

Challenges of Biodiversity Education: A Review of Education Strategies for Biodiversity Education

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Abstract

Biodiversity conservation has increasingly gained recognition in national and international agendas. The Convention on Biological Diversity (CBD) has positioned biodiversity as a key asset to be protected to ensure our well-being and that of future generations. Nearly 20 years after its inception, results are not as expected, as shown in the latest revision of the 2010 CBD target. Various factors may affect the implementation of the CBD, including lack of public education and awareness on biodiversity-related issues. This paper explores how biodiversity education has been carried out and documents successes and failures in the field. Based on a comprehensive literature review, we identified four main challenges: the need to define an approach for biodiversity education, biodiversity as an ill-defined concept, appropriate communication, and the disconnection between people and nature. These represent obstacles to the achievement of educational targets, and therefore, to accomplishing conservation goals as set forth by the CBD.

Keywords: Biodiversity education, environmental education, education for sustainable development, biodiversity awareness, biodiversity communication.

Introduction

With the speech that launched the international year of biodiversity at the American Museum of Natural History, the Executive Secretary General of the Convention on Biological Diversity (CBD), Ahmed Djoghlaif, revealed that the 2010 target set in 2002 by the 110 Heads of State during the Johannesburg World Summit on Sustainable Development had not been met (AMNH podcast, 2010). In fact, none of the national reports submitted by the affiliated parties to the CBD were able to show that the target was achieved. Rather, they confirmed that biodiversity loss continues at an unprecedented rate (Djoghlaif, 2010). To name a few examples, the fourth National Report to the CBD from countries such as Brazil, Singapore, Canada or Kenya, showed improvement in certain areas of their National Biodiversity

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Strategy and Action Plans but none were able to fully achieve the 11 goals of the 2010 CBD target (CBD-National Reports, 2011). Different political, institutional, technical, societal and educational factors have been recognized as obstacles for the implementation of the Convention, such as lack of political will, lack of mainstreaming and integration of biodiversity issues into different sectors, institutional weakness, lack of financial and human resources as well as lack of public education and awareness, among others (CBD –COP6, 2010).

Furthermore, several surveys have been carried out in different countries since the implementation of the CBD to understand the levels of awareness on biodiversity. Many of these do not show encouraging results, suggesting that education, outreach and public awareness strategies are failing to elicit the interest and motivation needed for people to act in favor of biodiversity conservation, and that the message of the importance of sustaining biodiversity is not getting across. To name one example, results from the recent global survey conducted by Survey Sampling International and sponsored by Airbus on behalf of the Secretariat of the CBD, reveal the need for increasing the efforts to inform and empower future generations (Airbus Report, 2010). According to the survey, which was conducted in 2010 across 10 countries and sampled 10,000 children between the ages of five and eighteen, 40 percent ranked watching TV or playing computer games as a priority, compared to a mere 4 percent who considered that the environment came first. Additionally, only 9 percent ranked looking after animals as most important (CBD press release, 2010). This suggests that biodiversity education and other communication strategies have not been able to successfully permeate different sectors of society so that the general public, governmental authorities and other actors are able to take action and consider biological resources as a relevant issue that is part of their daily lives and values.

In spite of these low levels of awareness, biodiversity conservation has increasingly gained relevance in national and international agendas. International agreements such as the CBD, have been able to establish a framework to involve nations in protecting biodiversity, and organizations like the International Union for the Conservation of Nature (IUCN) or the World Wildlife Fund among others, continually work worldwide in programs and projects that seek to sustain this natural asset. According to the CBD, effective action to address biodiversity loss not only depends on strategies such as promoting the use of market incentives, establishing land-use planning policies, mainstreaming biodiversity in decision-making at different levels of governance, and involving all relevant stakeholders. It also relies on communication, education and awareness strategies to ensure that “everyone understands the value of biodiversity and what steps they can take to protect it, including through changes in personal consumption and behavior” (SCBD, 2010).

Education has been acknowledged as an important tool to achieve sustainability as well as biodiversity protection through the transformation of human attitudes towards nature (Ehrlich & Pringle, 2008). In this sense, there are great opportunities for education to contribute by helping citizens become well-informed, critical and competent, and in consequence, able to act in favor of biodiversity (Dreyfus, Wals & van Weelie, 1999). This review paper explores how biodiversity education has been practiced and examines some of the challenges and opportunities for this emerging field.

Methods

For the literature review, we assessed more than 70 articles available on the Internet containing the terms: biodiversity education, biodiversity awareness, biodiversity outreach, biodiversity education in cities, biodiversity and education for sustainable development, biodiversity and environmental education, and biodiversity communication. Two main

search engines were used, Google scholar and Columbia University's online database CLIO (<http://www.columbia.edu/cu/lweb/>). We then used content analysis to track term usage frequency, and to organize conceptual themes and topics.

