to personal interaction with public officials and community members. These experiences illustrate the range of topics that can be covered through inquiry-based instruction. The model lessons contribute to values education. I have provided examples that, as a whole, reflect the orderly progression necessary to changing citizenship behavior (from Figure 1). The progression flows from "Entry-level Variables" to "Ownership Variables" to "Empowerment Variables." The knowledge, skills, and attitudes in each of the three categories in the sequence are prerequisite to citizenship behavior in environmental issues. Since values education is inextricably linked to citizenship behavior, following the Hungerford and Volk progression is logical. I have suggested time allotments. A concluding
assignment for each lesson provides for the instructor a gauge of the students' attainment of the stated goals and objectives.

Week 1-2: Ecosystems

Entry-level Variables: environmental sensitivity, knowledge of ecology.

Goals: To provide an opportunity to develop sensitivity towards an ecosystem or its components; to build ecological knowledge. To identify patterns within an ecosystem; to use description as a tool.

Objectives: To develop skills in written and oral description of natural elements; to understand the characteristics of a viable scientific model; to be able to create such a model and use it to make and test predictions; to begin to understand and apply the term ecosystem; to understand that students' initial definitions of these terms are a type of model that may be tested and modified throughout the course.

Procedure:

Part 1: 60 minutes

1. The entire class convenes outdoors. Students work in groups of three. (These groups remain constant throughout the course.) Each group is told to locate an item or group of items that may be easily observed from the class area (for example: a stand of fir trees, or a rock and the moss growing on it). They are told to select pairs of items that seem to exist in some sort of pattern (for example, the rocks have moss growing only at their base; the fir trees are smaller at the edge of the stand and larger nearer the middle).

2. Students are told to use as many different forms of description as possible to communicate to the class the appearance of the patterns observed among the items. Allow about 45 minutes for description writing.

Part 2: 60 minutes

1. Each group presents its descriptions to the entire class, with the described items in view. Each description should take a maximum of 5 minutes.

2. The instructor introduces the term ecosystem and its origin.

3. Groups are instructed to create their own tentative definition for the term ecosystem. They are told that this definition will be a kind of scientific model; such a model may be tested repeatedly for its accuracy, its ability to serve as a basis for predictions, and its simplicity.

4. Each group reads its definition to the class.

Assessment: The "model" definitions of an ecosystem should be reviewed on a weekly basis by student groups. Each group should reflect on the material learned that week relevant to ecosystems. Groups decide whether their definition remains suitable in light of the new information. If not, the definition should be modified. Each group describes and explains in class any modifications they have made to their definition. This assessment tool is an ongoing process, and emphasizes the students' roles in critiquing their own progress. At
the end of the course, the instructor may furnish several textbook definitions of the term for comparison to the students' work.

Week 3-4: Water
Entry-level Variables: attitudes toward pollution, technology, and economics.
Ownership Variables: personal investment in issues and the environment.

Goals: To explore personal attitudes toward natural elements or settings, and attitudes toward technology; to try to understand the source or cause of those attitudes through discussions and reading; to explore the personal investment others have in environmental issues; to try to understand the source or cause of that investment.

Objectives: To gain experience in the written and oral expression of personal attitudes; to develop skill in analyzing one's own and others' attitudes without alienating or insulting; to develop skills in analyzing, through collaborative discourse, the attitudes and personal investment described in a selection of non-fiction nature-writing.

Procedure:
Part 1: 60 minutes
1. Students will have been writing a learning journal (Pankratius 1993). They will have been assigned before this class to describe an aspect of the natural environment in which this course takes place that was new or strange to them. They should have written about what was new or strange about it, how it compares or contrasts with their expectations and experiences, and whether their feelings toward it have changed as they spend time there.

2. In class, the instructor asks each student to share what he/she has written in the journal. The instructor facilitates discussion of sources and causes of the attitudes expressed by each student. The instructor should discourage any comments that indicate a student's attitude was "wrong," or similar condemnations. Comments and questions should encourage discovery through reflection and revelation. (For example: On what impressions were your expectations based? How did those movie characters react to the desert? Did you sympathize with them? Why or why not?)

3. The instructor closes the discussion by asking students to look for patterns in the causes of different attitudes expressed in class. A list of at least a few should be compiled in class.

4. Students are assigned to read "Atchafalaya" in John McPhee's The Control of Nature. They should come to the next lesson prepared to discuss the following: What are the personal and professional experiences of Rabelais, Dugas, Houck, the Army engineers, et al., and how do those experiences appear to translate to their attitudes toward the river and its behavior? Has McPhee cast a positive or negative light on the other people? What would be his motive for doing so? With whom do you relate most? Why? Does McPhee
present alternatives to the courses of action the various river people have taken? Can you suggest alternatives?

