

**Environmental Education's Role in Sustainable Development:
Three Case Studies from India, South Africa & the United States**

By

**Scott Reilly
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Drs. Holly Petrillo & Michael Demchik

Executive Summary:

The Rio Summit in 1992 produced *Agenda 21*. This international agreement developed a strategy for addressing sustainable development throughout the world by calling for increase community participation in addressing environmental, social, and economic concerns that affect their community. Although there was much debate about approaches for sustainable development, there was near universal support for the need to provide improved educational opportunities for students that allows them to develop valuable life skills such as communication and critical thinking.

The importance of providing students with opportunities to develop these skills is seen as a valuable component in educational reform. By developing a curriculum that stresses interaction and inquiry with the human and natural resources of a community, it is possible to develop the skills students will need to address future concerns. Environmental education that focuses on these community resources can contribute to the essential variables of increased student ownership and empowerment in the learning process, which are important to student skills achievement.

Environmental education programs that contribute to educational reform and sustainability have many different variables depending on location, cultural contexts, or community concerns. However, some program variables are generalizable and can be applied in a variety of settings and programs. An identified need, a strong emphasis on natural and human resources located within the community, program structure, and long-term commitment to developing student's skills are four variables necessary for educational reform and program success.

Literature Review:

Introduction

Education has been identified as an essential component for sustainable development worldwide. The role of education can also positively influence the management of the world's increasingly stressed natural resources through the incorporation of successful techniques of environmental education. Environmental education provides students with the knowledge, skills, and experiences essential to become successful community leaders, as well as making intelligent decisions pertaining to the management of their natural resources.

Education & Sustainable Development

Education has made many valuable contributions to societies and development globally, and is recognized for the important role it has in improving livelihoods worldwide. Quality education should prepare societies to actively participate in global politics and economics, as well as provide people with the skills necessary to make informed decisions and take responsible actions. Throughout the world, societies have recognized education as a key component of sustainable development.

Sustainable development has been promoted since its inception over 20 years ago as an effective means to abate the degradation of human and environmental systems. The United Nations defines sustainable development as a development strategy that focuses on meeting the demands and needs of present-day citizens without compromising the future's ability to meet theirs'. Sustainable development concentrates on aspects of the economy, society and environment in order to achieve its goals (Hart, 1997). However, it can be an often misused or overused statement in the endorsement of policies worldwide, drawing attention away from the

original environmental intentions of the strategy and focusing more attention on the social and/or economic aspects. The economic, social, and environmental aspects of sustainable development and policy formation should be equally represented and balanced (Hart, 1997).

In 1992, the United Nations and representatives from 178 countries met in Rio de Janeiro to discuss the state of the environment and social/economic development and to craft a political course of action for these topics. The Rio Summit was the result of an identified need to develop more appropriate, sustainable strategies in addressing development. *Agenda 21* was an important outcome of the Rio summit, and focused the world's attention on the objectives necessary to reach sustainable development. *Agenda 21* stated that in order to accomplish these objectives "... [there is] the need for individuals, groups and organizations to directly participate in environmental impact assessments and to know about and participate in decisions which potentially affect the communities in which they live and work" (Agenda 21, 2008).

The identification of *Agenda 21's* sustainable development objectives were initially met with much debate, however, near unanimous agreement was eventually reached in the need to improve education standards worldwide (Sitarz, 1993). Education involves more than simply increasing literacy rates of citizens; it should also facilitate the development of skills necessary for continued learning once formal schooling is complete such as critical thinking and communication. *Agenda 21's* fundamental educational objectives recognized the need for an increased societal awareness towards the environment and development (Sitarz, 1993). Formal education that focuses on sustainability has been shown to aid in development aspects later in life such as increased agricultural production, women's rights, standards of living, and lowered birthrates (Hopkins & McKeown, 2002).

To achieve the educational objectives set forth by the United Nations in 1992, governments, administrators and teachers worldwide have to identify and understand the need for different strategies to be used. This is especially true for developing nations. An essential component for education in the developing world is that it needs to address the concerns of the poor, focusing on issues that affect populations directly such as improved health and nutrition (Hernandez & Mayur, 2000). The increased attention of issues-based educational concepts is also multidisciplinary, infusing aspects of the biological, physical, social, economic and spiritual environments to strengthen the effectiveness of education (Sitarz, 1993).

Agenda 21 is geared towards promotion of sustainable development at the local level. Global education reform that focuses on issues affecting citizens, specifically youth, at a local level can influence the relationship, interest, and understanding between humans and environmental systems. Through the development and application of knowledge, skills, values and behaviors necessary to inspire critical thought processes, youth will be able to increase their capacity to explore and understand issues more thoroughly and identify appropriate courses of action (Bory-Adams, 2006; Fien & Tilbury, 2002). Education reform has the potential to include the world's youth on many facets of sustainable development, and to give them the tools necessary to overcome many of the challenges faced in the future.

