

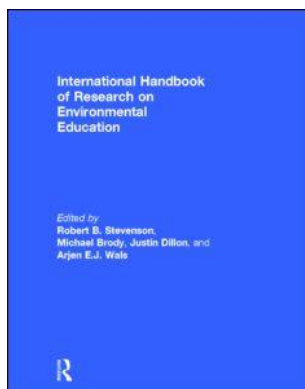
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## **Socioecological Approaches to Environmental Education and Research**

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# 3

## Socioecological Approaches to Environmental Education and Research

### *A Paradigmatic Response to Behavioral Change Orientations*

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#### Introduction

Environmental education as a new demand for educational systems has been launched in many countries toward the end of the sixties in the twentieth century as a response to growing fears about the degradation of the environment. What was in a first attempt more or less a private initiative of engaged biology and geography teachers became a more political initiative in the context of the political strategies concerning environmental protection framed at the United Nations Conference on the Human Environment in Stockholm 1972. Certainly, there have been nature education movements before that time, assumedly emerging in the first half of the twentieth century. However, the evolving educational debate on *environmental* education may be seen as closely linked to the evolving political debate on environmental protection (Fensham, 1978). The Stockholm declaration comprehending twenty-six principles which calls “upon Governments and peoples to exert common efforts for the preservation and improvement of the human environment, for the benefit of all the people and for their posterity” entails in principle 19 the role of education within the process of environmental protection as “essential in order to broaden the basis for an enlightened opinion and responsible conduct by individuals, enterprises and communities in protecting and improving the environment in its full human dimension” (United Nations Environmental Programme [UNEP], 1972).

Five years later environmental education was declared as an indispensable instrument for improving the environment at the United Nations Education, Scientific, & Cultural Organization—United Nations Environmental Programme (UNESCO-UNEP) Conference on Environmental Education in Tbilisi 1977. The demand in principle 19 of the Stockholm Declaration that “education

should broaden the basis for a responsible conduct by individuals, enterprises and communities” was taken up in the goals formulated in recommendation 2:

The goals of environmental education are:

- a. to foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural areas;
- b. to provide every person with opportunities to acquire the knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment;
- c. to create new patterns of behavior of individuals, groups and society as a whole towards the environment. (UNESCO-UNEP, 1978, p. 24)

With this declaration, the ultimate goal for environmental education of behavioral change for the benefit of the society was addressed to individuals, groups, and society. Education was seen as a main instrument to solve environmental problems. Additional to the political systems, within the field there are numerous stakeholders concerned with environmental problems—e.g., nature protection organizations, water supply businesses, power plant businesses, consumer organizations, gene technology businesses, environmental researchers, and others—and they are all addressing educational institutions to respond to the societal demands in order to help solve environmental problems.

There have been conceptualized and explored various ways as reactions to societal requests concerning environmental problems, raised by stakeholders, environmentalists, educators themselves or environmental education researchers. Some important strands are (compare the seven traditional currents, Sauv e, 2005):

- promoting individual behavioral change through improving educational strategies and research (Hines,

Hungerford, & Tomera, 1986/1987; Hungerford & Volk, 1990; Sia, Hungerford, & Tomera, 1985/1986; Zelezny, 1999); for an overview of German research publications see Lehmann (1999); a “retrospect and prospect” in Reid and Scott (2006); and recent review by Heimlich and Ardoin (2008), attempted to provide a foundation for behavior related discussions in environmental education

- enhancing environmental awareness through environmental literacy usually closely linked to natural science literacy (e.g., Bybee & Mau, 1986; Giordan & Souchon, 1991; Volk & McBeth, 1997)
- enhancing nature-human-relationship and ecological awareness through nature experience (e.g., Bögeholz, 2006; Chawla, 1998; Lehmann, 1999)
- promoting action competence through action oriented learning (e.g., Bolscho & Michelsen, 1999; Eulefeld, Bolscho, Rode, Rost, & Seybold, 1993; Eulefeld, Bolscho, Rost & Seybold, 1988; Jensen & Schnack, 1997; an overview over the German tradition give Nickel & Reid, 2006)
- promoting ethical reflection and awareness of cultural contexts and diversity (e.g., Agyeman, 2002; Greenwood & McKenzie, 2009; Hargrove, 2000; Jickling, 2004a, 2004b)
- educating for becoming critical through transformative and critical education (e.g., Heid, 1992; O’Donoghue & McNaught, 1991; Posch, 2003; Robottom, 1987; Robottom & Hart, 1993; Stapp, 1974; Wals, 1993; contributions in Mrazek, 1993, such as Del Pilar Jimenes Silva, 1993; Gough, 1993; Hart, 1993; Robottom, 1993).

