ENVIRONMENTAL EDUCATION AND THE LEARNING OF ILL-DEFINED CONCEPTS: THE CASE OF BIODIVERSITY

Arjen E.J. Wals & Daan van Weelie

Sponsored by the Dutch Ministry of Agriculture, Nature Management and Fisheries, Wageningen Agricultural University and the University of Utrecht jointly investigated the diversity of meanings, values and uses of biodiversity in order to tap its educational potential more fully. Some of the research questions were: What does biodiversity mean? Does it mean the same to everybody? What are some underlying assumptions, values and ethics? What are the possibilities and limitations of the theme of biodiversity in educational settings? How can the theme become existentially relevant to the everyday life of citizens? What should the role of education be in this regard? The answers to these and other questions are to result in a blueprint for designing diverse teaching materials and learning activities. This contribution outlines the research, some preliminary findings and elements of the blueprint. The notion of conceptual ill-definedness is introduced.

> People from diverse backgrounds talk about biodiversity. Politicians, environmental activists, conservationists, agronomists, foresters, plant and animal taxonomists, geneticists, bio-geographers and ecologists, they all have absorbed and adapted the word biodiversity and talk to each other and to the public, albeit in different languages. All use biodiversity as the hot word in today's small talk, the fashionable keyword to an eloquent but superficial conversation, a worthy successor of earlier panaceas such as ecology, environmental quality, sustainable use or global change.
>
> (Van der Maarel, 1997:3)

BIODIVERSITY AS AN EMERGING THEME IN SCIENCE AND SOCIETY

The concept of biodiversity is receiving world-wide attention as a result of attempts by many national governments to translate the 1992 Convention on Biological Diversity into concrete measures and actions. The level of biodiversity is generally considered to be a key indicator of the quality of life on earth. Biodiversity is an emerging theme in science and society, at least among policy-makers and scientists concerned with phenomena like resource management, nature conservation, ecological infrastructure and gene banks. An analysis of journals in the natural sciences, mainly related to the biological sciences, shows an exponential growth in the number of so-called biodiversity-hits (the number of times the word 'biodiversity' appears in the title of an article; Harper & Hawksworth, 1995). Biodiversity-related research is sponsored by global institutions such as the World Bank and UNEP. Whether based on scientific interest or on opportunism, biodiversity concepts have entered the world of the natural sciences, particularly those pre-occupied with the conservation of species and ecosystems (i.e. Huston, 1994; Rosenzweig, 1995; Heywood *et al.*,1995).

Table 1 provides just one example of different emphases a biological scientist can use in studying aspects of biodiversity. We should emphasise that

Table 1: **Some commonly used meanings of biodiversity in the natural sciences** (based on Magurran, 1988)

Genetic diversity	
Species diversity	
	- number of species per area (richness)
	- number of individuals per species per area (abundance)
	- alpha-diversity
	- gamma-diversity
	- epsilon-diversity
Guild diversity	
Habitat diversity	
	- within habitat diversity
	- niche width
	- beta diversity (differentiation diversity)
Ecosystem diversity	
Landscape diversity	

this is only one classification and that there are many others. The point is that within the scientific community there is a diversity in meaning of biodiversity concepts and in ways with which to assess biodiversity.

Biodiversity has also entered the world of policy-makers, environmental organisations and nature conservation agencies. Long before Rio de Janeiro, the IUCN's World Conservation Strategy already made reference to biological diversity (IUCN, 1980). The Rio-convention on Biological Diversity, signed by more than 160 countries, accelerated the speed with which governments around the world adopted 'biodiversity' as a policy theme. The ratification of the Rio-declaration by many governments implied a re-thinking of conservation-policy and the allocation of funding to research and development that would assess, monitor and develop biodiversity at the national level, and, more recently, at a trans-national or interregional level (IUCN, 1994). The increased attention for biodiversity is also illustrated by the amount of media coverage biodiversity is getting and the number of World Wide Web biodiversity-hits (number of home pages that contain the word 'biodiversity'): over 68 000 (as of August 1997, using the search engine Altavista.Digital.Com).