Youth may play an important role in meeting the objectives of *Agenda 21*. *Agenda 21* looked at youth's vital role in the realization of sustainable development, focusing on their right to receive a secondary education that is innovative and aimed at building practical problem solving skills. *Agenda 21* also addressed the need for the increased participation in the environmental decision-making process for youth of both genders (Sitarz, 1993). The use of environmental education programs that focus on fostering ownership, empowerment, and active

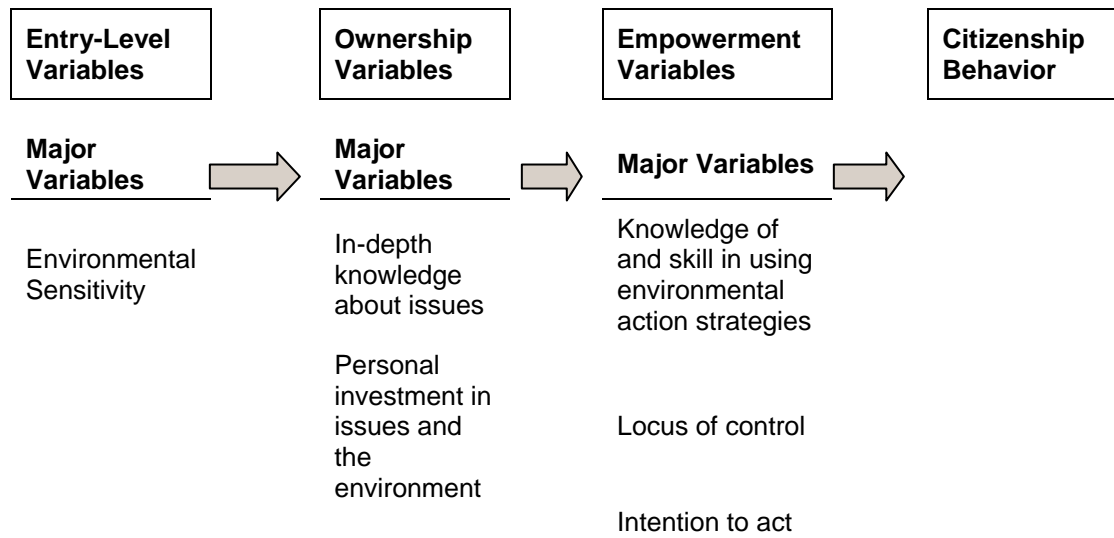
participation may have the potential to positively influence youth in meeting the goals of sustainability stated by *Agenda 21*, and be a key contribution to educational reform.

Environmental Education & Student Empowerment

Environmental education is a multidisciplinary field, drawing from the social, physical and biological sciences. According to the Environmental Education and Training Partnership, or EETAP, environmental education encourages citizens to make knowledgeable and informed decisions about their environmental behavior based on the awareness, knowledge, skills, and attitudes instilled in them (2000). Environmental education relies on both formal and non-formal teaching techniques to accomplish the ultimate goal of encouraging citizens to make informed and positive actions toward the environment. Environmental education makes use of many disciplines, techniques, and resources to accomplish its goals. Since students learn from an array of non-traditional, multiple intelligences such as naturalistic, interpersonal, or intrapersonal, environmental education can be a strategy that bridges many learning styles (EETAP, 2000).

Environmental education's methodology and goals can be incorporated into *Agenda 21*'s objectives for sustainable development in education. Education that focuses on sustainable development and critical thought has an increased likelihood of success, and environmental education's multidisciplinary nature makes it an ideal strategy for development (Fien & Tilbury, 2002). However, environmental education in the developing world often has different criteria for success because of different socio-economic factors affecting populations. There is a strong need to link the ideals of environmental quality, human equality and human rights together to increase the effectiveness of environmental education and development (Fien & Tilbury, 2002).

Figure 1.-Behavior Flow Chart: Major and Minor Variables Involved in Environmental Citizenship Behavior



Adapted from Hungerford & Volk (1989) with exclusion of minor variables.

Considering the ultimate goal of environmental education is positive citizenship behavior towards the environment, Hungerford and Volk identified many variables that should first be addressed to influence this final behavior (Hungerford & Volk, 1989). The variables were separated into three groups: entry-level, ownership and empowerment. Each variable and its influencing factors build upon the previous, contributing to overall citizenship behavior (Figure 1). In their research, Hungerford and Volk also pointed out that the final variable of empowerment creation is an often neglected “cornerstone” in practices of environmental education. These key variables, and the factors that contribute to their realization, are necessary for environmental education to be effective; thus their incorporation into programs is essential (Hungerford & Volk, 1989).

Environmental education that stresses the preliminary variables of ownership and empowerment are crucial in the promotion of education for sustainable development. The

increased participation of youth in environmental investigation and decision making can lead to an increased sense of empowerment and achievement, thus contributing to sustainable development and the objectives of educational reform (Barraza et.al, 2003). Therefore, if educational programs want to accomplish the goals of both sustainable development and environmental education, they should stress student participation and action in order to create stronger feelings of ownership and empowerment in the learning process (Hungerford & Volk, 1989).

