

## **Environmental education and eco-literacy as tools of education for sustainable development**

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**Abstract:** The purpose of this paper is to propose environmental education and eco-literacy as components of education for sustainable development through the examination of an eco-literacy program offered by EARTH University in Costa Rica to rural community public schools. To illustrate these components we examine the development of a program/curriculum used in 17 elementary schools. We draw two important conclusions from our examination. First we found that external national political, social, and economic forces were important to the program's success. Secondly we illustrate the importance of developing and programs that address the specific needs and issues of the local region.

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Environmental education (EE) has evolved through no lack of controversy, politicization, and changes of direction in defining and limiting its broad reach across the educational curriculum. Where science education has fallen short, principally because of its inability to address the economic, social, cultural, and political ramifications of environmental degradation (Disinger 2001; Scoullos, Argyro, and Vasiliki 2004), EE holds promise to holistically mitigate the damage suffered by human interaction with the eco-system. The Tbilisi Declaration of 1977 (Tbilisi Declaration 1978) outlined a number of objectives and principles which have guided the development of environmental curriculum and programs. Yet these guidelines did not clearly specify what was to be accomplished or achieved.

UNESCO (1997) and environmental educators who have subsequently developed programs and curriculum since the Tbilisi Declaration have expanded the focus and are more specific on how EE should be accomplished. Yet terminology has remained ambiguous as do the specific results and goals of EE. Terms such as eco-literacy (EL) and education for sustainable development have been synonymous with EE in the literature and are often used interchangeably with differing meanings. The purpose of this paper is to propose EE and EL as components of education for sustainable development through the examination of an EL program developed by EARTH University (Escuela de Agricultura de la Región Tropical Húmeda) in Costa Rica in cooperation with neighboring rural community public schools. Specifically this paper will examine the principles and evolution of EE out of science education, the goals of EL, and the contributions both have made to education for sustainable development. Secondly this paper will examine how these principles and goals are used in EARTH's EL program to promote sustainable development in rural communities.

## **From Science to Environmental Education**

Natural science education as a predecessor to EE focused on the observation of natural phenomenon but lacked consideration of the social or economic forces that have influenced ecological relationships (Bowers 2001; Desinger 2001). Perhaps one of the most important shifts in conceptualizing EE was the acknowledgement that the management of an eco-system was not value-free and was based as much on social values and perspectives as on scientific fact. While Desinger has called for EE to be value-fair, he admitted that historically societal, economical, and political priorities have influenced decisions towards how eco-systems were to be managed and consequently the emphasis placed in the classroom on resource management, environmental conservation and preservation. Critics such as Bowers have argued that science education has been a double-edge sword that while useful for acquiring meaningful accomplishments it has also led the world towards an ecological catastrophe as the result of "globalizing the Western consumer lifestyle (p.174)." Past efforts at EE and preservation, Bowers noted, have been framed in the context of industrialization and the preservation of natural resources for the purpose of consumption not for sustaining the natural systems on which all life depends. This does not imply that science education is not important to the study of the environment, however there needs to be a mutually beneficial relationship between the two (Scoullos, Argyro, and Vasiliki 2004).

The numerous goals and principles listed in the Tbilisi Declaration illustrated that EE had to promote the notion that students be given an understanding of the natural world and to become

critical thinkers, active participants and balance and acknowledge how economic and social needs influence ecological relationships in their own communities (Tbilisi Declaration 1978). Starting with one's own community in the early years of schooling, the declaration called for the development of knowledge, problem solving skills, and values clarification in relating to environmental sensitivity. It also included a focus on environmental issues from regional and global perspectives so that students received insights into environmental issues in other regions of the world which in turn would work to foster empathy, responsibility, and cooperation in addressing conservation and improvements in the environment. EE is based on the premise that both the natural and human built environments, locally and globally, are interdependent and include interactions between biological, economic, social, and cultural forces (UNESCO 1980).