Socioecological approaches to environmental education have been developed within the “becoming critical” strand, outlined in this chapter.

### The Nature of Socioecological Approaches

Socioecological approaches build on the assumption that the individual change concept of environmental education and a predominant natural science perspective on environmental problems are simplifications and do not form adequate approaches to the multilayered challenge of environmental problems. The notion “socioecological” has been founded on findings from case studies in secondary schools, which gave a strong argument for environmental education focused on critical reflection of real life situations regarding the interface of social and natural sciences (Kyburz-Graber, Rigendinger, Hirsch Hadorn, & Werner Zentner, 1997a, 1997b). In the context of science education, a related concept was developed, the *socioscientific* issues approach, which shows similarities albeit not explicitly linked to environmental education questions (Cross & Price, 1996; Laugksch, 2000; Ratcliffe, 2007; Zeidler, Sadler, & Simmons, 2005). The notion “socioecological”

seems to be implicitly existent in various concepts of critical environmental education. Thus, the whole range of related concepts may be summarized as “socioecological approaches.” During the last years, the notion “socioecological” seems to have been evolving particularly as an approach to research on the global level. It is used to describe the challenge of global resilience management of human-environment systems for which the notion of socioecological systems is used (Walker et al., 2002; Young et al., 2006).

The socioecological approaches to environmental education emerged as ways for dealing with conflicting multilayered demands concerning the environment in the nineties of the last century when interdisciplinary environmental research programs were conducted (e.g., Swiss priority program environment 1992–2000, the German research program “Man and Global Environmental Change” 1995–2001). Out of those research findings and similar initiatives, these key issues for socioecological perspectives on environmental education were described:

- questioning the nature of natural and social sciences and its interfaces;
- questioning the ways how knowledge is produced, reflected, disseminated, and continuously interpreted; and
- inquiring the interfaces between sciences and social questions.

The characteristics will be outlined providing arguments for the foundation of socioecological approaches illustrated by research studies as examples for ways of knowing in environmental education. It is argued in the following sections that socioecological approaches are

- *constructive*: learners and researchers construct and reconstruct knowledge on the basis of their own inquiries and case studies, and adopt environmental problems as socially constructed
- *reflective*: learners and researchers approach learning processes as reflection on ways of knowing and mediating knowledge
- *critical*: learners and researchers approach phenomenon and notions of environmental problems in critical and relational dimensions, including questioning historical and future perspectives
- *participatory*: learners, teachers, and researchers cooperatively interact while being aware of different interests and needs

### Socioecological Approaches Are Constructive in the Way Environmental Problems Are Explored

A key aspect of socioecological approaches is the way in which environmental problems are addressed, inquired, analyzed, interpreted, and what conclusions are drawn regarding solutions.

It has been and still is a widely agreed approach to environmental problems to analyze what causes those problems, to analyze how they could be avoided and how their effects can be mitigated (Haeberli, Gessler, Grossenbacher-Mansuy, & Lehmann Pollheimer, 2002). The preferred measures are consistently seen in technological progress and changing people's behaviors. With increased interdisciplinary inquiries researchers are recognizing that the concept of environmental problems has to be extended into ontological, epistemological, and methodology questions embracing not only nature science but as well social, economic, ethical, philosophical, and other aspects. This broadened perspective was also described in the concept of "environmental issues" (Ramsey, Hungerford, & Volk, 1989).

A most important part of environmental problems is to point out the difference between observable and measurable facts and their interpretations. Thus, what is the meaning of the term "environmental problem" is not merely the observed facts, but as well what people and experts infer and interpret from the facts, which causes and effects they attribute to them, and what kind of solutions they are searching for (Hirsch, 1995).

In a wider sense, the notion "environmental problem" has to include the ontological question of which "reality" is assumed to be researched, that is, the world of the people concerned, or their view of the world; the world of nature science which sees its strengths in restrictions to objectively observable facts, or the world of culture documented in literature, historical sources, arts and music, or other worlds. (See the typology of conceptions of the environment and its relations to educational paradigm given by Sauvé, 1996.)