Student action skills can be developed through active participation in environment based problem solving programs incorporated directly into a school curriculum. At the Kualapu'u Elementary School on Molokai Island, Hawaii, 5th and 6th graders actively use the skills learned in class to investigate, analyze and decide the best possible solutions to solve environmental issues within their community. Finally, at the end of the year, the students present their findings within their community, during different conferences or before government panels. It was found that students who participated in the program had an increased awareness towards environmental issues, as well as an increased ability to look critically at the issues investigated and what possible actions that appropriately address it (Cheak, Volk & Hungerford, 2002). The Kualapu'u School clearly demonstrates development of the major variables important for influencing both ownership and empowerment that are necessary for the responsible citizen behaviors identified as the essential aims of environmental education.

Environmental education has the potential to create feelings of ownership and empowerment by offering students direct, hands-on experiences for its participants. Active youth participation that focuses on issues and their resolution gives first-hand experience and understanding about the environment, and develops the skills to actively study and protect it

(Cooper, 2007). By actively studying their environment, youth are obtaining in-depth experience and knowledge, by using skills to conserve their environment; they are developing a greater sense of empowerment. Youth participation encourages an increased level of understanding regarding human-environment interactions and has the potential to increase a sense of stewardship for the environment (Cooper, 2007; Barnett et al., 2006).

Engaging youth in education that is hands-on and issues-based can also contribute to other applications of reform set forth by the United Nations. Cullen (2001) writes:

“Curricula that provide the necessary knowledge related to the issues, tools to adequately analyze and evaluate issues, and skills to help resolve issues are essential. These ingredients are proven links to success in promoting environmental behavior.” (pg. 38).

Governments and schools can work to create an environment where skills and ideas can be developed to meet the challenges to sustainable development. Through the use of issues-based environmental education programs, schools can meet the reform objectives by increasing student interest in the sciences, social studies, writing and beyond (Barnett et al., 2006; Cheak et al., 2002; Hansen et al., 2003; Lieberman et al., 1998). Researchers also observed increased interest in science by pre-adolescent aged girls, an age where interest in the sciences often begins to diminish (Barnett et al., 2006; Lieberman et al., 1998). Perhaps most important is the overall increase in interest about the learning process, as well as increased enthusiasm, pride and ownership in student accomplishment, which can lead to lifelong learning and responsible environmental behaviors (Lieberman et al., 1998; Hansen et al., 2003; Cheak et al., 2002).

Youth participation in environmental education programs that focus on issues and stress the importance of the students' involvement generate feelings of ownership and empowerment. These variables are crucial foundations that can lead to positive environmental behaviors in youth, as well as contribute to meeting the objectives of sustainable development and educational

reform (Lieberman et al, 1998; Hungerford & Volk, 1989). Environmental education can also be a valuable technique in promoting environmental protection and resource conservation in the developing world (Ford, 2004).

Environmental Education Curricula Characteristics for Resource Conservation

Education plays a vital role in successful sustainable development. The link between environmental resource conservation and sustainable development has led researchers to identify environmental education and youth as playing important parts to ensure success. Throughout the world, natural resources are increasingly under greater human pressures, and increased environmental education is viewed as an important strategy to protect these resources (Ford, 2004).

Environmental education curricula can assist in a guiding responsibility for successful program development by concentrating on explicit concepts. Education and curricula materials that address local concerns can foster responsible action and advocacy by students based on their previous experiences and knowledge. Environmental education curricula that focus on students' cognitive knowledge and builds on previous experiences contribute to the skills development necessary to address environmental concerns, such as issue identification and investigation (Culen, 2001). A measure of success can be assessed through students' understanding and contribution in the community decision making process (Stevenson, 2007) and therefore the skills necessary to encourage student participation should be incorporated and developed in school curricula.

The environmental behaviors of youth can be positively influenced in the course of practical learning and participatory experiences in nature. The increased participation can lead to

an increase in environmental knowledge, as well as the development of skills necessary to protect and conserve the environment (Haigh, 2006; Hart, 1997). However, development of the skills necessary to conserve the environment is often not sufficient to promote lasting sustainable behaviors in youth. Studies have shown that students also need to be given the opportunity to reflect and share their newly acquired knowledge and experiences with one another, as well as within the community, and identify appropriate courses of action (Hart, 1997; Ernst & Monroe, 2004). Therefore an invaluable component of curricula development should address reflection and dissemination of student experiences.

The development of critical thinking skills and habits from environmental education can also contribute to educational reform. Not only are critical thinking skills and habits important for education, they are essential in dealing with complex environmental issues and natural resources management (Ernst & Monroe, 2004). Programs and curricula that focus on students' participation and local issues investigation are a valuable avenue to the development of these important skills. Ernst and Monroe identified four characteristics for program success in creating critical thinkers:

- Integrated multiple disciplines using a common environmental theme.
- Involved open-ended projects that required hypothesizing, investigating issues, and conducting research.
- Empowered students' to be responsible for their own learning.
- Provided opportunities for students to reflect on what they have done or learned, helping them make the connection to the real and local purpose of their efforts (Ernst & Monroe, 2004).