BIODIVERSITY AS AN EMERGING THEME IN ENVIRONMENTAL EDUCATION

Environmental education is an interdisciplinary field rooted both in science and society, concerned not only with environmental literacy, but also, and perhaps foremost, with the relationship people have with their environment. As such the field cannot be immune from new trends in conservation and environmental protection. When new concepts emerge from science or society that bear relevance to the people-environment relationship such concepts have to be scrutinised from an environmental education perspective. We only need to look at the kaleidoscope of curriculum materials and articles on the subject of 'Education for Sustainability or for Sustainable Development' to illustrate that the field responds rather quickly to emerging concepts. (Examples include: Fien, 1993, 1996; Huckle & Sterling, 1996; Wals, 1996). Biodiversity is likely to have a similar impact. Already environmental education curriculum materials have been developed or are being development around the world on the subject of biodiversity. (Examples include: Binder *et al.*, 1995; WWF-US, 1994 (in press)).

Environmental educators will need to gain some conceptual clarity with regards to biodiversity - leave alone for now the question whether such clarity can transcend a particular context or use - by asking some fundamental questions which correspond to the various 'learning domains' of environmental education: knowledge-insight, involvement-values, responsibility-morality and, finally, skills-action competence. Some of these questions are: What is biodiversity? What is happening to biodiversity? What are the causes of this happening? What are the consequences of this happening? What do you think of that? What can organisations do about it? What can you do about it? What should we be doing? What should we not be doing? There are no simple answers to these questions and the answer is likely to vary with context.

Table 2: **Towards a general blueprint for environmental education and biodiversity**

Overview of Research	
Goals: essential criteria, guidelines, principles and constraints for developing the theme of biodiversity within environmental education	
Method:	Objective:
Expert-interviews	*General Orientation* (meanings, values, ethics, philosophy, psychology, policy, EE)
Literature review	*In-depth Study* (meanings, values, ethics, psychology, instruction, EE)
Delphi-study	*Concrete Operationalisation* (learning enhancement criteria, objectives, guidelines)
Analysis of learning activities	*Analysis of Existing Operationalisations* (creating imagery of cases examples and cases)

After outlining the research programme on which this paper is based and, which is to result in a blueprint for curriculum development, we look at some of the different meanings, values and uses of biodiversity, continue by introducing the notion of 'ill-definedness' and end by looking at some of the implications for environmental educators who seek to infuse biodiversity issues into their programs.

RESEARCHING THE EDUCATIONAL POTENTIAL OF BIODIVERSITY

The general research question, which was posed to us by the Dutch government, can be formulated as follows: What are essential criteria, guidelines, principles and constraints when developing the theme of biodiversity within environmental education programs for people aged 15 years or older? In trying to answer the different parts to this question, we made use of four research tools (Table 2): Expert consultations, literature review, Delphi study (Linstone & Turoff, 1975; Mayer, 1996) and analysis of learning activities.

Table 3: **Expertise consulted in expert interviews**

Expert	Pedagogics	Biology	Environmental Education	Environmental Policy	Philosophy of Social Sciences	Philosophy of Biology
1)	X		X		X	
2)	X		X			
3)	X		X	X		
4)		X				
5)		X				X
6)		X				X
7)	X				X	
8)					X	X
9)		X	X			

1. **Expert consultations.** In order to generate starting points for a selective reading of the extensive biodiversity literature a series of nine expert interviews was conducted as a first step in the research process. The experts interviewed were chosen to be knowledgeable in a variety of relevant fields (Table 3) in order to get as many perspectives as possible early on in the research. The interviews were audio-recorded and transcribed for content analysis.

2. **Literature review.** We made use of some standard works on biodiversity as both a potentially scientific and political concept. Furthermore we included some international policy documents on biological conservation, a review of recent trends in environmental education and some research articles that dealt specifically with biodiversity and environmental education. Our selection was in part based on the expert interviews held earlier.

3. **Delphi study.** Biodiversity is a new theme for environmental education. Since its meaning, value and use are still in question, so is its educational potential from an environmental education perspective. Although it appears that there is consensus at the (inter)national policy level about the meaning and importance of biodiversity, early indications are that such consensus is lacking in both the scientific and the environmental education community. If the general blueprint is to be of any use, it is crucial that it is grounded in the experience, ideas, desires and concerns of the various user groups, and that some kind of agreement is reached as to what learning about biodiversity entails. The complexity of the theme and the wide array of possible educational operationalisations make it difficult to satisfactorily identify workable issues, specific needs and individual points of view, and to involve people in the decision making process. The Delphi process is designed to tackle such complex issues by first eliciting opinions or judgements from all respondents, summarising the various opinions, then confronting each respondent with alternative points of view and providing them with an opportunity to revise their original perspective in light of new information. The Delphi process is thus basically a programme of sequential questioning