To achieve these goals, the Tbilisi Declaration (1978) and subsequent scholars of EE in the past three decades have called for an interdisciplinary approach to the problematic of addressing environmental degradation and natural resource depletion as a way of providing a balance perspective and wider vision of environmental issues as well as more emphasis on the human dimension of environmental change (ICEE 1997; Palmer 1997). For example, the inclusion of political science has been useful in the examination of the legal and political ramifications of environmental issues, history for looking at the different influences and changes in perspectives over time, and aesthetics for the consideration of values. The interdisciplinary approach to EE offers a holistic and balanced perspective of human interactions in their ecosystem and enables students to better understand the multidimensional decision-making task of meeting social needs.

In addition to this move to an interdisciplinary curriculum, scholars in pedagogically conceptualizing EE have questioned the traditional passive transmission of scientific knowledge and called for more active learning strategies that involve student-centered teaching and examination of real-life problems. Klien and Merritt (1994) linked the goals and principles of EE to constructivist learning theories and found many similarities, suggesting that students and teachers be actively engaged in constructing knowledge of the environment through their experiences rather than passively learning pre-determined knowledge. To achieve local significance lessons need to include; a) real-life problems that students must resolve, b) student-centered lessons c) group interaction during the learning process and d) authentic assessment that measures student progress. Dillon (2003) and Scoullos, Argyro, and Vasiliki (2004) noted that learner involvement was essential in the study of the environment and that EE was most valuable when it embraced pragmatic social constructivist approach. They suggested that environmental programs were more effective when students actively participated in activities perceived to be useful and culturally acceptable.

The incorporation of economic, social, and political considerations into the focus of EE has been useful in increasing awareness and focusing attention on the multifaceted nature of environmental degradation and preservation. Yet EE has fallen short in explicating exactly what students should study. The focus has been on form rather than content and on principles rather than practices and stated results. Where EE has addressed the "how", EL has expanded this framework to address the "what" or rather the content related issues of EE which is where we now turn.

## **Eco-literacy and the Path to the Sustainable Community**

Scholars of EE have called for the development of EL or specific understandings that teach students their connections to the environment and natural surroundings (Capra 1999; Orr 1994; Smith-Sebasto 1997). Orr (1992) warned that there has been a steadily growing void between the control of humanity over its environment and the lack of specific and general knowledge about it among individuals. Not only does this alienation between humans and their natural world go unacknowledged by those in traditional EE but when it is presented to students it is simplified and trivialized to the point where the development of any meaningful understandings or knowledge to effect change is limited (Smith-Sebasto 1997).

While EL requires a degree of awareness of the physical environment, it has gone beyond the mere identification of plant and animal species to understandings and knowledge of the ecological relationships and interactions and the long term impact of human action on the environment (Capra 1999; Orr 1994; Smith-Sebasto 1997). Smith-Sebasto noted that implicit in this connection is a value system that promotes environmental understanding and respect for a relationship between humans and their surroundings that does not give primacy to human existence over its environment. The cycle of valuing and appreciation begins with the development of knowledge and understandings and continues to grow as people learn about what they value and value what they know.

Roth (1991) operationalized EL developing three different categories that ranged from knowledge acquisition to taking action on environmental issues. The first level of literacy is for students to recognize basic environmental terms and provide definitions of their meanings. Building on the first category the second level is the ability to use environmental knowledge and concepts to formulate positions on particular environmental questions. The third level of environmental literacy is the ability to gather and evaluate information, select alternatives and take action on different environmental issues. EL is thus defined as not only the ability to identify, classify, and name different aspects of the environment, but includes the ability to take action and participate in the decision-making process of environmental problems and issues.

EL is a logical component of education for sustainable development as its focus on the various interactions of different elements in the environment includes human activity which is essential to the achievement of a self-sustaining community that preserves its resources for future generations. Capra (1999) and Wolfe (2001) noted that the guiding principles of EL provides a framework that is relevant to the health and creation of sustainable communities which intends that human activity and technologies do not thwart the natural capacity of the eco-system to sustain life. The focus of sustainable development as a goal of EE and subsequently EL was endorsed by the UN General Assembly in 1987 for the purpose of among other things to develop programs that were locally relevant and culturally appropriate and took into consideration local environmental, economic, and societal conditions (UNESCO 2005).