Environmental problems also include epistemological questions of how knowledge on environmental problems is generated. With reference to environmental problems, it is generally thought that the most relevant knowledge is produced by nature scientific approaches following a positivist research strategy: observing, measuring, setting hypotheses, conducting experiments (Robottom, 2003). As Robottom states:

Environmental issues do not fundamentally consist of objectively existing facts that are more usually the concern of science and science education. If it is recognised that environmental issues actually consist of differences of opinion among human beings about the appropriateness of certain environmental actions, then it can be seen that environmental issues are best understood within a social discourse rather than a scientific discourse. (Robottom, 2003, p. 34)

From an interpretive or critical perspective, environmental problems as they are perceived and mediated in society cannot be taken for granted but they have to be explored as concepts of individuals and social groups—are they well educated or not, scientifically experienced or not—who construct and reconstruct their views and

beliefs against their biographical and contextual background (see the three images of environmental education described by Robottom & Hart, 1993). Individuals are constantly interpreting and evaluating their observations, experiences and, in particular, what they hear, read, and see. In the strict sense, every oral or written expression of human activities has to be seen as a social construction. Thus, approaching environmental problems requires not only scientific knowledge but also inquiries on how people interpret and value what they came to know about a specific environmental problem. Extended ways of gaining knowledge about environmental problems are biographies, life stories, literature, all kinds of historical and current documents, oral history stories, individual experiences, and so on. Thus, environmental problems cannot be adequately approached if it is not taken into account that they are shaped by interests, needs, values, interpretations, conditions, and social contexts of the people concerned, as well as by arguments and views suggesting how environmental problems might be solved (Haeberli et al., 2002; Wals, 1993).

### **An Example for a Socially Constructed Environmental Problem: The Loss of Biodiversity**

There is probably no doubt that the loss of biodiversity is a worldwide and severe environmental problem touching economic, health, global inequality, and long-term ecological aspects. It entails questions regarding how food can be produced in a sustainable way in the long run for an increasing world population without damaging existing species as gene reservoirs; additional aspects are the need of pharmaceuticals on the basis of plants, sustaining the dynamics of food chains, economic changes due to loss of certain species (e.g., in fish grounds), the loss of attractiveness to tourists due to substantial changes in features of the landscape and its affective and aesthetic meanings for people, and others. Probably almost everyone asked would reinforce the claim that sustaining biodiversity is an important environmental problem in general. Still, in the details, there are many differing views about which species are in danger, if it matters at all, about spatial and temporal aspects of loss and the effects of loss of biodiversity, about what should and could be done, and not least, about what the role(s) and responsibility(s) of individuals and social groups in this process might be. If the loss of biodiversity is taken as a fact backed merely by natural science research findings the conclusion might be close that the problem can be solved through better education of people in terms of knowledge transmission and raising awareness (to follow these arguments see, e.g., Lindemann-Matthies, 2002).

If the loss of biodiversity is looked at as a socially constructed environmental problem, many more aspects related to human behavior have to be deliberated:

Even if individuals recognized how their behavior might have an impact on the decline of biodiversity—which is

not directly obvious, everyone is generally confessing that he or she loves nature and is caring for nature—they will probably not be able to draw conclusions and to change anything in their life in favor of saving biodiversity, perhaps blaming the collective responsibility which is difficult to capture (for the problem of individual and collective responsibility and behavior a number of research projects have been conducted and synthesized in Haeberli et al., 2002). In a wider perspective, an environmental impact may be interpreted not only as the effect of inappropriate behavior, but also as the unexpected side effect of human activities. It may be argued that what people do or do not do is usually not decided according to environmental attitudes, but according to events in their private, professional, and public lives that primarily determine the actions people take. They usually make decisions in their daily lives based on their need, or desire, to be successful in their work, to drive to work, to produce goods, to go shopping or to enjoy their leisure time. They may not be blamed because they usually do not harm the environment on purpose. Whether the environment is attacked by those activities—and if so and how—is then dependent on subjective judgments and is supported or opposed by social groups, political strategies, and media reports (Haeberli et al., 2002; Kyburz-Graber, Hofer, & Wolfensberger, 2006).