Results and Discussion

We found less than 20 articles that contained the exact term "biodiversity education" and most of these addressed it as either Environmental Education (EE) or Education for Sustainable Development (ESD). No article provided a precise definition of biodiversity education but rather prescribed guidelines and suggestions. The majority of articles revolved around EE and ESD approaches for learning about environmental topics, including biodiversity. After a thorough review of the articles found, six main topics were identified: (1) Emergence of biodiversity on the international agenda, (2) Biodiversity as an educational theme, (3) Issues with the biodiversity concept, (4) Suggested guidelines for biodiversity education, (5) Communicating about biodiversity, and (6) the disconnection between people and nature.

Biodiversity Agendas

With increased realization of the need to halt biodiversity loss due to human population growth and deleterious environmental change, the biodiversity crisis became a popular discourse in conservation around the 1970s (Haila & Kouki, 1994). At the same time, worldwide recognition of the issue of sustainability emerged as a key theme of the 1972 UN Conference "The Human Environment", held in Stockholm, with the main outcome being the recognition of the necessity to pursue a sustainable development based on an economic growth and industrialization that would not cause environmental damage (Adams, 2006). Subsequent events and conferences helped to mainstream and position this idea such as the World Conservation Strategy (1980) and the Brundlant Report (1985). The latter, a report titled "Our common future", was convened by the UN to address the growing concerns about the deterioration of ecosystems and natural resources, and emphasized the need for national governments and institutions to start addressing this new target for global change. Most importantly, the commission suggested that governments should look into the prospect of agreeing to a species convention that would reflect principles of "universal resources" (United Nations, 1987).

In this respect, 1992 marked an important year for the environment and biodiversity. During the United Nations Conference on Environment and Development in Rio de Janeiro, Brazil, a set of agreements were signed at the Earth Summit, including two very important binding agreements, the Convention on Climate Change and the Convention on Biological Diversity, the latter being signed at the time by 150 governments and which has now more than 190 affiliated parties (CBD, 2010). Both treaties sought worldwide commitment to achieving an economic development agenda that would not be driven by ecological destruction but rather by the ideal of sustaining all biological processes that support life. This in turn, it was argued, would contribute to poverty alleviation and other social and economic targets. Thus, the CBD agreed upon three main goals: the conservation of biodiversity, its sustainable use, and the fair and equitable sharing of the benefits arising from the commercial and other utilizations of genetic resources. These goals are grounded in the recognition of biodiversity's intrinsic value and the fact that it underpins ecosystem functions while providing the goods and services that sustain our life and well-being (Hubbard, 1997).

More specifically, the convention requires the affiliated parties to implement these three objectives and to have achieved by 2010 a "significant reduction of the current rate of

biodiversity loss at the global, regional and national level, as a contribution to poverty alleviation and to the benefit of all life on earth" (CBD, 2009). Recently, the tenth Conference of the Parties (COP 10) was held in Nagoya, where participants to the Conference agreed on three main inter-linked goals: a new protocol on access to and benefit sharing of the benefits accrued from the use of genetic resources, a ten year Strategic Plan (2011-2020) to meet the objectives of the CBD and that sets a new species extinction target, and a strategy to mobilize the necessary resources to increase global support for conserving biodiversity. The convention seeks to fulfill these objectives by having Parties commit to developing national programs for the conservation and sustainable use of biodiversity that can include "ex situ" and "in situ" conservation strategies, while also carrying out environmental impact assessments of proposed projects that can influence biodiversity conservation (CBD, 2010).

Education and Biodiversity

In terms of mechanisms to fulfill the convention's objectives, the CBD acknowledges the importance of public education and awareness as a crucial tool. Specifically, Article 13 urges the contracting parties to promote and encourage the understanding of conserving biodiversity, to procure its propagation through media and to include these topics as part of educational programs (CBD –Article 13, 2006). It also requires them to strive for cooperation among States and international organizations in developing education and awareness programs to support the goal of conserving and using biodiversity in a sustainable manner. In order to facilitate the implementation and management of the CBD, as part of the country's national biodiversity strategy (van Boven & Hesselink, 2002), the Convention has established the Communication, Education and Public Awareness (CEPA) program. Its main goal is to aid in communicating and raising awareness about biodiversity while integrating it into the education systems of all participants to the CBD.