Sustainable development in the 21st century calls for new approaches to solving environmental issues and managing our collective natural resources. *Agenda 21* called for a renewed focus on education and the environment in order to ensure sustainable development. Students need to actively participate in promoting sustainable development and natural resource

protection. Not only because of increased experience and concern for the environment, but through personal inclination to act on the environment's behalf, and the ability to succeed because of prior development of their critical thinking skills and knowledge (Palmer, 1997).

Case Studies:

Introduction:

Uttaakhand Environmental Education Center, the Kualapu'u Public School, and the South African National Biodiversity Institute vary greatly in location, culture, and community concerns. Each case study examines how environmental education was used in contributing to educational reform and sustainability, and what factors contribute to successful implementation of the programs.

Uttaakhand Environmental Education Center (UEEC) – Uttaranchal, India

The Area

Uttaranchal is a state in northern India, bordered by Nepal in the east and China to the north. The state area is approximately 51,000 km² and consists primarily of mountain ridges and valleys, with some peaks having an altitude of over 7,800 meters. Uttaakhand Environmental Education Center (UEEC) works with some of the nine million inhabitants who live in the state, primarily in the zones between 1,000 and 3,500 meters. The area in which UEEC works is forested primarily by oak (*Quercus incana*) and is part of the upper watersheds of many large river systems of the Asian sub-continent, principally the Ganga and Yamuna Rivers. The abundant rainfall of the region (between 1000 and 2000 millimeters annually) contributes to

these river systems. Agriculture, remittances, and tourism are the most important economic contributors of the state (Pande, L., 2002).

UEEC History

In 1986 the government of India decreed the importance of teaching environmental education in schools throughout the country. This decree was in reaction to an increased awareness of unsustainable practices throughout the country, particularly in agriculture. Realizing that rural villagers were unable to produce enough food to meet their yearly need due to increased population growth coupled with a decrease in the land's carrying capacity, education and government officials introduced environmental education themes into the national curriculum (Pande, A., 2001). The government hoped to use environmental education programs in schools and communities as a conduit to increase awareness about the environment, and give citizens the knowledge and skills to respond to environmental issues (Pande, L., 2002).

The UEEC was created to meet these goals as a non-governmental organization (NGO). The mission of UEEC “works to develop cohesive communities empowered to create personally and ecologically rich, sustainable lives for themselves and future generations, using ‘the village as an ecosystem’ as an organizing concept” (Hollweg, 2007). UEEC strategies for sustainable development focus on the development and strengthening of women's groups, the construction of village pre-schools, staffed by trained teachers, and the implementation of a state wide environmental education curriculum (Hollweg, 2007).

UEEC & Environmental Education

In order to advance the mission of UEEC the concept of “the village as an ecosystem” became the dominate strategy for promoting their goals. This concept and corresponding curriculum, uses the village as the unifying model, focusing on the local village ecosystem and

the human/environment interactions taking place. Rather than observing their surroundings in a form of “nature-study”, students use their village ecosystem as a practical laboratory in which to apply ideas learned in the classroom to their lives within the village (Pande, L., 2002).

UEEC and the government identified three possibilities for implementing the concepts of environmental education into schools: infuse environmental education themes into (1) pre-existing curriculum, (2) an extra-curricular class or club, or (3) a separate class. After the three alternatives were tested, the third option was chosen as the most beneficial and holistic for students (Pande, A., 2001). Continued development and improvements of the class has led it to be a mandatory subject for students during their grades 6 through 10 (Pande, L., 2002). As a separate long-term class, ideas and skills from several other subject areas can be incorporated and gives students ample time to develop these skills in a practical setting.

However, to effectively teach the necessary concepts and skills development, a new curriculum was needed. Existing materials were often too broad and difficult for students to relate with or understand such as worldwide deforestation (Pande, L., 2002). Because of these factors, a curriculum that addressed the “...concepts of sustainability and the carrying capacity of the village ecosystem” was needed (Pande, L., 2002). Collaboration between teachers, ecologists, and community members enabled the development of a curriculum entitled *Our Land, Our Life* for the class. The concepts of *Our Land, Our Life* are geared toward promoting an increased student understanding of ideas through practical skills development, idea exploration, and how these concepts relate to and interact with the village. A final consideration of the curriculum focuses on successful teacher development in using the curriculum by way of practical and effective trainings (Hollweg, 2007).

Extensive teacher training, community input, and the successful implementation of the curriculum concepts to students contribute to positive outcomes. The successful use of *Our Land, Our Life* can be attributed to its focus on action orientation and practical experiences through continued teacher training, strong community partnerships, and effective curriculum application (Pande, A., 2001; Pande, L., 2002). The concepts used in UEEC's curriculum build off of the experiences and ideas of previous grades, beginning with practical discussions and development. Once foundational information is presented, course teachers develop student-led investigations, data and experience dissemination, and finally possible courses of action to take. The student investigations gather data from numerous sources such as community members, local government officials, as well as personal quantitative experiences. A final step gives students opportunities to share their investigations and potential solutions in community forums (Pande, L., 2002; Jackson, 2003). For example, 6th graders would study the natural vegetation of their village, while 7th through 10th graders would use those preliminary experiences in forest-area rehabilitation practice. Hollweg (2007) observed many action-oriented student outcomes such as the development of native gardens and rainwater catchments, as well increased student confidence and interactions within the educational and village community.