Education for sustainable development addresses environmental and cultural preservation and degradation and speaks to the need for education that focuses on the study of the cultural and ecological integrity of the places people inhabit (Orr 1994; Woodhouse and Knapp 2000). People must have knowledge of, listen to, and live in harmony with their local environment and

with each other in order to achieve local and cultural sustainability. It is important to note that UNESCO in its 2005 document on reorienting teacher education to address sustainability did not disregard the need to focus on global sustainability but stated that even though sustainable education needed to be based on local needs and conditions it recognized that a focus on the problematic of local communities often had global consequences. Similar to the goals of EL, education for sustainable development must focus locally as opposed to being imported from outside sources UNESCO (1997/2005).

### **Creating and Implementing a Community-Based and Eco-literate Program**

Costa Rica is known as a leader in its efforts to protect its biodiversity and conserve its environment and natural resources. Close to 30 % of the country is under some form of environmental protection, which is one of the highest rates in the world (Menkhous and Lober 1996; Vaughan, Gack, Solorazano, Ray 1999). The country has implemented in both formal and informal education setting EE programs that stress protection and conservation of its environment and natural resources. Yet it is important to note that the environmental protection policies that presently protect the country have stemmed largely from necessity due to the fragility of the eco-system and a failing agricultural infrastructure (Biesanz, Biesanz, Biesanz 2001). Yet historically, Costa Rica followed the development patterns of many Central American countries where government programs and policies during the 1960s and 1970s promoted the elimination of forest cover for cattle, banana, and coffee production. In Costa Rica these policies contributed to the deforestation of more than one million hectares (Hall 2000). The environmental protection policies that presently protect the country have stemmed largely from necessity due to the fragility of the eco-system and a failing agricultural infrastructure.

Several factors led to the transformation of Costa Rica's focus on environmental stewardship. The transformation started with a reform of the education system in 1983 (Hall 1985) and a subsequent focus on EE later in the decade (Vaughan et al 1999). Changes in environmental awareness also occurred at the community level through a series of programs and public service announcements that were produced by the government and NGOs. These campaigns provided for the protection and rational management of the environment by making the population aware of environmental problems and the need for active community participation in finding solutions. It was within this context that the Costa Rican legislative assembly in 1986 approved the creation of EARTH University in the Atlantic zone.

As a nonprofit private university, EARTH is dedicated to education in the agricultural sciences and natural resources. Its mission is to promote sustainable agricultural development in the tropics by seeking a balance between agricultural production and environmental preservation. As part of its outreach program, the university created an EL program that supports sustainable agricultural and community practices in the surrounding communities through a multi-layer approach. The approach is designed to inform and affect teacher training in both the content and pedagogy of EE, which in turn acts as an impetus for development of EE programs in the community schools and community.

The EARTH community-based EL program utilized the guiding principles of EE and EL for sustainable development as outlined by UNESCO (1997/2005) in its recommendations for EE programs. Specifically the program focused content and pedagogy on local problems, embraced a constructivist philosophy, was interdisciplinary and invited external evaluation. It also followed the instructional goals of EE (Roth 1991) which included the development of ecological knowledge and awareness, investigative skills, and training to take positive action for the maintenance of the environment and quality of life at the local level. The interdisciplinary approach to the examination of local environmental issues assured that teachers and their students holistically identified and developed awareness of their local eco-system in the context of their social and economic needs.