Table 4: **Schematic representation of the Delphi 'EE & Biodiversity'**

Overview of the Delphi-study	
Goal: mapping contents, contexts and goals for learning about biodiversity from an EE-perspective, and b) generating support from involved user or interest	
Element	**Objective**
Round 1 questionnaire in	- encouraging creative and critical thought among the participants in order to generate contents, contexts, goals and criteria for learning about biodiversity - analysing and summarising the main arguments put forward by participants for feedback round 2
Round 2 ing questionnaire emerged	- anonymous feedback of selected contents, contexts, goals and criteria and correspond- arguments to all participants - drawing the attention of participants to possibly new issues or sub-questions that from round one which seem of particular interest

interspersed with information and opinion feedback (Mayer, 1992; Linstone & Turoff, 1975). The questioning is usually conducted by several rounds of questioning using questionnaires and carefully selected representatives of groups that are in one way or another involved in the issue at stake. Table 4 shows the Delphi process designed for this research on environmental education and biodiversity.

The participants represented a variety of interest and/or user groups: Environmental policy-makers, environmental education resource persons, upper secondary school teachers, curriculum developers, NGO workers and members of youth organisations who focus on environmental issues. To assure that as many possibly relevant perspectives emerge from the study a category of people was added which contained philosophers, artists and writers. For each category a minimum of five participants were nominated by a key informant who was well known within a specific category.

The first round of questioning contained the following themes: (a) meaning and value of biodiversity, (b) related concepts, (c) generating specific learning themes, (d) relationship with other environmental education topics, (e) expected learning outcomes/goals, and (f) learning enhancement (didactic) criteria.

4. **Analysis of learning activities.** A final element of the research, to be completed in the autumn of 1997, is an analysis of various learning activities that have been designed around the world to incorporate biodiversity in environmental education. The activities will be analysed on content, assumed meaning and values of biodiversity, learning goals and learning enhancement criteria. The materials collected so far are still rather limited and vary in scope and quality, nonetheless they do give an idea of the various ways in which biodiversity can be integrated in environmental education learning activities.

Table 5: **Biodiversity Between Science and Politics**

	Solid Scientific Base	Weak Scientific Base
High Political Impact	1	2
Low Political Impact	3	4

RESULTS

Meanings

When looking at the different meanings the participants in the study attributed to biodiversity we found differences between those who emphasised the political strength of the concept and those who stressed its ecological base. The matrix below shows that there

are at least four ways of looking at these two components.

According to some a solid ecological base is an essential prerequisite for biodiversity to have any political impact. Others suggested that biodiversity has political impact but a weak scientific (ecological) base and that ecologists use mainly the concept opportunistically to draw new research money for already existing research on related concepts. A distinction can be made between political or symbolical definitions of biodiversity on the one hand and scientific definitions of biodiversity on the other. The symbol of biodiversity refers to the environmental problem of the decreasing variation of life and to the normative demand that we should do something about it. But for biodiversity to be a symbolic concept there need not be anything 'out there' one could identify and name 'biodiversity'. In other words, as a symbolic concept biodiversity has no empirical reference. In order to know exactly what is lost, however, and what should be done to stop 'biodiversity' losses, scientific concepts or concepts referring to the variety of life with empirical reference, are essential. Such concepts refer to entities - phenomena 'out there' - that can be identified and, indeed, somehow measured. One question we should pose as environmental educators is: How to deal with this continuum of meanings that exists between 'strictly' political uses and meanings of biodiversity on the one hand and 'strictly' scientific uses and meanings on the other?

Table 6: **Four Content Dimensions of Biodiversity**

Organisational - genetic - species - ecosystem	**Spatial** - local - regional - global
Time - seasonal - annual - centennial - evolutional	**Functional** - habitat - specialisations - behaviour - reproduction

Environmental education about biodiversity thus should not be limited to certain scientific aspects of biodiversity. Values of biodiversity, i.e. economical, aesthetic and ethical ones, should be taken into account as well. In other words not only one, but many biodiversity concepts and corresponding values and meanings should be covered in environmental education. The selection of the specific or concrete meanings and values of biodiversity to be incorporate in an environmental education program depends to a large extent on learners who have their own ideas, experiences, interests and motivations. At the same time we have to acknowledge that biodiversity concepts cannot be totally contextual and learner dependent. There is a core of biodiversity concepts which transcends specific contexts. This biodiversity core needs to be described and made available to educators. The development of biodiversity as a learning area of environmental education hinges on a deep understanding of so-called core meanings (Table 6) and values (Table 7) on the one hand, and on a deep understanding of the life-world of the learner on the other.