The recognition of education as a tool to increase knowledge and awareness about biodiversity is not only acknowledged by the CBD. Environmental Education (EE) and Education for Sustainable Development (ESD) were both established as strategies to address environmental concerns through education, although each emerged at different times and from different contexts. Stapp (1969) first defined EE as a new approach, "designed to produce a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution." Parallel to the shift in thinking about how development should be accomplished and to the surge of biodiversity conservation around the 1970s, EE emerged as an important field of education dealing with the natural environment and conservation issues (Palmer, 2003). In 1968, a UNESCO Conference in Paris on Biosphere Reserves called for the development of curriculum materials on the environment, the promotion of technical training and the need to raise global awareness of environmental problems as well as to set national coordinating bodies for EE globally.

The International Workshop on EE held in Belgrade by UNESCO and UNEP in 1975, produced one of the first intergovernmental statements on EE, "The Belgrade Charter- A global framework for EE." The charter established several objectives, which included creating new patterns of behavior of individuals and society towards the environment but also supported a new form of development whereby poverty alleviation, equitable access to resources, pollution mitigation and controlled resource consumption would be sought as part of a new global ethic. Such an ethic would embrace the attitudes and behaviors that individuals and societies need in order to respond to the complex relationships between humanity and nature, which should result from a reform of educational processes (The Belgrade Charter, 1975). This vision was later supported by the Tbilisi Declaration on EE that

resulted from the first global intergovernmental conference organized by UNESCO and UNEP in 1977. The Tbilisi declaration built on the Belgrade Charter's main EE objective, which states that EE should contribute to the formation of a world population that is aware of and concerned about the environment and its problems, and that has the knowledge, skills, attitudes and commitment to work individually and collectively towards their solution.

After Tbilisi, EE evolved accordingly to the state of the art in the environmental and educational field, consequently restating its objectives, structure and breadth of action to include topics such as land-use management, endangered species and climate change education (Hungerford, 2010). New perceptions about environmental issues brought new concerns, ideas and paradigms for education. In 1983, the "World Commission on Environment and Development," also known as the "Brundlandt Commission," suggested that environmental issues were intertwined with economic and social issues. It also argued that education played a critical role in the search for sustainable living (Ulbrich et al., 2010). This resulted in Education for Sustainable Development (ESD) which evolved as a result of the new paradigm on development that later became reinforced at the Earth Summit in 1992 and subsequent conferences (i.e. World Summit on Sustainable Development in Johannesburg, 2002). As McKeown (2002) suggests, this new concept of education was not shaped by the education community itself but resulted from international political and economic forums in which ESD's conceptual framework became structured, specifically through Agenda 21 which is a comprehensive plan of action "to meet the challenges of environment and development" (UNEP, 2010) adopted at the Earth Summit in 1992. Agenda 21 reoriented education towards sustainable development and included alongside environmental education, development education. Chapter 36 of the agenda specifies that both environmental and development education should acknowledge the dynamics of the biophysical and socio-economic environment as well as human development, and encourages the need to integrate these in all disciplines, emphasizing the use of formal and non-formal methods of communication (UNDESA, 2009). Overall, ESD emphasizes the need to have a broader understanding of the interconnections between society, economy and the environment (McKeown & Hopkins, 2003).

Biodiversity education also seems to share common goals with what has been conceived as conservation education. In fact, Jacobson et al. (2006) argue that conservation education shares many goals with EE in the sense that both intend the learner to gain awareness and sensitivity to the environment, knowledge and basic understanding of the environment, attitudes that derive from a set of values and feelings of concern towards the environment that lead to its protection, and skills that allow the individual to identify and solve environmental issues. At the same time, Jacobson et al. (2006) recognize how conservation education also shares goals with ESD since both share the common goal of protecting environmental systems to sustain life while accounting for social justice and ensuring proper economic development.

Biodiversity as an educational theme for EE and ESD

The underlying causes of biodiversity loss come from social, economic, political, cultural, and even historical features of every society (WEHAB working group, 2002). These causes are driven by factors that range from poor governance to a lack of knowledge and awareness about the importance of biodiversity in underpinning the functioning and hence, the provision of the ecosystem services that we need for our well-being. Thus, it is evident that biodiversity loss is a multi-dimensional problem, not only having repercussions for the environment but also compromising economic growth and development, threatening livelihoods, while increasing our own vulnerability as a species.

In this sense, both EE and ESD acknowledge the relations and interdependencies between environmental and socio-economic issues and both recognize biodiversity as an important crosscutting educational theme, and as a concept that can portray such complexities. EE's approach is focused on developing an environmentally literate citizenry through pedagogical models that provide problem solving and environmental management skills, which account for social realities and that intend to change the behavior of individuals towards environmental issues (Sauvee, 1999). EE's ideals are framed within a context that recognizes the "human influences, including economic, cultural, political and social issues" (NAAEE, 2010) that affect the environment in different ways. In this sense, it considers "biodiversity" as a theme through which the learner can explore causes, connections and consequences of environmental issues such as the biodiversity crisis and how it affects us (NAAEE, 2010). Different organizations have used EE approaches to biodiversity conservation and there are also several projects that have been carried out globally through EE activities with a biodiversity focus. Projects such as "Project Wild" with an emphasis on wildlife conservation and which is supported by The Council for Environmental Education, or "Project Learning Tree" which focuses on forest conservation, are both good examples of programs in the US that intend on contributing to biodiversity conservation. The World Wildlife Fund has also used EE programs to foster wildlife conservation, as so has the IUCN.