The EL outreach program focuses mainly on the overarching theme of local watershed deterioration and management which has important implications for the region. In particular deforestation and agricultural pollution have resulted in an inappropriate use of water and misuse of natural resources in the zone (Montoya and Russo 2006a). Presently, the extensive cultivation of pineapple generates significant pressure on the aquifers and underground waters placing large amounts of agrochemicals, such as insecticides, fungicides, and fertilizers into the watersheds (Sherwood 2007). Illegal logging has also contributed to increases in damage to the environment (Hall 2000).

A series of workshops over nine months provided the means for developing the program structure and delivering the content. Educators from 17 different local elementary rural public schools attended the workshops that focused on environmental problems endemic to the zone, interdisciplinary curriculum development, and constructivist pedagogy. EARTH University students and the project directors visited the rural communities before and during the workshops to work with the schools and communities in identifying social and environmental issues of the region related to the overarching theme of watershed management. A primary goal of the workshops was the development of a published EL textbook/curriculum. The textbook was compiled with the collaboration of the classroom teachers, children in the schools, EARTH students, and program directors (Montoya and Russo 2006b). It served to keep the program focused locally and provided curricular scope and sequence.

Content in the textbook included general scientific terms and knowledge that applied to the local communities and could be used in classrooms with students. Six thematic units focused on the general themes of ecology, natural resources, water and watersheds, and soils. The curriculum concluded with very specific themes of local food production and waste management. The content in each unit ranged from general to specific and from theoretical to practical applications. For example, the unit on soils started with lessons on the structure of soils and importance of soil while subsequent lessons focused on practical applications of how students may protect the soil in their school garden. Content and topics that were covered in the workshops were taken into the classrooms, taught, and brought back to future workshops for refinement and publication in the textbook. The completed textbook included numerous photographs and examples of students and teachers working and learning in their own communities and students' artwork illustrated many of the different lessons.

The textbook served the dual purpose of allowing students and teachers to construct their own knowledge of local ecological structures and to be actively engaged in the learning process. Using the textbook as a primary means of guiding the program gave to the students and teachers what Freire (1974) has described as ownership of local knowledge and history. It acknowledged their power to describe and analyze their cultural and natural environment. Rather than rely on a curriculum that was generated by the Ministry of Education in the nation's capital of San José, teachers and students had a vested interest in the knowledge that was being created about their communities.

Directly related to and implicit in this focus on local knowledge construction in the curriculum was the inclusion of constructivist pedagogy that Klien and Merritt, (1994) have noted is an important component of EL in accomplishing the goals of EE for sustainable development. The textbook/curriculum utilized the constructivist approach by giving students the opportunity to work with local and meaningful real-life situations that personally affected them and their communities. In the second unit on natural resources there are four lessons on protecting the natural resources in the community. The first lesson opens with students developing a drawing of a local forest or nature reserve. They then take a field trip through their local community and in their notebooks keep notes and catalogue sources of environmental destruction and contamination. Back in the classroom students discuss their findings in small groups, develop a list of the problems they discover, the possible causes of the problem, the consequences of the problem, and propose different solutions. The small group findings are presented to the rest of the class and the class in turn develops an outline of the environmental problems they detected and possible solutions. Students are assessed through their development of a class collage that exhibits their knowledge of environmental problems to their community. Individual assessment is carried out through the development of a composition that explores the problems of their community.

Aligned with the guiding principles of EE for sustainable development (Disinger 2001; ICEE 1997; Palmer 1997), the EL curriculum utilizes an interdisciplinary curriculum as a way to move beyond the scientific domain of EE and holistically examine the human dimension that included the teaching of values and principles, human interaction with its environment, esthetics, and a wider vision of community problem-solving. The historical nature of environmental problems and the uniqueness of the geographic location requires the teachers and students to examine not only the forces and lifestyles that have contributed to environmental problems but the human and physical geography of the zone that have shaped it (Montoya and Russo 2006a). Within each thematic unit, lessons move from a focus on content to experiential learning allowing students to learn not only the theory of the subject but draw personal and group conclusions through the activities. By focusing on real-life situations in the local environment, students and teachers meet the guiding principles of EE for sustainable development (UNESCO 2005). They also meet the instruction goals of EE that identify and develop awareness of their local environment and encourage them to take action in the form of proposing solutions to the rest of the community (Roth 1991).

