

Conference Strand: SUSTAINABILITY EDUCATION

Evaluating EE on Environmental Quality Criteria Linked to Student Actions

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ABSTRACT

In a crowded curriculum, environmental education must compete for its place in the classroom. Some funding agencies are beginning to question EE's efficacy in the ultimate goal of achieving environmental protection. Educators and researchers would benefit from a means to evaluate the link between pedagogy and environmental quality; however, virtually no research assessing educational practices on the basis of tangible measures of environmental quality can be found in the professional literature.

In an original attempt to quantify relationships between EE pedagogy and environmental quality, both qualitative and quantitative methods were used to explore case studies from a sample of schools across the United States. Local environmental records and environmental quality indices were investigated before and after EE treatments and student-initiated environmental actions. Environmental conditions relevant to student action goals were determined for each site.

A research framework and evaluation model for objectively measuring the tangible effects of environmental education on environmental quality is offered for critical discussion. Researchers and practitioners alike are encouraged to follow a protocol for maintaining vital

records that will help determine strategies leading to actions that preserve environmental quality. Ultimately, the data collected may hold promise for utility in both educational and public policy arenas.

INTRODUCTION

Environmental education, as defined by the Tbilisi Declaration (UNESCO-UNEP 1978) and operationalized into curricular goals by Hungerford et al. (1980), has sought its place in the general education curriculum for nearly 30 years. The end goals of EE include the development of individuals exhibiting responsible environmental behavior and the creation of a world citizenry equipped and motivated as participants in the solutions to the globe's environmental problems (Stapp 1969; Childress & Wert 1976; Hungerford & Peyton 1976; UNESCO-UNEP 1976; Rubba & Wiesenmayer 1985). This goal had not been adequately met by the mid-1980's (Volk, 1984) and there is little evidence to suggest significant progress toward the goal over the last 20 years (Marshall Institute 1997; Volk & McBeth 1998; Salmon 2000). The "Grail of EE" is the combination of instructional methods that augment the predictor variables for responsible behavior and lead to actual protections for the environment. Despite this emphasis, virtually no research assessing educational practices on the basis of tangible measures of environmental quality can be found in the professional literature.

The purpose of this research project was to propose a means for examining what evidence exists to attribute tangible measures of environmental quality to student-initiated actions resulting from EE curricula. An educational adaptation of the "Oslo-Potsdam Solution for International Environmental Regime Effectiveness" (Underdal 1992) was developed and evaluated as a quantitative tool for testing and fairly comparing the efficacy of varied EE programs. This adaptation, termed the environmental education performance index (EEPI),

identifies the degree to which student-initiated actions resulting from EE treatments improve environmental quality from an initial state toward a hypothesized optimal state. With only one underlying dimension of evaluation being scored, the regime effectiveness can be assessed by either relating the first two variables – actual performance (AE) with the no-program counterfactual (NP) – or the last two variables – AE with the estimated optimal impact (OI) from an ideal combination of EE treatments – or by relating all three. The distance OI – NP defines the potential for improvement and AE – NP the degree of realized improvement due to the EE treatment. Dividing the latter distance by the former gives a simple coefficient of effectiveness falling within the interval of 0 and 1 allows researchers to begin addressing the effectiveness of EE efforts on the basis of tangible measures of environmental quality. A more thorough explanation and expansion of the model is given by Short (2007).

METHODS

The adapted EEPI model was tested using data from five case studies which were developed from descriptions of student actions which were identified in a study at Southern Illinois University–Carbondale during the winter and spring of 2006. Researchers gathered, compiled, and interpreted thirteen descriptions of student actions as conveyed by nine teachers. The sample of case studies came from locations that ranged from Maryland to Hawaii.

Participants in the study were teachers who had employed the IEEIA (Investigating and Evaluating Environmental Issues and Actions) curriculum model (Hungerford et al. 2003) in their classrooms. IEEIA (Appendix A) is closely aligned with the Tbilisi objectives (UNESCO-UNEP, 1978) and operationalized curriculum goals for EE (Hungerford, 1980).

Of thirteen student actions identified by the group, five descriptions of student actions were investigated more thoroughly and expanded into detailed case studies. Additional efforts to

triangulate data were made for the case studies. Using data from the case studies to develop and refine the EEPI scale, the environmental impacts resulting from student actions were assessed. Qualitative and quantitative data were collected to ascertain the veracity of claims that EE can be linked to environmental protection. Employing methods from both research paradigms helped to examine other variables that might contribute to positive or negative impacts on environmental quality. The contextual framework that emerged from these methods was important in determining the hypothetical counterfactuals and optimal impacts. Had only qualitative data been sought in this study, calculating relative EEPI effectiveness scores would have proven impossible. Conversely, building the case studies in the absence of qualitative data might have led to false conclusions about the reasons for the observed impacts. The selected case studies from the student actions described in the study included in the first tests of the EEPI model were: 1) Initiation of a Recycling Program in a Midwestern elementary school (RYC); 2) Withdrawal of a proposal for a Municipal Waste Incineration Facility (MWI); 3) Passage of a container deposit law known as the Hawaii Bottle Bill (HBB); 4) Wood Duck Nest Box habitat improvement in a Maryland Marsh (WDN); and 5) Riparian Habitat Restoration on a Midwestern high school campus (RHR).