ESD programs that use biodiversity education as a model for teaching about sustainability have also been carried out globally. For example, "The Beagle Project" (Biodiversity Education and Awareness to Grow a Living Environment) in the European Union, undertakes improving the quality of learning outside the classroom by providing the opportunity for teachers and students to take part in a project focused on monitoring the phenology of trees across Europe. The main goal is to engage students in sustainable development and biodiversity conservation. Others, such as "ESD-Educating for a sustainable future" or "SEED" in the UK, try to promote school-focused programs that deal with different environmental and sustainability issues such as biodiversity. For ESD, biodiversity depicts the complex interrelations and connections behind achieving sustainability, and so is seen as a topic that can portray key issues such as social justice, cultural diversity, politics or ethics (Lude, 2010). A recent review of biodiversity as a theme for ESD was carried out in various countries of the European Union through the workshop "Biodiversity in ESD: Reflection on school-research cooperation" held in Kassel, Germany on September 2009, with the attendance of teachers, education experts, program developers and researchers. The workshop acknowledged the importance of biodiversity as a theme for ESD through which teachers could develop the critical thinking skills needed to effectively change attitudes, beliefs and behaviors by integrating environmental, social, economic and cultural aspects (Taratsa, 2010).

Overall it seems that both EE and ESD recognize the importance of educating about and for biodiversity and they also acknowledge the multidimensional aspects of the concept. In essence, both seek the ultimate challenge of transforming society into a knowledgeable and aware citizenry that takes responsibility and that is conscious of the social, cultural, environmental and economical impacts of biodiversity loss and its effects in the future. Both attempt to create an environmentally responsible population that contributes to sustainable development (Kassas, 2002). But the question still remains whether biodiversity education is or should be founded on EE or ESD guidelines and the potential effects of such distinction for biodiversity education. These questions converge in an important debate about the relationship between EE and ESD and the role that each perspective plays in education. How do EE and ESD relate? Are they trying to achieve the same ultimate goal through different approaches?

Through a debate organized in 2000 by the IUCN in regard to ESD, participants agreed on the following four perspectives to depict EE's relationship to ESD: (a) ESD is the next generation of EE by including issues of ethics, equity and different approaches to learning, (b) ESD is a part of EE, (c) ESD and EE overlap and (d) EE is a part of ESD (Hesselink et al., 2000). A related issue to take into account in this debate is the fact that EE and ESD have both been constantly redefining their scope as well as their objectives, purpose and prospect over time, which may translate into inconsistencies when educating about a certain topic such as biodiversity (Marcinkowski, 2010). This redefining and structuring can be problematic. As Hungerford (2010) recalls, EE has tried to address a very wide range of themes and approaches in the course of its evolution which has made it very difficult for the field to have set definite "goals and standards that would support a well-thought-out and research substantive structure for EE." EE has also been accused of not being socially relevant, lacking interdisciplinary content (Hungerford, 2010), of being too advocacy-oriented and in need of professionalizing the field (Marcinkowski, 2010). On the other hand, ESD has been criticized for being based on a concept that has ethical, cultural and even conceptual issues and that might represent an anthropocentric ethic that cannot provide the basis for an integral human development, thus reinforcing the gap between man and nature (Sauvee, 1999). Additionally, different opinions from the educational sector view sustainable development as a homogenizing tendency that reduces "the conceptual space for self-determination, autonomy, and alternative ways of thinking" (Jickling & Wals, 2008) minimizing the ways in which people can be engaged into actually thinking about their relationship with nature.

Issues with the Biodiversity Concept

Even if biodiversity education is pursued through an EE or an ESD approach, both perspectives are confronted with biodiversity as a concept that may not be easily defined and taught. The CBD and other international agreements have put biodiversity in the spotlight, contributing to an expansion of the range of meanings and values that can be given to it (Wals, 2001). Dreyfus et al. (1999) point out political and symbolic definitions of biodiversity as well as scientific. Accordingly, biodiversity can be seen as a natural resource, as the base for sustainability, as a product of evolution or as what drives the ecosystem processes that are also essential for human well-being, among other definitions. This poses the question of how educators should deal with the continuum of meanings for a concept that is not easily referenced empirically. In fact, different education experts (Dreyfus et al., 1999; Kassas 2000; van Weelie et al., 2002) have referred to biodiversity as an ill-defined concept. Ill-defined concepts have various interpretations, are difficult to define, and are value-laden or normative as well as multi-dimensional.