It may be concluded that:

- exclusively blaming individuals for their thinking, feeling, and acting in view of how environmental problems develop and evolve is an overly simplifying strategy which can contribute to helplessness or point out the lacking political will of politicians to initiate democratic processes and to take adequate measures;
- people who are getting insight in the interdependence of society and ecology and who are improving their understanding of the ways how social and political processes develop are likely to be more critical participants in such processes; and
- generating knowledge about and within those interrelations in the context of real cases including real life complexities can provide excellent learning offers for students and teachers (see Kyburz-Graber, Hart, Posch, & Robottom, 2006; OECD-CERI, 1991, 1995).

Those conclusions constitute a key element of socioecological approaches to environmental education.

### **Socioecological Approaches Are Reflective in View of Learning Processes and Ways of Knowing**

Education has traditionally been assigned the role of transmitting existing knowledge and social values that are widely approved and accepted by society (Posch, 2003). In the last years it has not only grown the awareness that commonly agreed and approved knowledge is becoming rare not least because of widespread pluralism and

increasing knowledge production; but parallel to this, the knowledge transmission metaphor of learning has been replaced by a constructivist learning theory: learning is seen as an active knowledge construction process by the learner. The learning individual interacts in this process with knowledge provided from outside and contextual knowledge generated by him- or herself. The constructivist position emphasizes the fact that the individual is integrating new knowledge and experiences in existing structures in his or her mind, which have been implied through previous experiences, and learning processes. Bringing those aspects together, we claim that learning processes neither can be seen as uncritically accepting knowledge produced in unknown contexts, nor can it be seen as a passive knowledge reproducing process (Duffy & Jonassen, 1992; Gerstenmaier & Mandl, 1995; Knuth & Cunningham, 1993; Resnick, 1991).

Not astonishingly, there can be traced a coincidence of how the notion of learning has been developed in the last years into an individual and social reflectiveness, and the way how the notion of knowledge and knowledge production has developed into an understanding as a more critical and reflective interaction with information, not least in the context of environmental problems. This has also implications on the way that teachers and learners interact and how they both learn by sharing and exchanging knowledge.

Claiming that learning is an open and constructive, active, critical, and reflective process asks for a skeptical position against every attempt which tries to prove evidence for “best” educational approaches. Rather, it has to be assumed that environmental education pedagogy is highly contextual, depending on teachers’ and students’ previous experiences, on their local environments, school culture, and current societal trends. Thus, it might be more adequate to be interested in getting in-depth views of how environmental learning situations develop in this context, how teachers and learners get actively involved in social situations related to environmental problems, how they explore those issues and critically reflect about them.

Those are ways how socioecological approaches to environmental education set reflexivity on ways of knowing and processes of learning into educational practice.

### **Socioecological Approaches Are Critical in Ways of Looking at Environmental Problems and Environmental Education**

So far, it has been shown that socioecological approaches to environmental education allow participants in educational settings to explore environmental problems as social constructions and subjective, contextual interpretations of the world. Searching beyond the surface about reasons, conditions, interests, and power relationships of people concerned evoke critical stances on how and why environmental situations are like they are. “Criticality” is thus another key element in environmental education related to socioecological approaches. It is a crucial part within the

debate on environmental education as behavioral change or socially critical education (see, e.g., contributions in Mrazek, 1993; Robottom & Hart, 1993; Robottom & Sauvé, 2003; Sauvé, 1997; Walker, 1997).

“Critical” in the context of education may be related to discourses on “critical thinking” as well as to discourses on “critical pedagogy” (Wolfensberger, 2008). Wolfensberger traces the discourse on “critical thinking” back to historical roots of philosophy. In this tradition, the nature of “critical thinking” is seen as an intellectual process in which statements, arguments, or whole theories are approved in terms of coherence with logical deductions. In this tradition, John Dewey’s work can be seen which is referred to in the evolving discourse on “critical thinking.” In his book *How We Think* published in first edition 1910, John Dewey describes the key notion of “reflective thinking” as:

that operation in which present facts suggest other facts (or truths) in such a way as to induce belief in what is suggested on the ground of real relation in the things themselves. (Dewey, 1933)

Thinking is seen as an ongoing process of perceiving, relating, and approving facts, beliefs, and values with the aim of developing comprehensive concepts of the world. John Dewey postulates a critical attitude as a precondition for reflective thinking in the sense that doubts and skeptical attitudes will induce questioning situations and reflecting problems.

