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## **Developing critical thinking in environmental education: a video study of classroom discussions on socio-ecological issues in secondary schools**

Kyburz-Graber, R ; Wolfensberger, B ; Hofer Kurt, K

**Abstract:** An important task of science education is to develop the ability to judge the meaning and significance of scientific progress and future perspectives. It is widely agreed that students should be enabled to deal with scientific innovations and to utilize them in a critical and responsible way. This process demands integrating scientific knowledge, knowledge about social processes and awareness of personal and social values. Increasing judgement skills by applying critical thinking is thus a relevant element of science education today.

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**Developing critical thinking in environmental education.  
A video study of classroom discussions on socio-ecological issues in  
secondary schools**

*Regula Kyburz-Graber, Balz Wolfensberger, Kurt Hofer, Institute for teacher  
education, University of Zurich, Switzerland*

### **Introduction**

An important task of science education is to develop the ability to judge the meaning and significance of scientific progress and future perspectives. It is widely agreed that students should be enabled to deal with scientific innovations and to utilize them in a critical and responsible way. This process demands integrating scientific knowledge, knowledge about social processes and awareness of personal and social values. Increasing judgement skills by applying critical thinking is thus a relevant element of science education today.

An educational area where critical thinking has always been a prior goal is environmental education. In the last years outcomes of social environmental research studies (see e.g. Häberli et al. 2002) engaged the debate about the complexity and contextuality of environmental issues. One of the main outcomes of that environmental research program which ran for 10 years was the prior role of learning processes: In order to contribute to substantial changes in society, learning processes should not be limited to analysing impacts on environmental situations but should also question and finally change values that support those situations (double loop learning according to Argyris and Schön 1978). In the context of that environmental research program we developed a socio-ecological approach to environmental education together with schools in a co-constructive process (Kyburz-Graber et al. 1997a, b). The socio-ecological concept is taken as the theoretical basis for this research study on critical thinking.

#### *The socio-ecological approach to environmental education*

The socio-ecological concept is based on the assumption that environmental problems are not caused deliberately but that they happen as side effects due to human actions (Hirsch 1993). An example can illustrate this assumption: People who take a plane to reach their favorite holiday destination do not want to harm the environment even if they know that they do so by their choice. Air pollution and noise is not caused on purpose but happens as a side effect of peoples' action flying to their holiday destination. And because holiday trips are a need in modern human life, they are generally well accepted – at least by the actors themselves – and side effects are legitimated. Individuals and social groups judge impacts on the environment in different ways, depending on their experiences, interests and their social context. Environmental problems can therefore not be regarded as mere facts but have to be seen in a broader sense as social and individual constructions.

The socio-ecological approach to environmental education focuses on action systems instead of environmental problems and single isolated actions. It takes local situations of everyday life as a basis. Learners are asked to critically analyse real-life issues by exploring experiences of people concerned as well as preconditions of actions. This approach builds on the concepts of human needs and actions as opposed to the syndrome approach which is supported by German environmental researchers and focuses on environmental degradation problems. Based on the

theoretical background we developed three components which constitute the socio-ecological concept:

*Problem-orientation:* Social issues and real situations (not traditional topics based on school book texts) which provide complex situations are taken as starting points for interdisciplinary environmental education. Such a problem-oriented approach refers to the fact that environmental issues are social constructions and can only be adequately explored and understood if the social context of individuals involved is taken into account.

*Relation to previous experience:* Since learners construct their knowledge on the basis of previously existing knowledge and beliefs, individual experience can serve as an anchor in every phase of the learning process and may provoke reflection if it is used as a basis for reasoning, questioning and change.

*Participation:* Dealing with socio-ecological issues in education has to include experiences with participatory processes as a kind of model for the way in which society has to handle ecological questions. Environmental problems and possible solutions have to be found in a process of organizational learning by collaboration, debating conflicts, reflecting tensions and finding solutions by negotiation and compromise according to the people involved.