In this sense, and due to the complex interrelationships that they imply, concepts such as biodiversity or sustainability do not transfer easily into people's minds (Wals, 2001). Menzel and Bogeholz (2009) suggest that the concept of biodiversity entails various challenges. First, the concept involves diversity at three different levels, ecosystem, gene and species, and not all of these levels are usually acknowledged by people, even by educators. Additionally, the reasons for and consequences of biodiversity loss surround complex ethical, economic and social issues while learners might only relate the problem to ecological issues. Finally, since biodiversity loss is a global problem that is typically exemplified by "biodiversity hotspots," this reduces the problem to certain localized areas, therefore omitting the fact that there are interactions at different levels (i.e. regional, global) that also have effects on biodiversity. These complexities may pose difficulties for both teachers and learners. On the other hand, Dreyfus et al. (1999) argue that such intricacies may actually serve as a starting point for learning about biodiversity. By "recognizing the

different political, symbolic and scientific uses” of it and exploring its different meanings, values and uses, educators can foster “critical thinking skills and respect for different ways of looking at the world” (Dreyfus et al., 1999). This implies that in order for people to understand what biodiversity is, they may need to understand what biodiversity means ecologically, culturally, socially or economically and how its loss affects all of these dimensions. In addition, people should not be excluded from the environmental/scientific literacy that can provide the basic knowledge about society and the environment, that enables people to think critically about biodiversity and what its loss entails (Kassas, 2002).

Our research indicates that biological diversity seems to be an abstract and confusing issue as a theme for education. We concur with Dikmenli and the observations of others that the lack of clarity in the limitations, ethics and assumptions of biodiversity loss is certainly part of the challenges that education faces (Dikmenli, 2010). This uncertainty leads to questioning what the objectives and guidelines for biodiversity education should be.

Suggested guidelines for Biodiversity Education

Most of the articles reviewed that dealt with biodiversity education addressed it either through an EE or an ESD approach. Lindemann-Matthies et al. (2009) suggest that biodiversity is a concept “suitable for ESD as it reflects the interaction of ecological, economic and social issues particularly well and requires the learner to take into account different perspectives to arrive at balanced opinions.” Under an ESD approach, biodiversity education would encourage the construction of knowledge applied to solving problems in different contexts. The learner would be given the opportunity to build critical skills and to increase his/her awareness of the scientific and non-scientific aspects of biodiversity. An appropriate setting for discussion should also be accounted for (Gayford, 2000). Others have suggested the need to specify key themes that focus on different aspects of biodiversity and that serve as a framework for educators (Lude, 2010). Lude (2010) for example, centers on four main themes: diversity of ecosystems (wilderness, cultivated landscapes, urban landscapes), ecosystem services, climate change and the future, and consumption and behavior. Lindemann-Matthies et al. (2009) suggest a biodiversity education that enables people to:

- Understand the different meanings, interpretations and uses of biodiversity as well as their cultural, spiritual and economic heritage.
- Be aware of and understand the significance of biodiversity in their own environment as well as how they interact with it, and to be able to recognize how our actions have effects on it.
- Acknowledge the relationship between diversity and human well-being.

An approach to biodiversity education from an EE perspective may suggest similar guidelines. For example, Van Weelie and Wals (2002) highlight the need for enabling individuals to learn about the different interpretations and uses of biodiversity, to critique its conceptual use in environmental and political discourses and to value it in order to develop the necessary skills that allow the person to understand, construct, critique and transform their world. Only by exploring biodiversity’s different meanings, values and uses will people be able to develop the critical thinking skills needed to deal with the issue of biodiversity loss. According to Dreyfus et al. (1999), it is also necessary for people to be environmentally literate and to know about how science contributes to issues such as biodiversity loss. Additionally, it should also be kept in mind that providing information is not enough to change people’s behavior, which is precisely why educational programs should also take into account the public’s own previous knowledge as well as their own views about biodiversity issues in order to avoid imposing dominant perspectives (Fischer & Young, 2007).