Part 2: 60 minutes

5. In the class discussion, the instructor should refrain from providing his/her own views, and should merely elucidate the ideas presented by students. The instructor asks if, in the Atchafalaya scenario, a change in attitudes seems necessary. What makes it necessary? Who would benefit from a new attitude? How do you define “benefit?” Is there a right way and a wrong way to deal with the river? How are you defining “right” and “wrong?”

6. The instructor reiterates the bases of students’ attitudes listed in the previous class. He/She asks what similarities and differences exist between these and the bases identified in “Atchafalaya?” The instructor asks if the students’ judgements of the Atchafalaya scenario may be applied to their own experiences? Why or why not?

Assessment: The students are instructed to continue exploring their attitudes and feelings toward the natural setting described in their journals. Entries on this topic should be made at least once a week. Students are instructed to continue to provide possible reasons for their attitudes, and to describe the extent to which any course material has influenced their feelings. The total content of the entries on this topic (at course’s end) should not be judged according to a student’s like or dislike of the natural setting. Rather, the work should be judged based on the thoroughness with which the student seems to have investigated his/her attitudes and the causes thereof.

Week 5: Food Sources

Entry-level Variables: environmental sensitivity; knowledge of ecology.
Ownership Variables: In-depth knowledge about issues; knowledge of the consequences of behavior.

Goals: To gain knowledge of the availability and depletion of wildlife resources; to develop sensitivity towards a particular species of organism (the grizzly bear); to understand the causes and results of the depletion of that organism’s resources.

Objectives: To identify a few plants and animals (natural food sources of grizzly bears) in the wild using published descriptions and drawings; to place these food sources in appropriate categories based on trophic levels; to be able to identify causes for the depletion of the food sources; to use first-hand knowledge and written sources to deduce the impact of food source depletion on the bears and their environment.

Procedure:

Part 1: 90 minutes

1. Each group of students is provided with descriptions and pictures from nature guides of 3-4 different organisms eaten by grizzly bears.
(This lesson assumes that the course takes place in or near Glacier National Park, in which there are grizzlies.)

2. The groups are instructed to use the descriptions to locate actual specimens of these food items. The instructor should circulate to assist in identification. If working in a park, students should not collect specimens, but merely identify them. If park rules allow, certain specimens may be eaten by the students.

3. After all specimens have been identified, the entire class convenes and the instructor introduces the concept of trophic levels. The instructor guides the class in placing the specimens, and the bear, in appropriate levels. The instructor should provide some information on the nutrient values of these foods and on the quantities of these and other food sources necessary to sustain a given number of bears.

4. Students are assigned to read a textbook passage on the cycling of energy through food sources, consumers, waste materials (excrement and carcasses), and soil, in terms of trophic levels. The reading should provide examples of the impact of a disruption of the cycle on specific organisms. The examples should be relevant to the class locale.

Part 2: 90 minutes

1. The class should convene at the site of one or more depletions of grizzly food sources, for example, a timber clear cut, a center of human development (shopping area, forest road, freeway interchange, park village).

2. Students, armed with their nature guide descriptions, are given about 15-20 minutes to locate the food specimens they identified in the previous lesson. They might not be successful.

3. The class then convenes and the instructor asks students to consider the reading assignment. The instructor asks students to suggest some potential results of the food depletion on this area (aside from the absence of bears). These suggestions might include an absence of particular nutrients in the soil, resulting in the absence of a variety of plants or animals dependent on the soil.

4. The instructor selects certain of the “missing” plants and animals and asks students to consider the impact of their absence on further populations and habitats.

Assessment: Student groups are assigned to write a summary, with diagrams, explaining qualitatively the causal relationship between the availability of grizzly food sources and the health/presence of at least two other species of plant or animal. These assignments should be judged according to their accuracy and completeness, based on the information with which the students were provided.

Week 6-7: Evolution and Earth History

Ownership Variables: personal investment in issues.

Goals: To acknowledge the various biases inherent in scientific endeavors through examination of student work and discussion based on reading:
Objectives: To practice making the decisions needed to construct a classification of organisms in a food/energy pyramid; to be able to identify specific ideas and biases as they are reflected in the process and finished product through collaborative discourse; to understand (through reading and discussion) how a professional interpretation (by Charles Walcott) of the evolution of extinct organisms was influenced by social and scientific biases.