The curriculum is interdisciplinary and includes an emphasis on the geography and biology of the zone as well as language arts. While the focus on biology and geography were obvious, one of the most important tools for learning is writing because writing intersects

critical thinking, knowledge acquisition, and attitudinal change (Montoya and Russo 2006c). In the process of writing, students must face and shape their beliefs. Writing also serves the dual purpose of communicating findings to the community and other students and provided one of several methods of authentic assessment. Likewise written communication is important for listing the environmental issues that confronted the community, the impact this has had on the community and lastly, noting alternatives and solutions.

Music and art are included in the curriculum as it helps students to relate to their natural surrounding and express their attitudes, values, and knowledge both and visually and aurally. Several of the lessons use songs as introductory activities to stimulate student thinking about the topic that they will be exploring. For example at the start of a lesson on natural resources, the teacher teaches a popular song by Maná (1994), *Dónde jugarán los niños* (Where will the children play), that tells the story of a grandfather talking to a child about how the environment has been destroyed in his lifetime and there are no longer places for children to play. The song is a starting point for students to visualize their world through music and start thinking about and listing the benefits of the natural resources in their community. Art is also used as a principal activity that gives students a visual image of the ecological structures of their community. It is also used as a culminating activity to demonstrate and assess what students learn from the lessons. In a culminating lesson on watersheds, students construct a watershed out of a variety of materials in the classroom and labeled the different areas based on their field observations.

A final but important consideration of the EARTH eco-literacy program focused on the evaluation and assessment of student learning which is essential for the long-term success of any EE program (Blumstien and Saylan 2007; UNESCO 2005). In a content analysis of 56 reports on tropical EE programs Norris and Jacobson (1998) noted that the use of long-term or follow-up evaluation was correlated with higher rates of program success. Although not built into the original program design, two separate and independent follow-up evaluations of the EARTH EL program found that despite some serious deficiencies, the program was successful in influencing and reaching the rural schools surrounding EARTH in developing higher levels of understanding and concern for the local and national environment (Ortuño 2007; Whiting 2007).

Both Ortuño (2007) and Whiting (2007) used a used a mix of questionnaires, surveys, participant observations, and interviews to evaluate and unpack the extent to which teachers, EARTH students and faculty, and community participated in the program and embraced the precepts of EL and took responsibility for their local eco-systems. Ortuño, in particular, examined the relations between the principal program facilitators and the other participants and the degree of motivation and sustained acceptance participants collectively demonstrated in working together to take the program ideas and materials out into the rural schools and communities. Even though both evaluations were completed over the same time period, they remained independent of each other and were surprisingly similar in their results and conclusions. The independent evaluations spoke to the importance of continued critique and evaluation of community-based EL programs in informing the direction and content of such programs.

The evaluators noted that two of the most salient deficiencies in the program were the lack of contact and sustained connections and communication between the EARTH facilitators



and students and community school teachers, students, and the community at large. These deficiencies appeared to lead to a lack of program knowledge and objectives and the lack of commitment to the program's goals in neighboring communities and schools. The evaluations also noted that the high turnover of teachers in the schools and infrequency of visits by EARTH students jeopardized program continuity. These results were not surprising given the fact that the project is part of EARTH's community work experience that requires students to commit only a small fraction of their four year college career working in community service projects.

Despite these concerns, the evaluators found that the program was pioneering new expectations and commitments to EE and EL in the surrounding communities. They called for more development of practical materials and less focus on the theoretical framework, more workshops for the teachers, and more visits by EARTH students and facilitators. Ortuño (2007) suggested that in order to increase the viability of the program, EARTH needed to increase the number of workshops for teachers and sustained monitoring and supervision of EARTH students in the communities. Program facilitators also needed to increase community involvement and the involvement of other local institutions in the region.