Kassas (2002) proposes five pivots to guide programs for biodiversity education. First, biodiversity education needs to embrace all the meanings associated with biodiversity but it also needs to define the scope in space and time (setting spatial and temporal boundaries) of a specific issue. The second pivot is the need for education programs to specify the perspectives to be used in their course on biodiversity that emphasize ecology and that develop an intimacy with nature. The third pivot is defining the goals and matching those with the actors'. The fourth pivot refers to having appropriate themes/sites for biodiversity education such as a school garden or a riverbank. Lastly, the fifth pivot is that of assimilation of the program whereby what was implemented to help achieve the goals is therefore monitored to ensure that all actors (learners, teachers, program planers, etc) and factors such as resources and learning sites have played a role. Alternatively, a three-year study in the Netherlands, performed by van Weelie and Wals in 1999 and which included policy-makers, environmental educators, curriculum developers, teachers, youth and NGO-representatives, came up with a six-point framework for making biodiversity meaningful. The framework comprises the following six "stepping stones":

1. Determine pedagogical perspectives and based on them, set learning goals (e.g. an ecological literacy perspective focused on ecological concepts, relationships and interdependencies).
2. Select specific themes and contexts that are complementary to overall learning goals in a certain educational setting.
3. Analyze meanings of biodiversity in different contexts using a simple working definition, for example "biodiversity represents variability in biological entities in a specific space at a specific moment in time."
4. Set concrete learning objectives that are compatible with the general learning goals and the specific themes that were selected. Wals (2001) suggests drawing the objectives from four pedagogical arguments: the emotional argument whereby personal meaning is given by reconnecting with nature through sensitization and experience; the ecological argument that leads to understanding relationships, functions and interactions; the ethical argument that deals with values, critical assumptions and taking a moral position; and the political argument whereby the person is able to debate about controversial issues while making choices and developing action competence.
5. Valuing of biodiversity through the examination of different interests and values given by different stakeholders, while contrasting these to our own.
6. Contextualizing the concept of biodiversity through the learning contexts and objectives chosen to understand biodiversity, which were determined in the previous steps.

In general, the articles that suggest guidelines for biodiversity education converge in the need for building the critical skills and environmental literacy that could eventually lead people into action towards biodiversity protection. They also highlight the need for selecting key themes that can showcase biodiversity's multiple dimensions and hence it's various uses, values and meanings.

Communicating about Biodiversity

In 2002, the Biodiversity Project carried out a national Survey in the US to measure American attitudes towards biodiversity. It was conducted by the public opinion firm Belden Russonello and Stewart, and interviewed 1500 adults, 18 years old and older. Poll findings revealed that 4 in 10 Americans recognize and describe the term biodiversity and 55 percent

mentioned that maintaining biodiversity was important to them at a personal level. Additionally, the top values for protecting biodiversity as well as main issues and concerns were identified. Based on these poll results, the Biodiversity Project concluded that basic literacy is needed to help people make the connection between why it is important to protect biodiversity and what actions to take (The Biodiversity Project, 2002). In another study carried out in 2007, the European Union through the Gallup Organization, performed the survey "Attitudes towards biodiversity," where 25,000 citizens above 15 years of age and from the 27 member states, were interviewed. The European Union has put legislation forward regarding biodiversity and environmental protection since the 1970s and most recently has established its Environmental Action Program for 2002-2012. Surprisingly and after more than 30 years of environmental legislation, the survey revealed that only 35 percent of the people interviewed know the term and its meaning, while another 30 percent had heard of the term but did not know what it meant. The remaining 35 percent had never heard of the term. Five percent of those interviewed mentioned that their primary source for information on biodiversity came from the school or university (Gallup Organization, 2007).

These results reveal an important challenge for biodiversity conservation and specifically for crafting communication and education strategies that can contribute to achieve the basic scientific literacy that allows people to know and understand about biodiversity. The CBD itself recognizes that the population in general is not adequately informed about the different issues related to biodiversity (CBD-UNESCO, 2001). This lack of information may be due to the scarce interest of the media on biodiversity issues, the lack of effective communication among scientists, and the lack of public interest on biodiversity. Malcom (2001) suggests that there may be a gap between the scientist's perception and the public's awareness about biodiversity in spite of a perceived informedness about environmental issues in recent times.

Mass-media campaigns and programs are usually designed to educate the public at large. Media such as television, video, radio, the Internet, and community organizations have all great potential to disseminate environmental knowledge and raise awareness (Kassas, 2000; Malcom, 2001). However, polls such as the ones aforementioned, evidence that there is still much to be done in order to reach more people. It also shows that there is a need for broader and deeper public understanding about biodiversity and why it is important to conserve it. But mere understanding about the issue does not necessarily lead to action. This is why Novacek (2008) suggests that, to attain deeper understanding and more committed stewardship of biodiversity through communication programs and strategies, it is necessary to first identify the audience that wants to be reached, including their level of understanding. Additionally, the message should be crafted accordingly to the audience as so should the mechanisms for delivering these messages.