Clearly, species diversity is not the only variety of biological diversity. For instance, measures of 'niche width' describe the diversity of resources that an organism (or species) utilises. Similarly, habitat diversity is an index which measures the structural complexity of the environment or the number of communities present (Magurran, 1988:4). In one of the interviews with experts, a professor of plant ecology stated that many more definitions of non-species diversity are possible. In his research, for example, he uses diversity of functional groups called guild diversity. However, conservationists almost invariably view species diversity as species richness (see e.g. Norton, 1986). This is usually based on the rationale that species have the right to exist (Ehrenfeld, 1988) or that they have an actual or potential economic benefit to *homo sapiens* (Frankel & Soulé, 1981; Helliwell, 1973, 1982). The preservation of genetic diversity is another frequent concern. Some stress the importance of conserving polymorphism while others (e.g. Vida, 1978) warn of the dangers of interbreeding in populations isolated in nature reserves (for references see Magurran, 1988:4, 108).

The point is that there are many ways of measuring biodiversity depending on how it is defined. When looking at diversity at, for instance, the level of genes or ecosystems, one will inevitably come across a variety of lenses and instruments with which to observe and measure biodiversity. Hence it is meaningless to state that people should help prevent the

Table 7: **Some Values of Biodiversity** (source: McNeely *et al.*, 1990)

DIRECT VALUES
- consumptive use value: assessing the value of nature's products that are consumed directly, without passing through a market (firewood, fodder, and game meat).
- productive use value: assessing the value of products that are commercially harvested and sold in a market (timber, fish, ivory, medicinal plants).

INDIRECT VALUES
- non-consumptive use value: contributing to ecosystem functions (watershed protection, photosynthesis, regu lation of climate, and production of soil).
- option value: keeping options open for the future (a safety net of diversity).
- existence value: knowing that certain species exist.

loss of biodiversity without specifying what kind of biodiversity is meant and how it is being measured. It is even possible that one and the same conservation measure can lead to an increase of biodiversity according to one index and to a loss of biodiversity according to another. This brings us to the symbolic meaning of biodiversity which inevitable leads us to values of biodiversity.

Values

Already in the above section some values of biodiversity emerge that can be connected to the symbolic meaning of biodiversity. We can ask ourselves whether biodiversity has a particular value and, if it does, for whom? Intuitively one is inclined to think 'of course biodiversity is valuable' for 'life' is valuable and 'variation is better than more of the same.' This might be true at a very basic level, but as soon as we get beyond the symbolism and start digging for meaning and empirical references we enter a world of buzzing confusing and complexity, as we have already seen.

There are many questions that can be asked about the use and value of biodiversity. Some will argue that its value is in its use and that the task is to first demonstrate in economic terms the contribution biological resources make to a community's social, cultural and economic development. Others, recognising a non-economic value of biodiversity as well, have come up with more comprehensive value categories for assessing the value of biological resources (see, for instance, McNeely *et al.*, 1990).

From the literature reviewed, the expert interviews and the two delphi-rounds we can conclude that a great diversity in meanings, uses and values of biodiversity emerge. This diversity gives rise to the notion of conceptual 'ill-definedness', is a quality not unrelated to other so-called key concepts in environmental education.

BIODIVERSITY AS AN ILL-DEFINED CONCEPT

As a result of the research we have come to see biodiversity as an ill-defined concept which can be characterised by the following features:
* tendency of being inclusive rather than exclusive (or hard to narrow down)
* can be interpreted in many different ways
* value-laden or normative
* hard to operationalise in specific application domains

Educational research on the learning of 'fuzzy' concepts suggests that conventional learning and instruction methods falsely treat such concepts as scientific ones with clear conceptual boundaries in order to allow for straightforward knowledge transfer (Spiro & Jengh 1990; Spiro *et al.*, 1991). Consequently the learner develops a rather rigid or static understanding of the concept which may be sufficient for passing a test or examination, but totally inadequate for application in authentic problem situations or application domains, which tend to be far more complex and dynamic.