Our Land, Our Life is taught to over 35,000 students within the Uttaranchal state by 600 UEEC trained teachers in 318 schools. The government and UEEC have plans to increase the number of participating students and schools throughout the region (Pande, L., 2002). In order to ensure continued course effectiveness and improvement, it is continuously evaluated by trained teachers, UEEC staff, and government officials. The course's effectiveness is also evaluated by positive community actions towards the environment (Pande, A., 2001). However,

UEEC is faced with challenges in maintaining the course's overall effectiveness, development, and teacher retention.

Conclusion

The unique approach taken by UEEC to address environmental and community concerns can attribute its success to a long-term commitment toward community improvement, its adaptability, and developed community trust (Hollweg, 2007). The expansion of these attributes allowed UEEC to promote their goals, and contribute positively to improving community resources in the villages in which they work. By creating opportunities for students to experience and learn first-hand about their village resources, UEEC is able to influence sustainable development and resource management in the region of Uttaranchal through improved educational techniques that use the village environment as a unifying theme.

Kualapu'u School & PRISM– Molokai, Hawai'i

The Area

The island of Molokai is 670 km² and is the fifth largest in the Hawaiian chain, located east of O'ahu and north of Lana'i. The small island is home to a wide variety of habitats, influenced by elevation, location, and rainfall. Elevations range from sea level to 1,515 meters, and rainfall ranges from over 7,000 millimeters in the wetter eastern half of the island to much less in the dry western part. Vegetation in the eastern part of the island is diverse rainforest on higher quality soils, while the western portion is grasses and consists of poorer quality soils. Census figures estimate 7,500 permanent residents, where over 40% of the residents are native Hawaiian descendents. Above state average rates of unemployment traditionally impact the island population. Fishing, agriculture of tropical fruits and subsistence crops, and tourism are

the primary economic means of the island. The island is also home to numerous traditional aquaculture ponds (Cheak et al, 2002).

Kualapu'u School & PRISM History

Poor academic student performance and numerous social concerns on the island of Molokai in the mid 1990's led two 5th/6th grade teachers to look for alternative teaching strategies. This realization, and the hope to provide students with skills necessary to address social and environmental concerns, guided the Kualapu'u Public School teachers to seek assistance from Drs. Harold Hungerford and Trudi Volk, professors of Environmental Education Curriculum Development and Instruction with the University of Southern Illinois, Carbondale. The Kualapu'u program entitled PRISM (Providing Resolutions with Integrity for a Sustainable Molokai) was developed explicitly to engage students academically and provide the skills and experiences necessary to resolve important community issues, to become future community leaders (Cheak et al, 2002; Smith, 2007).

PRISM & Environmental Education

The PRISM program developed on Molokai worked with two grades from a public school and about 100 students (Volk & Cheak, 2003). The program is designed for in-depth student inquiry of environmental issues facing the community, and making responsible decisions based on student collected data relating to the issue. During the PRISM program students are brought together with community leaders, politicians, and natural resource managers to discuss issues affecting the community such as solid waste management, energy use or biodiversity. Community members and resource managers serve as valuable sources for student data collection, and can stress to students the importance of quality data in decision making (Cheak et al, 2002).

Hungerford and Volk recommended the use of “Investigating and Evaluating Environmental Issues and Actions” (IEEIA), an environmental education curriculum framework, in order to address the goals of PRISM. IEEIA is also used as an “umbrella” framework to include all academic subjects in the 5th/6th grades, allowing students an opportunity to use overlapping themes in their investigations. The PRISM program follows a process in which students select a local issue for investigation, plan and carry out the investigation, offer suggestions based on collected data, and assist in issue resolution (Volk & Cheak, 2003). Students develop their investigation throughout the school year while working in small, mixed groups of 5th and 6th graders, and conclude their investigations by presenting their findings and recommendations at a two day seminar presented for the community at the end of the year.

The joint 5th/6th grade classrooms contribute to increased student involvement and understanding of the IEEIA curriculum. Students have clearly defined roles and expectations to fulfill, depending upon their grade. Fifth graders assume the role of “apprentice”, developing skills for issue analysis, how to access information, instrument design, and data collection and interpretation. Sixth graders serve as “mentors” towards the younger students and peers, guiding them through the issue investigation and skills development process. The 6th graders also build a deeper understanding of the process by sharing their knowledge with the younger students. Throughout the academic year, student groups continue to address issues from previous years and analyze how previous issues connect with current ones, working towards their successful resolution (Cheak et al, 2002).