To be more effective, communication strategies should be designed to take into account that their goal goes further than simply presenting people with information about the environment and the issues related to it (Ham & Kelsey, 1998). Communication strategies would improve their effectiveness by first evaluating the attitudes, values, and social structures of their target population, as responses generally relate to particular levels of education, economic background, cultural affiliations and religion beliefs, which will in the end showcase how willing people are to devoting time and effort to environmental protection (Novacek, 2008). Additionally, it is best to attempt to design strategies for specific groups and contexts rather than attempting to reach a wide audience (Ham & Kelsey, 1998). For example, 71 percent of the respondents for the 2002 Biodiversity Project Poll felt that biodiversity provided them with inspiration and peace of mind and several others provided reasons to protect the environment such as respect for God's work or for the future of

coming generations. These answers showcase different motivations and therefore different ways of thinking and acting towards the environment.

Another key factor in designing effective communication strategies is crafting the message. Coffin & Elder (2005) review the main strategies about how best to communicate about the effects of urban sprawl on biodiversity. Many environmental issues do not rank as a priority for people and may be easily undermined by concerns such as the economy, health care, or social security, thus making it difficult to elicit public support. Coffin & Elder (2005) conclude that in order to engage people, messages must give them a reason to care, and they must appeal to values as well as personal interests by describing the threat and by providing a solution that gives people practical steps to help and to ultimately make them feel empowered. Solutions could suggest supporting public policies or doing personal actions that may involve changing a certain behavior like driving less or consuming less plastic bags, for example. Additionally, the message should not overwhelm the public with a sense of despair towards environmental issues but rather it should try to emphasize the links between other species, habitats and human needs, highlight responsibilities and opportunities to help, use specific facts through a language that speaks to the audience, and lastly, try to make biodiversity real by drawing attention to local issues that affect people personally (The Biodiversity Project, 1999) such as the effects of sprawl or of polluting a watershed.

Once the audience is described and the message is crafted, Novacek (2008) suggests that effective linkages between the scientific community and the public need to be made through media such as news and educational programming. In general, adults mostly learn about science through television and print media, which is why it is important for the scientific community to use these channels of dissemination. Additionally, issues such as global warming and climate change have garnered widespread attention, which is advantageous in the sense that they can be used to make the connection between public concerns and biodiversity. The message used by media is important and should be educational rather than sensational or oversimplified. Internet also provides an important means of communication about scientific research results and conservation initiatives, potentially engaging different audiences and even serving as educational resources.

The Disconnection from Nature

"Nearly half of the world's people live in urban areas and are increasingly disconnected from nature" (Miller, 2005). This important disconnect may increase the indifference of people towards biodiversity issues. Miller (2005) argues that there has been an "extinction of experience," which stems from a cycle of impoverishment that initiates with the homogenization of flora and fauna, and continues with disaffection and apathy due to a biologically depauperate environment. In order to reconnect people and nature, Miller suggests the importance of increasing the opportunities of children to have contact with nature in cities. This is consistent with Richard Louv's opinions in his book "Last Child in the Woods" (2005). In addition, native biodiversity can contribute to a sense of place and belonging (Turner et al., 2004).

Dunn et al. (2006) refer to conservation of biodiversity worldwide as an issue dependent on urban nature, and term the phenomena the "pigeon paradox" to describe how conservation will depend on people's direct experiences with urban nature. As urbanization proceeds and urban landscapes become drastically altered, most of the biodiversity with which people relate and interact with are non-native species easily considered pests. To improve people's experiences with urban nature, Dunn et al. (2006) propose restoring native ecosystems in order to improve access to more natural landscapes within urbanized areas.

What is interesting is that their approach does not consider education as an important tool for closing this gap, given that it could be part of an integral strategy to influence a reconnection with the outdoor world.

With important changes in the environmental and social dimensions associated with urbanization, it is important to have a citizenry that values and that has an interest in their local environment and which consequently, has the skills and motivations to act in favor of its protection. In this respect, EE strategies have been widely used as a tool to help people gain the knowledge and skills necessary to understand and deal with the complexity of environmental issues (Hungerford, 2010). Formal education strategies can increase the opportunities for bringing the learner outside of the classroom and therefore closer to nature. As Louv recounts (2005), education strategies and curricula in the US tend to emphasize learning about scientific facts and issues without prompting any hands-on experience. In fact, Louv argues that this broken bond between children and nature stems from an “overly abstract science education” that fosters a distancing rather than a reconnection between them. In addition, academic studies (Barker et al., 2005; Dillon et al., 2006) that evaluated school activities in the UK and other countries, evidence the need to increase the number of opportunities for outdoor learning by school students given the benefits in terms of increased awareness about biodiversity (Lindemann-Matthies, 2005).