Procedure:
Part 1: 90 minutes
1. Student groups are presented with samples of a variety of living organisms (preferably labelled in their natural settings, within an area of less than a quarter acre). The instructor should have selected about five samples each of producers (plants, algae, fungi), first and second order consumers (photos or drawings may be necessary for anything larger than a bug), and scavengers. Soil and animal feces may also be included.
2. Groups are instructed to create a flow chart showing which of the items is eaten by which other items. Students should estimate relative quantities of each food item needed by its respective consumers. The instructor should be careful not to impose preconceptions about what this flow chart should look like (i.e. do not mention "pyramids"). Allow about 50 minutes for this exercise.
3. The entire class convenes and each flow chart set up for display. The instructor asks the class to examine each chart for hierarchies (among the organisms) that seem to be reflected in the chart. For example, one group may have placed producers at the bottom of the chart, while another placed the scavengers at the bottom. The instructor should then ask if there is a right and wrong orientation for the chart. Ask also if student attitudes towards the various organisms influenced their placement on the chart. The point of the discussion is to elucidate how biases in attitudes about organisms (their importance to each other, their place in nature relative to humans and to each other) may influence scientific classifications of their relationships.
4. Students are assigned to read Chapter One “The Iconography of an Expectation” from Stephen J. Gould’s Wonderful Life. Students should bring to class a basic idea of the true nature of evolution; the way that evolutionary progress has most often been misconstrued, the meaning of the terms diversification and decimation and their application to evolution; the discoverer of the Burgess Shale and his mistake.
Part 2: 60 minutes
6. In the next class, the instructor facilitates discussion based on these questions: When Gould says Walcott misinterpreted the Burgess Shale in the early 20th century, what questions come to mind? (Hopefully students will ask about who Walcott was, what manner of scientists and scientific thought guided his thinking, How did people envision human evolution before Walcott’s work? Why did Walcott’s interpretation go unchallenged for so long? Of what significance is
the popularization of the "march of progress" iconography? At the end of the chapter, Gould says it is more valuable to discuss the critters themselves than to talk in abstract terms, as he does in Chapter One. Do you agree with this based on your experience in this lesson?

Assessment: Student groups are told to return to their flow charts (outside of class time) and to analyze their work for biases. The flow charts should be modified, if necessary, and turned in to the instructor. The charts should communicate no value judgements about different types of organisms (none should appear "superior" to others). They should indicate only the relations among the groups of organisms in terms of relative energy intake and output.

**Week 8: Current Issues**

Ownership Variables: personal investment in issues and the environment. Empowerment Variables: knowledge of and skill in using environmental action strategies.

Goals: To identify a current, local, environmental issue in which personal interest is significant; to develop skills and knowledge in using public agencies and their publications as resources for EE.

Objectives: To identify which agencies are concerned with the environmental issue chosen by each group; to identify which individuals and publications will be most useful in researching the chosen issue; to formulate appropriate questions about the actions taken by an agency concerning the chosen issue; to read agency publications critically.

Procedure:

Part 1: 50 minutes

(Part 1 may take place at the end of week 7, to allow time for students to prepare and present the material assigned in step 5.)

1. The instructor should have considered students' hometowns and other beloved locales near the university in compiling a list of about 10 current issues.

2. Students should form new working groups for this lesson, if necessary. Each group should consist of a maximum of four students who have selected the same topic from the list of current environmental issues. Some students may need to work with their second-favorite issue in order to avoid working individually.

3. Once working groups are formed, the instructor provides the groups with directories of public agencies involved in environmental issues (Forest Service, Division of Fish and Wildlife, state EPA, etc.). The directory should not include phone numbers, but should describe briefly the purpose and operation of each agency. Groups have 15-20 minutes to peruse the directory and begin selecting one agency to investigate.
4. The entire class convenes and each group reports on its issue and 2-3 agencies they imagine would be involved in the issue. The instructor provides suggestions and ensures that each group leaves this lesson with a clear choice of one agency to pursue. Doing this as a large group provides students with a little information on issues and agencies other than their own.

5. Groups are assigned to locate literature published by their selected agency that describes, analyzes, and/or proposes solutions for their selected issue. (The instructor should have made sure beforehand that such publications are available either through the library or the agency itself.) Groups should read the publication and prepare a presentation for the class, as follows.

Part 2: 120-140 minutes (about 8 presentations of 15 minutes; two meetings would be best, at the end of week 8)

1. Group presentations include a summary and analysis of their agency’s views, analysis, and actions. In those cases where adequate analysis would require more information than the agency provided, the group should indicate the type of information needed. The group should suggest reasons why this information was not provided, based on their knowledge of the agency. The group should solicit ideas in class from other groups and the instructor about which other agencies (or any other sources) could provide the missing information.

Assessment: Students’ attainment of goals may be assessed in part based on the completeness and accuracy of their group presentations. For a more ideal assessment, students should be contacted during their first year of teaching (or student teaching) with a questionnaire. Students should be asked whether they used a public agency as a source, the type of information they obtained, and how they gauge their confidence and competence in gaining and using the information. A long-term assessment tool is appropriate, since the ultimate goal of this course is to affect long-term behavior (teaching methods) of the students.