Student achievements from participation in the PRISM program have been impressive. The students have been locally active in developing restoration of traditional fish ponds, writing letters to the editor, and implementing island recycling programs. PRISM students have also

influenced statewide legislation by testifying in favor of a “Bottle Bill” at the state capital. For their efforts, the United States Environmental Protection Agency office in San Francisco awarded the school the 2003 Environmental Achievement Award “for exceptional work and commitment to the environment” (Smith, 2007).

PRISM students also exhibited notable academic increases in critical thinking skills, environmental literacy, as well as knowledge of ecology, environment, and environmental and social issues. Oral and written communication skills also showed improvement from PRISM students exemplified by the reading of more complex texts to public verbal presentations about their investigations (Cheak, et al. 2002). In addition teachers, parents, and community members found that participating students exhibited increased personal confidence, poise, and self-esteem in school and their daily lives (Volk & Cheak, 2003).

However, not only were the students positive recipients from participating in the PRISM program, so too was the entire community at large. Parents and other community members were observed to be more engaged in community affairs. Adults found themselves listening and learning from the students, and making positive community contributions based on these interactions, such as beginning to recycle in their private homes (Volk & Cheak, 2003).

The positive outcomes of the PRISM project were in part due to the program’s respectful and easily assimilated methods into the cultural traditions of Molokai. Native Hawaiian cultural traditions place high value in group work and opportunities for all community members’ opinions to be valued by the whole. The student-centered and inquiry-based strategy preserved and strengthened the Native community traditions due to student investigations that relied on many community members as primary or secondary sources of information. In addition, the

IEEIA process encouraged small groups in which all students participated equally in the discussion and process (Volk & Cheak, 2003).

Conclusion

In the 2004-2005 academic year, the original teachers from the Kualapu'u School left the school because of new federal academic restrictions imposed by the "No Child Left Behind Act". However, because of continued community support and interest in PRISM, a charter school for 5th-8th grades was started. The Aka'ula School employs the same IEEIA curriculum approach and in 2006 had 61 students enrolled (Smith, 2007).

Student, teacher, community, and environmental benefits were clearly observed and measured at the Kualapu'u School. Education can be used as a catalyst towards observable and positive contributions to society by giving students the knowledge, understanding, and skills needed to make confident choices related to their communal resources. Smith concluded that:

Place-based education as exemplified in ...Molokai is resulting in the cultivation – to varying degrees – of the critical analysis and activism needed to move human communities in the direction of equity, justice, and sustainability, issues many are beginning to see central to our era (2007).

South African National Biodiversity Institute (SANBI) – South Africa

The Area

A final case study focuses on the Cape Floral Region of South Africa, comprised of the provinces Western and Eastern Cape along the extreme southern tip of Africa. The region has been identified as a UNESCO World Heritage Site due to its high plant diversity and number of endemic species. In a region of about 80,000 km², over 8,500 species of plants have been recorded. The region is classified as having a Mediterranean Climate, with mild year round

temperatures. Western Cape rain falls in the winter months of June-September, while the Eastern Cape experiences its rains during the summer months (Lovejoy & Woodyard, 1991).

The region is also home to over 10 million inhabitants, punctuated by Cape Town, a large metropolis located in the middle of the Cape Floral Region. Large scale and subsistence agriculture employs large portions of the rural populations. A major concern facing all populations of South Africa is the HIV/AIDS epidemic, where over 5.5 million people throughout the country are infected, impacting 1 in 5 adults (HIV & AIDS, 2008). Apart from the HIV/AIDS epidemic, the urbanization of the region, introduction of invasive species, high levels of poverty, and climate change are seen as major concerns facing the area's biodiversity (UNEP-WCMC, 2008).

SANBI & EE History

The South African National Biodiversity Institute (SANBI), formerly the National Botanical Institute, consists of eight national botanical gardens that focus on the study and conservation of the regional biodiversity. The gardens are supported through a mixture of government funding, visitor revenue, and grants that allow them to accomplish their goal of native plant conservation. The largest and perhaps most famous is the Kirstenbosch Botanical Garden in Cape Town. Kirstenbosch is nearly 100 years old and has been selected as a UNESCO World Heritage Site with more than 4,700 native species (Lovejoy & Woodyard, 1991).

Traditionally, the gardens served as centers for ecological studies and visitor education for wealthier, white tourists under Apartheid. During the late 1990's SANBI began to look at and develop environmental education programs that incorporated social issues and consumer

choices for a broader range of the population. Fullard states that “the important role for education to attain sustainable development is recognized globally and it is strongly argued for botanic gardens to engage in ‘stronger’ forms of Education for Sustainability” (2006). With this realization, and the knowledge of the threats affecting the Cape Floral Region, SANBI embarked on numerous environmental education programs that focused on using native gardens as the unifying theme and engaging more marginalized segments of the population (Fullard, 2006).