Wolfensberger outlines how the “critical thinking” discourse has been taken up by Ennis (1962) and is reflected in numerous and ongoing endeavors to define concepts of “critical thinking” and develop strategies to promote them in educational settings (Brookfield, 1987; McPeck, 1981; Paul, 1990; Siegel, 1988). Critical thinking is defined as “rationale reflection” (Ennis, 1987), a combination of rationale and critical attitude (Siegel, 1988), questioning assumptions behind values, ideas, and actions (Brookfield, 1987), “reflective skepticism” linked with specialized knowledge (Brookfield, 1987; McPeck, 1981). In a similar way, Dubs claims that the main characteristic of “critical thinking in a wider sense” is reflection on basic assumptions and values (Dubs, 1992). “Critical thinking” according to Dubs is the highest and most comprehensive form of rationale thinking. In line with a number of environmental education researchers (Barnes & Todd, 1995; Lemke, 1990; Mortimer & Scott, 2000; Roth & Lucas, 1997; Wals, 1997) and from a discourse theoretical perspective, we claim that discourses in education can provide those environmental learning situations where critical reflection can take place.

While the discourses on “critical thinking” are related to philosophical traditions of “Critical Rationalism” and “Pragmatism,” the “critical pedagogy” discourse on the other hand is linked to postulates of “Critical Theory” (Burbules & Berk, 1999). The common basis of the two conceptions of “critical” is the assumption that reality

exists, but most people have more or less subjectively distorted views of it. A critical approach is aimed to engage people in questioning situations and analyzing multilayered perspectives on the world. According to the two positions of critique such inquiries may be conducted in different ways: “Critical thinking” may help people to rationally analyze existing knowledge and examine underpinning assumptions and beliefs. On the contrary, “critical pedagogy” claims that analyzing reality means to explore and expose structures in society that privilege certain social groups while other groups are excluded or oppressed. Social inequality, power relationships, interests guiding research and knowledge production, and emancipation are notions in the context of “critical pedagogy.” While “critical thinking” is needed for critical analysis, “critical pedagogy” goes beyond it claiming that societal institutions producing and implementing knowledge, and related ideologies have to be questioned *and* transformed. “Critical pedagogy” links reflection and action, interpretation and social change (Burbules & Berk, 1999, p. 52; see also Karr & Kemmis, 1994).

Socioecological approaches to environmental education share with the two outlined positions of “criticality” the ontological assumption that there is a reality beyond human interpretation. But in contrast to the “critical thinking” and the “critical pedagogy” position the socioecological approaches follow the constructivist epistemological position that reality cannot be recognized itself. This is based on the constructivist assumption that knowledge on reality is an ongoing constructing and reconstructing process of all kind of actors according to their subjective experiences and their social, political, and cultural contexts. The aim of a socioecological approach to environmental education is to allow

Young people to explore social issues in the real world by questioning values, perceptions, conditions and opinions. While doing this, they look behind and beyond the norms of social boundaries and critically question what is generally understood as objective scientific facts. (Kyburz-Graber, 1999, p. 416f)

Talking about “critically question what is generally understood as objective scientific fact” (Kyburz-Graber, 1999, p. 416) socioecological approaches adopt a position of the “critical thinking” philosophy. On the other hand, socioecological approaches adopt more the position of “critical pedagogy,” criticizing the behaviorist individualistic change position in environmental education and arguing for an emancipative education aimed at self determination and empowerment for responsible judgment and action. Furthermore, the adoption of a “critical pedagogy” position in socioecological approaches is mirrored in the critique of social and scientific discourses on scientific and technological progress excluding inquiries on underpinning economic interests, ethical arguments for restrictions, and social inequalities. However, in contrast to the “critical pedagogy” position socioecological approaches

do not ultimately claim that schools should initiate and participate in social change activities. They hold to a more pragmatic position regarding the role of education in society: environmental education should provide learning situations for critical inquiry and reflection and thus distinctively contribute to students' capacity to critically question, explore, and interpret social developments (for a newly launched debate on "schooling and environmental education in view of contradictions in purpose and practice," see Stevenson, 2007a, 2007b).