The ill-definedness of biodiversity concepts - which at least partly results from a broad array of scientific, symbolic, political, societal and personal meanings- also characterises other key concepts in environmental education, e.g. sustainability, sustainable development, sustainable use or even nature conservation (see also Wals & Van der Leij, 1997), coping with ill-definedness, developing cognitive flexibility, critical thinking and contextualising knowledge, should perhaps be an integral part of environmental education learning goals.

It is interesting to note, however, that the degree to which the 'ill-defined' nature of 'biodiversity' was valued by the participants in the Delphi and by the expert interviewees, varied. Some found this lack of coherent and consistent meaning a drawback for using biodiversity in their teaching. They argued for using an easily-taught, agreed-upon ecological interpretation of biodiversity. Others found this lack of coherent and consistent meaning inevitable and typical for concepts that have both political and scientific connotations. They argued for teaching and learning that enables the learner to understand and critique such concepts on the one hand, and at the same time allows learners to attach personal meaning to the concept by exploring how biodiversity is part of their own lives.

IMPLICATIONS FOR ENVIRONMENTAL EDUCATION

How do we deal with biodiversity as an ill-defined concept in an environmental education programme? In round two of the Delphi, the participants were asked to reflect on five educational translations of concrete themes identified by themselves in round one. The selection was made from 21 themes put forward by the participants when asked to identify a topic that they considered appropriate for integrating concepts of biodiversity in environmental education. The participants were asked to indicate for each theme whether they thought the theme was suitable and, if so, whether it would be best used in the beginning, at the end or throughout the learning process. The results suggest a particular teaching and learning sequence for biodiversity as a theme for environmental education. We will first briefly describe the five themes:

1. **Backyard Biodiversity** - Focuses on the diversity of species in people's homes, schools, communities and backyards. Emphasis on accurate observation, identifying, naming, monitoring and learning by discovering.

2. **Design a Habitat** - Focuses on the conditions and requirement for species to thrive or survive. Emphasis on relationships, ecological principles, factors influencing habitat loss and creation and learning by designing.

3. **Biosphere, not Biosfear** - Focuses on the biosphere, its ecosystems, their relationships and their life support functions for species, including *homo sapiens*. Emphasis on understanding global linkages and interdependencies, the notion of a dynamic equilibrium and learning by investigating.

4. **The Last Dodo ... So What?** - Focuses on the extinction of species, most of which we have never known. Questions are raised about the current net-loss of species on a global scale. Is it really so bad? Emphasis on values, the role of people in affecting the state of biodiversity, the people-nature relationship and on learning by raising fundamental (ethical) questions.

5. **Shaping Biodiversity** - Focuses on our dependency on biodiversity and the way people shape biodiversity both positively and negatively. Emphasis on values and uses of biodiversity, impact of consumers and producers on biodiversity, development of action competence to positively impact biodiversity, and on learning by tackling and acting on controversial issues.

The analysis of the data indicates that, in the eyes of the Delphi participants, a sequence of learning activities should follow the following pattern: (1) (re)connecting with nature through discovery and sensitisation, and experiencing biodiversity to create personal meaning: Establishing an emotional foundation, (2) understanding relationships, functions and (global) interdependencies: Establishing an ecological foundation, (3) dealing with values, taking a moral position, raising critical questions: Establishing an ethical foundation, (4) dealing with controversy, making choices, development of action competence: Establishing a political foundation.

Conceptual ill-definedness appears to be a phenomenon that is well worth paying attention to in environmental education research, especially when its seen as an opportunity to give a concept personal (or local or contextual) meaning, value and use on the one hand, and to raise students' awareness of the ill-definedness that lies behind popular concepts that appear to be clearly defined on the surface. When the ill-definedness of environmental (education) concepts is viewed as such, learning about ill-defined concepts fits well with environmental education as a continuous learning process that enables participants to construct, critique, emancipate and transform their world in an existential way. **Construct** in this sense means building upon the prior knowledge, experiences and ideas of the learner; **critique** in the sense of investigating underlying values, assumptions, world views, morals, etc., as they are a part of the world around the learner and as they are a part of the learner him/herself; **emancipate** in the sense of

detecting, exposing and, where possible, altering power distortions that impede communication and change; **transform** in the sense of changing, shaping, influencing the world around them, regardless of scope or scale.

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