In socio-ecological environmental education the interactive discourse on observations, perceptions, values, beliefs and interpretations is a substantial part of the learning process. It mainly happens in classroom situations where outcomes of environmental analysis are discussed. Our previous studies have revealed shortcomings in cognitively demanding classroom discussions and a lack of critical thinking and reflection processes specifically in areas like problem analysis, reflection of personal experiences and participatory planning of learning processes (Kyburz-Graber et al. 1997a, b). This research project explores features of critical thinking in classroom discussions referring to existing concepts of critical thinking (e.g. McPeck 1981, Brookfield 1987, Paul 1990, Dubs 1992, Astleitner 1998, Petri 1998) and empirical studies (e.g. Zoller 2000). These concepts agree that critical thinking:

- goes beyond the mere application of logical thinking
- is rational thinking
- is reflective thinking
- requires well understood basic knowledge
- often follows the basic structure of 1. analysis, 2. synthesis, 3. evaluation

Our research questions are:

- What aspects of critical thinking can be found in classroom discussions on socio-ecological issues?
- How can critical thinking be promoted and what prevents it?

## **Methods**

The study consists of a video analysis of classroom discussions. In cooperation with upper secondary schools six interdisciplinary teacher tandem groups (biology and history or biology and philosophy) were selected to participate in the project. The tandems are working with a commonly defined frame topic based on the socio-ecological concept. The choice of the teachers involved was: Humans shaping the Garden of Eden? In this topic the Garden of Eden is regarded as an action system

which has to be analysed in its dimensions, processes and perspectives. The preparation and performance of the projects is up to the teachers' initiative and competence. Supporting workshops are offered by the research team where the socio-ecological approach, optional frameworks for the school projects, questions of interdisciplinary team work, etc. are discussed. A web-based platform invites teachers to cooperate in on-line discussions on topical questions and pedagogical methods. In each of the six classes, three phases of classroom discussions are videographed:

- Planning phase: identifying the leading idea of the topic and structuring it into sub-questions.
- In-between reflection phase: re-viewing the initial learning phase and identifying emerging and relevant aspects.
- Final evaluation phase: reflecting on the complexity of phenomena, the meaning and interpretation of measurable facts and opinions and identifying key outcomes.

A number of selected *didactical tools* invite teachers to generate interactive learning processes in class, e.g. *brainstorming, fantasy journey, interpretation of texts, moderation of learning processes, clarification and reflection of values and attitudes through the Socrates' dialogue*. It is the aim to find out how the teacher tandems manage to promote critical thinking. It is the contextuality of the situation, the dense description of the process that will inform a better understanding of critical thinking. To achieve this, existing concepts of critical thinking as well as socio-ecological categories (Kyburz-Graber et al. 1997a ,b, 2000) are combined (structuring content analysis, Mayring 2003). The video data material itself and the transcriptions are the second source for developing a code system (summarizing content analysis, Mayring 2003).

The technical equipment follows the experience of the TIMSS video studies. Video data and transcripts are analysed with 'Videograph' and 'MAXqda' software.

### **Expected results**

The analysis of the videographed lessons from the school projects is in working progress. The code system for the analysis of critical thinking in classroom discussions is being developed in an iterative process combining top-down and bottom-up approaches.

On the one hand, the analysis of the video documents focusses on the interactive process structure in class referring to the participation component of the socio-ecological concept, and on the other hand on the contents of critical thinking referring to the problem-based and experience-related learning components. At present, we have started with the content analysis of the transcribed classroom discussions. Episodes which turn out to be rich in critical thinking will later be analysed with respect to interaction looking for patterns of interaction which might promote or hinder critical thinking. The code system for the analysis of interaction is based on established categories (see Merkens/Seiler 1978; Lemke 1990). In developing the categories for the content analysis we partly recur on existing concepts of critical thinking. The basic categories are: 1. Describing a problem; 2. Analyzing a problem / generating hypotheses; 3. Proposing solutions or alternative interpretations; 4. Evaluating proposed solutions or alternative interpretations. Sub-categories were developed on the basis of discourse theory, thereby taking up the initiatives of education theorists such as Blake (1995), Endres (1997), Young (1992), and drawing