SANBI & EE

The biological wealth of the region serves as the natural focus for SANBI to promote its mission through environmental education. SANBI is increasing the region’s awareness of its biological wealth, and inspiring students and communities in the active participation of conservation and sustainable development by using native plants and gardens (Fullard, 2006). The increased engagement of SANBI in South Africa’s environmental education has transformed its mission as their gardens and resources are being used to “inspire and enable people from all walks of life to take responsibility for their environment” (Fullard, 2006).

During the Apartheid era, SANBI’s strategy in environmental education was passive and informal, concentrating mainly on visitors to the gardens. In the past decade their informal environmental education program has sought to connect with larger portions of the population. The gardens are now open to the general public, regardless of race, and seek to increase visitor appreciation of the native flora through guided tours of the gardens. Although a larger cross section of the population can now visit the gardens, many marginalized and poor citizens were not being exposed to these unique resources, therefore leading to more active, formal educational programs to be developed (Fullard, 2006; Ashwell & Bobo-Mrubata, 1998).

Outreach to marginalized populations, especially students, was initiated nearly a decade ago with the Garden-Based Program. Practiced at all eight gardens, this program provides disadvantaged schools, both primary and secondary, with transportation to and from the garden and free entrance into the garden. However, the school must meet certain criteria. These include primarily students that have never visited a garden, have difficulty paying admission, or have participated in positive environmental actions within their community. The three hour presentation is led by SANBI environmental educators and focuses on exposing the students to the garden, encouraging discussion about the gardens, and reflection about what students observe and how it relates to their communities (Fullard, 2006). In 2003-2004 academic year, over 25,000 students participated in the Garden-Based Program (EE Services, 2004).

In order to further increase SANBI's community presence, the Outreach Greening Program began in 1997. Rather than bringing students to the botanical gardens, SANBI develops partnerships with schools throughout the region to create native gardens in their communities. The indigenous gardens are seen as teaching and learning resources for the school and surrounding community. They can also be used as a strategy of incorporating environmental education into the curriculum, as well as involving the entire community in development, maintenance and enjoyment of the garden (Fullard, 2006; Ashwell & Bobo-Mrubata, 1998). As of 2006 the Outreach Greening Program has created over 30 native gardens in disadvantaged communities and schools located within the region (Qwathekana, 2006).

The Outreach Greening Program is seen as a long term commitment between SANBI with communities and schools. The development of the gardens takes three or more years from initiation to completion, beginning with small community nurseries, student input and design, to completed gardens. The resource intensive nature of the program has made secure funding

sources essential to success, relying primarily on government support and private trust funds (Qwathekana, 2006).

Student participation is another key component to the native garden development. With support from SANBI, the garden design is a primary role for students. Students are encouraged to interview local community members and chiefs about traditional and medicinal plants for inclusion in the garden. They also incorporate nutritional concerns into garden development by investigating community diet, and identifying fruit and vegetables to be planted to improve overall community health (Qwathekana, 2006). Through all these inputs, it was possible “to transform a weedy, dusty patch of school grounds into an oasis of endemic species that support the health and economy of the village” (Qwathekana, 2006).

Qwathekana observed this transformation of the Ethridge School in the East Cape Province. Before SANBI’s intervention, the school was isolated from the community with limited interaction and no access to water, as well as many social concerns within the community such as high unemployment and poor nutrition (Qwathekana, 2006). However, Qwathekana observed increased community pride and involvement, better learner and community nutrition due to the garden produce, and more engaged students in all aspects of the garden in which he attributed to the garden development program (2006). The gardens have been seen as refuges for endemic and endangered plants, serving as living laboratories for students to study plants and learn traditional knowledge for community elders (Ashwell & Bobo-Mrubata, 1998; Greening, 2007) The end result is an overall improved learning environment for students (Qwathekana, 2006).

The large financial and time investment undertaken by SANBI for the Outreach Greening Program also forces increased recognition in making the gardens sustainable. The gardens are

managed and maintained by both the schools and community, while SANBI continues to provide technical support in the form of Garden Maintenance Workshops. However, it was realized that the best way to promote garden sustainability was in teacher development programs that have students and teachers actively using the gardens as a learning tool. These programs work with school teachers on how they can successfully incorporate garden lessons into all aspects of the school curriculum (Qwathekana, 2006; Fullard, 2006). The program is not only about garden development, but successful “people development” in conserving the unique biodiversity of the Cape Floral Region (Ashwell & Bobo-Mrubata, 1998).

Conclusion

The uniquely rich Cape Floral Region, and threats to its conservation, assisted in motivating SANBI to take a more pro-active role in the conservation of the ecosystem. Through educating the region about native plants, SANBI is also attempting to address longstanding economic and social concerns. SANBI has recognized the need for community engagement in order to secure the biological, as well as the sociological, vitality of the region. The pro-active environmental education programs seek to accomplish these goals by increasing students’ and community awareness of their shared resources, and how those resources can be used in an educational context to promote the ideas of sustainability. SANBI realized the importance of school and community connections, improving these bonds in order to increase the likelihood of success.