Following Wolfensberger (2008) in his reflections, it may be concluded that socioecological approaches neither are restricted to a "critical thinking" position excluding social change discourses, nor do they entirely adopt a "critical pedagogy" position radically demanding an active role of education in social transformation processes. The notion of "criticality" in socioecological approaches may be characterized as reflective, deliberative, pondering, discourse oriented in view of critically discussing observed as well as medially transmitted facts, generally agreed knowledge, ways of knowledge production; individual and social values, beliefs, interests and interpretations, and their implications for social developments. This notion of "criticality" is close to what Burbules and Berk (1999) describe as an "alternative criticality" in terms of thinking "outside a framework of conventional understandings" (p. 59) and "willingness, to engage in such conversations" (p. 61). As necessary conditions they see the motivation of the individuals but as well "challenging and supportive relations" and "contexts of difference that present us with the possibility of thinking otherwise" (Burbules & Berk, 1999, p. 62).

### **Socioecological Approaches Are Participatory in Learning and Research**

Socioecological approaches are based on the assumption that learners are able to generate knowledge on complex environmental issues if they have the opportunity to explore, analyze, and interpret conditions, reasons, and expressions of human actions in real-life situations, getting in personal contact with people concerned and discussing possible developments.

Meaningful starting points for socioecological environmental education are real-life situations in which people are involved in their daily lives: family households, communities, political institutions, businesses, schools, supermarkets, recreation areas, etc. (Kyburz-Graber et al., 1997a; Kyburz-Graber, Hofer, & Wolfensberger, 2006). It has been shown in case studies on socioecological approaches in senior high schools that students and teachers as well as teachers and researchers come to manifold insights and are able to generate knowledge on environmental problems when they interact with real-life situations, reflect on values and value systems, explore conditions of action, work on possibilities for individual and structural change, and share and reflect their

experiences and emerging knowledge (Kyburz-Graber, 2004; Kyburz-Graber et al., 2006).

Given the ontological and epistemological basis of socioecological approaches as constructive, reflective and critical, all kind of methodologies can be appropriate for inquiries on teaching and learning processes on environmental problems, depending on the focus of interest and research questions: narrative inquiry on experiences in real-life situations; phenomenological studies on the way how students and/or teachers experience a new role in teaching-learning settings on real-life experiences with environmental problems; ethnographic studies on a real-life situation where people are dealing with an environmental problem; action research concerning the way how people act in a specific situation.

### **A Case Study as an Example for a Research Study on Socioecological Approaches to Environmental Education**

An example of a research study is a case analysis of five tandem-teams each formed of a biology and a history or philosophy teacher on secondary level who embarked on a socioecological curriculum development project taking three years in all. The research team invited the teachers to initiate a socioecological approach to a topic situated at the interface between natural science and society that was meaningful for the students in their actual context and could be linked to real-life situations regarding current private and public debates. Topics chosen were e.g., "Potential Benefits and Risks of New Biotechnologies"; "Consumption and Sustainable Development"; "Images of Nature."

The socioecological approach allowed the teachers to explore alternative ways of environmental education in the way that the students should be offered the opportunity to reflect on concurring perspectives regarding environmental problems, consider value judgments and interests, ways of knowing and uncertainties in knowledge production. The students' experiences with their focused inquiries on such questions and their reflections were shared in classroom discussions, which were video recorded, transcribed, and analyzed to get an in-depth view on contents and ways of discussion. The transcripts were analyzed in terms of descriptive statistics on interactions, arguments and contents, and by interpretative reconstruction as rich text (Wolfensberger, 2008; Kyburz-Graber et al., 2006).

Three topics were profoundly analyzed as case studies (Wolfensberger, 2008).

The classroom discussions evolved not surprisingly in highly different ways in terms of objectives, content, and interaction style. However, cross case analysis revealed a few similarities that allowed conclusions to be drawn regarding critical reflection on socioecological issues: The participants of classroom discussions were mostly concerned with raising facts related to the discussed topic and less with values, norms, feelings, and experiences.

Attempts to metacognitive reflection were visible, albeit only in few phases.