on the work of Jürgen Habermas (1981; 1983; 1991). According to Habermas (1981), communicative action always entails the raising of validity claims (in German 'Geltungsanspruch'). Thereby actors can refer to three 'worlds': to the external world of facts (the 'objective world' in Habermas' terms), to the social world of norms and values (the 'social world') and to the inner world of feelings (the 'subjective world'). Furthermore the code system makes a difference between just stating ideas and reflecting or analyzing them, and it allows observing on which type(s) of knowledge (e.g. natural sciences, social sciences, philosophy, common sense) participants build their statements. The data of all the school projects are treated with the same categories but independently from each other and described as case studies. Cross-case analysis is planned for specific aspects emerging from data analysis.

According to the project phases mentioned above which we derived from the socio-ecological concept, we expect that instances of critical thinking will be rather scarce at the beginning of the school projects, and that their frequency will increase in the course of time spent on the issue. Furthermore, it is expected that the quality and the content of argumentation will be influenced by several structural characteristics such as the topic and the didactic structure of the respective project, the experience of both teachers and students in classroom discussions or the behavior of the teacher. We shall illustrate this briefly with two examples:

School A: 18 year old students shortly before graduation worked on scientific and ethical questions in the field of life sciences. A rich corpus of reading material from the fields of ethics and life sciences was handed out to the students with the assignment to prepare a short input on pros and contras of various given aspects of life sciences and to guide the following classroom discussions. The discussions turned out to be very lively and committed, however they focussed mostly on the ethical aspects. Ethical arguments were put forward in criticising certain scientific practices and political proposals regarding life sciences. However, the ethical principles used in the discussion didn't go beyond the corpus the students also found in their reader. Furthermore, students didn't question the ethical principles themselves but rather treated them as given 'truths'. The discretion of the teachers in the discussion as well as the experience of the students and one of the teachers in forumlike situations and open classroom discussions might have promoted the liveliness of the discussion.

School B: 15 year old students. The Topic of this school project was 'body, fashion, cosmetics – and sustainability'. During one week students were working in groups on different subtopics such as ecological aspects of food, bodybuilding, beauty, cosmetical surgery, clothes. They were given oral inputs as well as reading materials but also assigned to do some fieldwork such as interviews. Each group had to report on the concept of their planned final presentation. This was followed by a classroom discussion as well as the presentations themselves. A third discussion attempted a final evaluation. 'Body, fashion and cosmetics' proved to be an attractive topic for the students insofar as they could draw on their real-life experience. To look for ecological aspects in this context seemed to be new for many of the students and may prove to be fruitful in the long run. In the short perspective of the school project however, the topic might have contributed to the strong subjective character of the discussion. Often, students gave only subjective accounts of their experiences with aspects of the topic, of their likes and dislikes. The tendency of one of the teachers to expect moral statements sometimes resulted in the mere reproduction of moral axioms by students. The class, which was formed only half a year before the project, didn't have any experience with open discussions yet. This, together with teachers who didn't openly challenge free discussion among students, gave way to a

discussion in which most of the students participated but which was mostly triadic (in the sense of Lemke 1990).

As mentioned above, data analysis has just started. Much work for the interpretation of the material still lies ahead. The research team will become more and more sensitized for the complex reality of critical thinking in different school projects. Maybe, critical thinking as it is posited in theory may not occur at all or rarely at best. If so, this should neither lead to rejecting the school projects analysed here as simply unsuccessful nor to discarding the often very normative theoretical contributions as solitary. It should rather stimulate research to further inquire into what critical thinking in the real-life context of school could mean, taking the high ideals of existing theoretical concepts for what they should be: a horizon.

## **Conclusions**

It is expected that the concept of socio-ecological environmental education will be further developed as a didactical instrument for structuring interdisciplinary teaching and learning both with respect to contents and pedagogy. The socio-ecological concept can hereby serve as a model for problem-based, experience-related and participatory teaching and learning processes.

The findings will contribute to a better understanding of what has so far been described as critical thinking. Descriptions of critical thinking processes with an analytical comment will be useful materials for pre- und in-service education for teachers aiming at the development of teaching competencies in promoting and coaching highly demanding cognitive processes in students.

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