Each case was described in detail with the object of impact for each case determined by the original research questions, recommendations, and action plans of the students. The impact variables of interest in developing the EEPI scale are given in Table 1. Effectiveness scores were determined for each impact variable. Combined effectiveness scores for individual impact variables were then combined to give an overall composite EEPI index score. The equation for the composite EEPI score was noncompensatory rather than additive so that a low ES value on one variable was not unrealistically offset by a high value on another variable.

Table 1. Impact Variables Assessed

	Impact Variables
RYC	Public Participation Landfill Burden Estimated Benefit From Not Using Raw Materials
MWI	Dioxin/Furan Concentrations from MWI Emissions Landfill Burden Estimated Benefit of No Emissions to Fauna and Flora and Disability Adjusted Life Year (DALYs)
HBB	Public Participation Landfill Burden Estimated Benefit From Not Using Raw Materials
WDN	Nest Box Occupancy Estimated Hatchling Population Increase
RHR	Habitat Area Riparian Zone Wildlife Diversity Stream Quality Indicators - (MBI & Taxa Richness) Soil Characteristics

RESULTS AND DISCUSSION

This study revealed that tangible measures of environmental improvement or maintenance linked to EE curricula can, indeed, be documented. In each of the five selected case studies (RYC, MWI, HBB, WDN, and RHR), educational benefits were reported, recognition was given to students and teachers for their efforts, and community support (to varying degrees) was evident. Each case provided evidence that skills in investigating and analyzing issues were developed. Students were also engaged in civic participation and positive environmental behaviors. Results of actual environmental impact evaluations are given for each case study in Table 2. The analyses revealed positive environmental impacts for each variable in all of the case studies with the exception of the “landfill burden” in the MWI case. We assume that this negative impact is related to the fact that no alternative to waste incineration was pursued.

Table 2. Summary of Actual Environmental Impacts from Student Actions

RYC	3813.17 tons of paper recycled 7.4 % of total waste stream
MWI	55,380 g I-TEQ of PCDD/F prevented 230% increase in cancer risk prevented - 80% Impact on landfill burden
HBB	69% Redemption Rate of HI 5 Materials 10,290 pounds of materials recycled 72,036 cubic feet of landfill space saved Coastal litter items decreased from 23,471 to 14,430
WDN	Increase in nest box occupancy from 26% - 69% 106 hatchlings / year 42 surviving adults added to marsh/ year
RHR	Habitat area increased from 3,295 m ² to 25,003 m ² Increase of 34 to 94 Woody Plant Species Increase of 6 to 86 Forb Species Increase of 44 to 75 Bird Species Increase of 3 to 8 Aquatic Invertebrate Species Decrease of MBI from 10.76 to 7.58

In addition to evaluating student actions on the EEPI scale, the five case studies were reviewed by a nine member expert panel that ranked the environmental effectiveness of student actions. Two different evaluation instruments were used by each panel expert. There was little intra- or inter-rater agreement found when scoring from the instruments was analyzed. The environmental effectiveness values attributed to student actions by expert evaluators were compared more directly to the EEPI Scores derived for each case study by converting the expert rankings to a 0-1 EEPI-type scale. When the comparisons between expert panel rankings and EEPI scores were made, no agreement between the expert rankings and the EEPI rank was found for any of the case studies (Table 3). Values on some case studies were essentially reversed.

Table 3. Comparison of Expert Ranking with Total EEPI Scores

	Converted CSR	Rank Order	Converted CSE	Rank Order	CSE Environment Only	Rank Order	EEPI Scores	Rank Order
MWI	0.667	1	0.754	1	0.667	2	0.090	5
HBB	0.622	2	0.734	2	0.679	1	0.594	1
RYC	0.333	3	0.681	3	0.617	3	0.106	4
RHR	0.311	4	0.652	4	0.604	4	0.560	2
WDN	0.111	5	0.641	5	0.583	5	0.507	3

The EEPI model was introduced in this work as one possible means of measuring the environmental impact of EE interventions with less bias and a less ambiguous set of environmental quality indicators. Tangible evidence of environmental protection efforts provides a more definite measure of EQ than the attitudinal surveys or self-reported behaviors on which EE assumptions of impact have traditionally relied. The relative scale of EEPI also provides a fairer mechanism for comparing a variety of projects across many grade levels due to its measure of progress from an initial to a desired state.

In the expert panel analyses of the five case studies presented, positive impacts of EE treatments on students and the actual environmental impacts are recognized and undisputed. The EEPI equations objectively assessed only the effectiveness of an action toward maintaining or improving environmental quality and were indifferent to the personal growth experienced by students. Our suggestion would be the continued use of mixed methods research to quantify both educational outcomes and environmental impacts in a contextual framework provided by qualitative information collected.

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