In several studies reviewed by Chawla and Flanders Cushing (2007), half to more than 80 percent of the respondents identified childhood experiences of nature as a significant and predisposing experience that would eventually influence their relationship with nature. Many of the respondents mentioned family members or other role models like teachers, as well as experiences such as scouts or environmental groups, as influential to their interest for nature. Witnessing the pollution of a place that has value and reading books about nature were also mentioned as influential. It is therefore not surprising that nature activities in childhood and youth, in addition to the influence of role models, can lead to an interest and action towards nature protection (Chawla & Flanders Cushing, 2007).

Learning about biodiversity should therefore not be limited to learning facts from textbooks in the classroom. Louv (2005) as well as many others cited in this review (i.e. Dillon et al., 2006; Chawla&Flanders-Cushing, 2007; Lindemann-Matthies et al., 2009) suggest more experiential learning in the classroom. Ham and Kelsey (1998) highlight the importance of the social context of learning such as when educational methodologies are designed to foster social interactions that enable the sharing of information, the contact with nature and people, and the consequent construction of knowledge. Tidball and Krasny (2007, 2010, 2011) argue that it is important for social and ecological perspectives to be incorporated through EE programs that involve participants in community development and in hands-on activities that enhance the environment such as planting trees, urban restoration and other practices, which build stewardship and social networks, and at the same time, contribute to community well-being.

Conclusion

Main Challenges for Biodiversity Education

Overall, we find that the biodiversity educational field faces four main challenges. The first challenge entails defining the approach for biodiversity education and understanding how the nature and strategies of both EE and ESD programs can potentially influence biodiversity education. A number of educators have agreed on characterizing Environmental Education (EE) as a multidisciplinary approach of education that focuses on nature, environment and society as interdependent and inseparable entities, although it has also been argued that EE

has been very environmentally focused, failing to show the synergies that lead to environmental change. On the other hand, ESD emphasizes on the interconnections between society, economy, and the environment and has been considered a more encompassing approach by including issues of ethics and equity as well as new forms of thinking and learning (Hesselink et al., 2000). But conceptualizing sustainability and its interdisciplinary implementation can be problematic for both schools and teacher education (Summers et al., 2005). Conceptual tensions over which perspective is a more appropriate fit for education may generate problems when defining the message and approach to be used in educating about or for biodiversity, although some biodiversity education efforts claim to be a mix of activities and mechanisms from both EE and ESD.

The second challenge refers to the difficulties posed to both educators and learners in handling a concept that is regarded as ill-defined. Additionally, its multi-dimensional character relating to social, economic, and environmental interactions make it a difficult concept to transmit easily and meaningfully to learners (Wals, 1999). The challenge for educators is to help learners find personal value and meaning in a concept that does not transfer easily into their minds. Several education scholars agree on the fact that biodiversity needs to be integrated outside the box of natural sciences while prompting learners into critically exploring different meanings, uses and values of biodiversity. Integration of biodiversity as an educational theme will also depend on the conceptual framework of the educators.

The third challenge refers to the importance of reaching different and broad audiences through a meaningful message. Survey and research results on public attitudes around the world show that the message about the importance of halting biodiversity loss is not getting across. This implies that the public needs to be further engaged. Thus, the importance of conveying the correct message through non-formal education and biodiversity communication strategies that can contribute to raise awareness and motivate all levels of society. The message needs to portray the complexity of the issue without engaging into fanaticism or a sense of despair, clarifying the issue as well as the opportunities for action. Outreach efforts need to center messages around public-held values, beliefs and concerns, and they should also understand and differentiate the audience, determining the best message accordingly in order to build the stewardship needed for action.

Lastly, the fourth main challenge for education is to reconnect people and nature. Given that most people live in urban areas, where the effects of urbanization have altered ecosystems and therefore how people relate to nature, various authors cited throughout this paper (i.e. Louv, 2005; van Weelie, 2002; Lindemann-Mathies et al., 2009, 2007, 2005) have suggested that education should focus on increasing contact with nature in childhood and youth through various types of activities. This early contact has been found to predispose people to increase their interest in nature (Chawla & Flanders-Cushing, 2007).

These four issues represent some of the challenges to be overcome if the level of public knowledge, awareness and understanding about biodiversity is to be increased and targets such as those set forth by the CBD are to be met. Based on these challenges, biodiversity education should guide learners into understanding and analyzing biodiversity's different meanings and dimensions. In this way, it would enable the learners to develop critical thinking skills about biodiversity and its protection. These skills can empower learners and help them realize their potential for action according to their own interests and concerns. Finally, while addressing the four challenges enumerated above, biodiversity educational programs should emphasize experiential and social learning in order to promote a new "concern" for and relationship with nature. This viewpoint reflects a broader,

comprehensive, systemic perspective, in order for educational approaches to contribute to efforts to halt biodiversity loss.



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