Case Study Critique:

Sustainable development addresses many concepts in promoting the improvement of human welfare globally. The preceding case studies focused on the educational aspect of sustainable development, specifically how the incorporation of the environment can meet the needs of educational reform and sustainable development. The similar characteristics used successfully in each case study provide essential knowledge for future studies and reforms.

Chapter 36 of *Agenda 21* focuses exclusively on education, and the need to build students capacity to meet the challenges of the 21st century (Sitarz, 1993). The inclusion of this chapter revealed the unanimous support for the need to improve education worldwide. This need for educational reform is manifested in each of the case studies, and uses the environment as the preferred medium to accomplish this. Environmental and community resource degradation were issues in each case study, and the need to address them in a sustainable manner led to an environmental education approach that focuses on the natural and cultural resources present within each community or region. However, the need, and how it is addressed, differs in scale. In the case of India, the federal government mandated that environmental education be taught in school, engaging students throughout the country to address unsustainable agricultural practices. The South African National Biodiversity Institute focused on the rich biodiversity of the Cape Floral Region and students within the bioregion, and the need to conserve unique flora of the area. Finally, on Molokai the need was localized to the social and environmental issues affecting the island, leading to the engagement of teachers and students in their resolution. The incorporation of environmental education strategies also made many contributions towards sustainable development such as an increased youth and adult understanding of environmental issues and participation in decisions pertaining to natural and social resources (Qwathekara, 2006; Volk & Cheak, 2003; Hollweg, 2007).

A second characteristic that is demonstrated within each case study is the focus on familiar and local natural and human resources available within the community. Rather than looking at issues or concepts that may be foreign to students, familiar resources are used to connect new concepts to what students have close at hand. All three case studies make use of many available natural and human resources, linking students to their well recognized environment. This approach can lead to greater student participation, interest, understanding, and willingness to resolve an issue that they know intimately, and affects them directly (Hungerford & Volk, 1989). An additional benefit is the influence these students have on the rest of the community, including adults, and the example they set forth to be better environmental stewards (Cheak et al, 2002; Volk & Cheak, 2003). The familiar environments in which much of the students' education takes place and corresponding participation in community actions have been seen as important components necessary for successful education reform and sustainable development.

Similar structural characteristics of the three case studies play an important role in contributing to education reform and sustainable development. Students are provided with opportunities to develop skills and participate in experiences that allow for the development of critical thinking and other skills seen as necessary for the 21st century (Agenda 21, 2008). Each case study is based on inquiry, whether rooted in how to improve the sustainability of a village, addressing solid waste issues in an island environment, or learning traditional knowledge of regional plants. Inquiry led students to formulate, develop, and carry out real-world investigations. These investigations have students draw on knowledge and experience from many subject areas providing an understanding of their interrelationship. A final structural similarity is the sharing and dissemination of the previous investigative process with peers,

community members, and government officials. Ernst and Young identified inquiry, multidisciplinary subject areas, and sharing of experiences as being vital components for program success (2004). The skills involved in problem solving and communicating findings and solutions are not only important for students, they will be an absolute necessity for citizens confronting environmental and societal issues in the future.

A traditional view of education identifies it as a means to renew life through the transmission of ideas, knowledge and values of society to youth (Dewey, 1936). In order to “transmit” ideas successfully, a substantial commitment of time must be made towards the goal of education and sustainability. The case studies explored in this paper realize the necessity of extended investments of time in order to give students optimal opportunity for skills development. Students involved in the environmental education programs build off of concepts learned in previous years, allowing them to develop a solid understanding of issues, and to see ideas and experiences come to fruition. This commitment to student development implies a genuine concern, and can also ensure greater long term success for students, programs, and the environment as a whole.

However, a major contributing factor to educational reform worldwide can be the changing political climate of a country, having both a positive and negative influence on education. In the case of the India, the government was able to influence the importance of environmental education nationwide through a federal decree, leading to the development of regional solutions to the address environmental education. Conversely, past and current political actions in South Africa and the United States contribute to difficulties faced in environmental education promotion. Although Apartheid is no longer practiced, the segregated and social issues created by this measure are still being addressed today. Meanwhile, changes in the

educational priorities of the United States led to increased teacher frustration on Molokai, and compelled the original PRISM teachers to leave the public school system and begin a charter school that is not directly accountable to the government.

Many factors are incorporated into environmental education programs that successfully address both educational reform and sustainable development. The combination of the need for improved education worldwide and rapid environmental degradation has led to increased opportunities for environmental education programs to enhance both. Programs that focus on familiar environments and communities promote student success and confidence on a local scale, and provide the foundation for solving larger societal and environmental issues in the future. Basing programs on sound structural processes supply students with an opportune learning environment to develop the skills necessary for life. Finally, a commitment of time for the long term development of the students, as well on resource conservation, provides students with the opportunity to understand, investigate, and resolve issues they face. However, changing or traditional political environments can directly or indirectly influence the educational process, and need to be accounted for. In order for sustainable development to meet its goals, citizens worldwide must be provided with the skills necessary to face future challenges. Using the environment as a unifying educational theme can be a successful strategy in providing citizens with those skills.

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