The interpretative reconstruction of the classroom discussions on “potential benefits and risks of new biotechnologies” revealed among participating students a concept of “division of labor” between natural science and social science/philosophy (Wolfensberger, 2008). Further, it produced an image of research that sees the researcher exclusively representing natural science and males, with an untamed urge to generate knowledge. Discussants expected that progress in natural science would contribute to determine ethical norms. Natural science research was attested the right of progress in favor of solving problems in the world. On the other hand, there were voices expressing the fear of an uncontrollable drive in research. Images of natural science and social science emerged also in classroom discussions of the project “images of nature.” The reconstructed science images seem to attribute subjective, value, and culture based knowledge to social science, and objective value-free knowledge to natural science. Comparing the three case studies there was evidence that the students were engaged in lively discussions but did not go as much into depth in terms of a critical reflection that is associated with socioecological approaches to environmental education (Wolfensberger, 2008).

One might conclude that the claim of critical reflection on environmental issues is too sophisticated and not practicable except with high experienced students. Seen from a different angle, in the light of learning to become critical, it may be argued that socioecological approaches provide learning environments where students and teachers are challenged to interact with controversial real-life topics and reflect on causes and reasons.

### **The Potential of Socioecological Approaches to Environmental Education as Paradigmatic Response to Behavioral Change Orientations**

A main feature of socioecological approaches is the critical reflection on environmental problems in a wide sense: questioning the nature of science and social sciences and its interfaces; questioning the ways that knowledge is produced, reflected, disseminated, and continuously interpreted; and questioning the interfaces between sciences and social questions.

Those questions seem to open up meaningful topical areas for exploring socioecological issues providing those “contexts of difference” and “communicative opportunities” (Burbules & Berk, 1999, p. 62) that can be seen as a prerequisite for critical approaches. This is a paradigmatically different account to environmental education compared to changing attitudes and behaviors (Robottom & Hart, 1993). Robottom and Hart (1993) critically point out that the changing behavior paradigm is built on the assumption that there is a common “view of what the world should be like and how such a state can be attained” (Robottom & Hart, 1993, p. 35). Socioecological

approaches, in contrary, build on the assumption that there is no determined set of goals that describe how an environmentally sound and sustainable world should be. It is rather an ongoing social process of critical reflection on worldviews and on mainstream attempts to problem solving. Learners and teachers are part of this social process.

Critical reflection in the sense of socioecological approaches has to be engaged and supported. It may be assumed that students develop their ability to reflect critically on epistemological questions of knowledge production and the role of sciences embedded in social contexts if the ability is explicitly promoted and linked to experiences with real-life situations. Stating this, socioecological approaches are coming close to science education concepts that assign critical alternatives to traditional science education: the “nature of science” and “socioscientific issues” movements (Aikenhead, 1997; Geddis, 1991; Lederman, 1992; Lemke, 1990; Osborne, Erduran & Simon, 2004; Sadler & Zeidler, 2004). Both movements emphasize the reflection on ways of knowing and the interpretation of knowledge embedded in social and cultural contexts, and the distinction between observations and inferences.

However, critical reflection in socioecological approaches is considerably more than learning how to use arguments in discussions, and it goes beyond the reflection on ways of scientific knowledge production. It profoundly questions real-life situations in view of socially constructed human-nature interrelationships.

Socioecological approaches do not provide strategies of ‘what works’ but they show that teachers and students adopt a critical perspective if they work on local environmental problems (Kyburz-Graber et al., 2006), raising questions about the human-nature relation and the meaning of and the knowledge on “nature” in various scientific and cultural contexts, and in historical and future perspectives. Instead of learning isolated facts, students are encouraged to start socioecological inquiries in real-life situations in which people are involved in their daily lives, and where students will discover inconsistencies, controversial issues, contextually interpreted knowledge. They will start to reflect on interests, beliefs, values, and the basis of knowledge and power. And not least, they start thinking on “nature,” they raise more or less unreflected metaphors linked with “nature,” they start reflecting on interdependencies between culture, nature, and economy. In short: it seems that the nucleus of socioecological can be seen in critical reflection on interrelationships between how “nature” is conceived and valued on one hand, and political interests and knowledge production and dissemination in society, on the other hand. This includes not least the critical analysis of the role of natural science and the interface between natural science and society. Critical views on the ways societies come to know about environmental problems may reveal values, beliefs, and varieties of “truths” underpinning how problems are identified and approached.



It seems to be a promising perspective for future research to explore in what learning settings and how learners come to critically investigate and reflect environmental questions and what kind of contextual knowledge they gain through their inquiries. Linked to such learning situations there will emerge another range of challenging questions concerning the way in which teachers and whole schools develop conditions for socioecological learning processes and what supports or impedes them in their endeavors.

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