EARTH University through its EL program has focused its efforts on working with educators and students as a way of strengthening its partnerships with surrounding communities. This partnership is aligned with UNESCO's (1997/2005) guidelines and recommendations for orienting EE to address sustainability and includes a focus on education that is local, culturally relevant, and based on local needs. In addition the program addresses local priorities and takes into consideration the local environment, society and economy. It is engaged in formal and non-formal education throughout the community as well as is a sustained effort that constantly reinvents itself to meet the needs of the community. In a similar EL program in Costa Rica, Vaughan et al (1999) found that there was significant intergenerational learning and that information was disseminated from the classroom to the community. Duvall and Zint (2007) found that schools act as agents for environmental learning and that factors that contribute to intergenerational learning, including actively involving parents in student activities and focusing on local environmental issues.

## **Conclusion**

Orr (1992), Smith-Sabasto (1997), and Theobald and Nachtigal (1995) have argued that the more students know about their community, its environment, its history, its economy, interactions of culture and its ecology the more they become vested in the health and welfare of their community. The community and its environmental and social health are necessary building blocks in an interdependent globalized world. Healthy sustainable communities, that recognize their interdependence, have the capacity to define their economic roles and connect with other communities. Thus redesigning education for the purpose of creating ecological sustainable communities is one of the most critical needs of today's society at both global and local levels.

It has been within this context that the EARTH EL program has used the principles of both EE and EL to promote sustainable development in rural Costa Rican communities located in the Atlantic zone of the country. Results from external evaluators indicated that the program has

been successful but this is apparently due to historical reasons as well as program design and implementation. Historically speaking, declining environmental quality and agricultural production in the region as well as the whole country has forced Costa Rica to consider alternative perspectives towards its environment. Confronted with an a rapidly declining agricultural and environmental infrastructure (Biesanz, et al 1999; Hall 2000) Costa Rica has had to seriously confront its past social, economic and political attitudes towards its eco-systems at both local and national levels. A second factor that has facilitated the implementation of environmental programs in Costa Rica is a legacy of conservation that has placed close to a third of the country under some form of environmental protection. Martin (2004) noted that present environmental policies that protect the country have promoted a sense of national ownership and pride in its environment and it is considered a civic duty and a salient part of the country's democratic disposition. Lastly, national educational policies have also contributed to a climate of environmental protection. Since 1983 there has been a purposeful inclusion and integration of environmental education and protection in the social studies and science curricula (Hall 1985; Ministerio de Educación Pública 2001).

Given this supportive social and political climate, the EARTH EL program has focused on local environmental problems through empowering educators to address local conditions, needs, and priorities, in the context of the economic, social, and cultural community structures. In working with local elementary schools, the program facilitators focused on developing life-long learning patterns and affecting change both formally and informally. These changes were based on the assumption that schools are influential and essential change agents in a rural community for intergenerational learning as information passes from the classroom to the community (Vaughan et al 1999).

The program also followed the basic tenets of EE and EL by moving beyond identification and knowledge of the local environment to include the human interaction and the effects of social and economic change on the local eco-system. Essential to these principles were instructional goals that focused on knowledge and awareness which would produce a knowledgeable citizenry. An educated community would thus be motivated and capable of making informed decisions and finding solutions to sustainable resource management and environmental degradation. Essential to this process was the application of a social constructivist leaning philosophy that presented students with real-life situations where they had to access and evaluate numerous sources of information and factors that influenced decisions. It also included an interdisciplinary curriculum that addressed knowledge development as well as perceptions, values, and awareness that were applicable to the sustainable community.

The EARTH program has offered a unique opportunity to examine and evaluate how the tools of EE and eco-literacy are components of education for sustainable development. While the program is valuable in that it uses the tools and philosophy of EE and EL, it is important to heed UNESCO's (2005) warning against finding programs where one size fits all. The program cannot be exported to other locations as its content and structure are unique and developed to address the specific needs and issues of the local region.

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