Reading List

Week 1-2: Ecosystems

Historical perspectives on science and nature
Donald Worster: Nature’s Economy
Carol Merchant: The Death of Nature
John McPhee: Basin and Range
Saroj Chawla: “Linguistic and Philosophical Roots of Our Environmental Crisis”
Annette Kolodny: The Land Before Her: Fantasy and Experience of the American Frontiers, 1630-1860
History of environmental education
Hungerford and Volk 1990; Iozzi 1989; UNESCO/UNEP 1977

Week 3-4: Water

Attitudes toward nature in history, literature, and culture
Edward Abbey: Desert Solitaire
Annette Kolodny: The Lay of the Land
Carol Merchant: The Death of Nature
Charles Bowden: Killing the Hidden Waters
Roderick Nash: Wilderness and the American Mind
John McPhee: The Control of Nature - "Atchafalaya"
Donald Worster: Rivers of Empire

Structure and goals of environmental education
Hungerford, Volk & Ramsey 1989

Week 5: Food

Sense of place and an ethic
William Kittridge: Hole in the Sky - "Owning it All"
Miyazawa: "Young Land Cultivation" and other poems
Susan Griffin: Woman and Nature
Terry Tempest Williams: Refuge
Carol J. Adams: Sexual Politics of Meat

Agricultural practices and problems
Donald Worster: Dust Bowl
Rachel Carson: Silent Spring
Richard White: Roots of Dependency: Subsistence, Environment, and Social Change Among the Choctaws, Pawnees, and Navajos

Changing values and behaviors
Engleson 1985; Hungerford and Peyton 1980

Week 6-7: Evolution and Earth History

History of concept and use of evolution
Charles Darwin: Origin of Species
Stephen J. Gould: Wonderful Life

Competition vs. cooperation
Thomas Huxley: "The Struggle for Existence"

Biases and hierarchies
Stephen J. Gould: The Mismeasure of Man
Riane Eisler: The Chalice and the Blade

Psychology of learning
Wright and Williams 1977

Week 8: Current Issues

History of environmentalism
Michael L. Smith: Pacific Visions
Alston Chase: Playing God in Yellowstone  
Aldo Leopold: A Sand County Almanac  
Designing a case study  
Ramsey, Hungerford and Volk 1992  
Designing a field trip  
Miles 1991  

B. Recommendations for Implementation  

The National Environmental Education Act of 1990 provided a network of agencies and offices (within the Environmental Protection Agency) whose support might be enlisted in implementing a state-wide EE training program. The Act created the Office of Environmental Education, regional offices, a Federal Task Force on EE, an Advisory Council, and a National EE and Training Foundation. The maximum agency budget for fiscal years 1995 and 1996 is $14 million/year. The goals and objectives set forth in the act are not comprehensive - unlike the Tbilisi Declaration, the document does not serve as a guide in designing EE curricula. The agencies and monies called for in the act may, however, provide assistance in establishing a teacher training course.  

Ideally, EE will become state-mandated in all grades in Montana and throughout the United States, and all teacher certification programs will include a course (or courses) similar to the one presented here. Wilke (1985) provides a checklist of ten tasks needed to enact mandatory EE at the state level, based on the Wisconsin effort (p. 6). This is his list:  

1. Formulate a small working group.  
2. Identify one or more organizations which will lend their name and support to the effort. Possibilities include conservation, environmental, EE, and educational organizations. Organizations you or members of the working group belong to should be considered. Although the burden of responsibility will fall on you shoulders, hopefully the organizations will be able to provide some financial support for items such as postage and printing.
3. Study your state's teacher education system. Learn how certification requirements are established. Determine who the decision makers are and where their power base originates.

4. Identify likely proponents and opponents of mandatory EE preservice teacher training. If they exist, state directories of educational and environmental organizations are helpful.

5. Organize a representative study committee. Membership should primarily include people who will support the effort. However, it is very important to include representatives of all interested groups, i.e., teachers, school administrators, teacher educators, as well as conservation and environmental group representatives.

6. Develop a survey letter or questionnaire to assess the need and support levels for preservice EE training. The letter should be sent to leaders of state organizations and institutions with potential interest in the effort.

7. Draft a proposal in whatever form is appropriate for the decision-making body. The author recommends the use of the preservice EE competencies described in Appendix A as guidelines.

8. Enlist the aid of the study committee to review, evaluate and revise the proposal.

9. Develop action strategies to build support for the proposal and neutralize opposition.

10. Submit the proposal and implement the action strategies.

Wilke states that the entire process for one state cost only about $3,000 over a period of about five and one half years. He notes that while putting the requirement in place was worthwhile, its success will have to be gauged by the continuing improvement or destruction of the environment. The University of Montana may contribute more immediately to the promotion of EE in Montana's schools by requiring this course for all education, or secondary education, majors.
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