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Active learning processes provide a basis for sustainable behaviour change

Didactic reasons for syndrome learning for the CIEA-Seminar 2006

Overview

1. Sustainable incentives

Since the Rio Conference in 1992, the research community has been seriously reflecting on the concept of sustainability. The model of a sustainable, forward-looking development describes a concept that takes into account the ecological problems caused by the present way of doing business and of living in the industrialised countries as well as the prevailing needs in the developing countries while bearing in mind the interests of future generations. This approach also starts to gain ground in everyday life. The first sustainability reports drawn up by companies are a visible sign of this approach. For teaching this means the following: Offers have to be developed which motivate the participants and allow them to look into the complex idea of sustainability.

2. The aim: Sustainable decision-making and responsibility

In order to understand the concept of sustainability, we need systems knowledge – i.e. knowledge about structures, functions, processes and how different effects are connected. Only somebody who is able to deal meaningfully with this knowledge is capable of acting. Systems knowledge is associated with assessments, ethical orientations towards the relation between humankind and nature, alternative thinking, foresighted thinking. Furthermore, knowledge about possible roads to sustainability is necessary. Cultural knowledge, experiences from the organisation of everyday life, the perception of children and teenagers and/or other cultures as well as traditional knowledge about how to interact with nature influence this knowledge.

3. Point of reference for the content: The syndrome approach as an analytical tool to help identify global patterns of non-sustainability

With its "syndrome concept", the German Advisory Council on Global Change (WBGU) has proposed a selection and a description of central issues that provide an example for structural problems of global change while giving consideration to the way ecological problems are linked. Based on expertise, global "clinical profiles" that reflect crucial changes in ecological, economic and social areas (cf. WBGU, 1996) were identified. With a conceptual analogy to medicine a syndrome has to be understood as a clinical profile of the earth that results from the interaction of economic, social or political dynamics with the ones of climate, soil features, water balance or vegetation.

Up to now, 16 syndromes have been recorded as global "clinical profiles": Smokestack Syndrome, Sahel Syndrome, Favela Syndrome, Overexploitation Syndrome, Waste Dumping Syndrome, Urban Sprawl Syndrome, Green Revolution Syndrome, Rural Exodus Syndrome, Contaminated Land Syndrome, Katanga Syndrome, Mass Tourism Syndrome, Scorched Earth Syndrome, Dust Bowl Syndrome, Asian Tigers Syndrome, Aral Sea Syndrome and Major Accident Syndrome (cf. WBGU, 1996).

The Advisory Council goes beyond this diagnosis: It identifies trends that are relevant to global change. The following components are considered crucial for global interconnections: Biosphere, pedosphere, atmosphere, hydrosphere, population, organisation of society, economy, psychosocial sphere and science/technology. Interactions occur between these areas and within the resulting interconnections specific "syndromes", typical patterns of interaction, can be identified. The individual trends are backed up by data that serves as indicator in order to be able to make statements about the strength and the importance of a syndrome.

The syndrome approach wants to be considered as problem-oriented, action-oriented research (WBGU, 1996:3). The analysis of environmental problems that have to be recorded by means of the syndrome metaphor takes centre stage. Recommendations for action are deduced from the diagnosis. Behind the somewhat cumbersome description "syndromes of global change" lies an interdisciplinary research approach that claims to connect and to structure various phenomena such as soil degradation, climate change, technology transfer, migration or the increasing ecological awareness in the population. The aim here is to recognise typical patterns of global change, to classify new incidents and to develop various ways of possible action or to be able to judge them.

4. From syndrome approach to syndrome learning: How to learn in a problem-oriented and interdisciplinary way

The syndrome approach as a starting point for an active, intensive discussion about sustainability is interesting because it does not only clarify the pivotal questions concerning the idea, but also does this in such a way as to include the complexity and the network character and makes them comprehensible. The results of this approach are starting points for integrated thinking and self-determined learning. Syndrome learning is based upon the research concept of the syndrome approach.

4. 1 From research approach to syndrome learning

Based on the WBGU research approach, a teaching concept was tested in schools in Germany at the beginning of 2000 (cf. BLK-Werkstattmaterialien, No. 8). The focus here was not on compiling a well-defined canon of knowledge, but rather to develop and promote learning-oriented research and research-oriented learning. Therefore, the aim here is to broaden the (school) subject-oriented mind of the learners so that it becomes more problem-oriented. The following points are taken into account:

- problem-orientation
- interdisciplinarity
- collective, research-oriented learning (principle of co-operation)
- as well as the three structural elements complexity, dynamism and insecurity.

This approach is relevant to sustainable learning for the two following reasons:

- It is a complement - from the point of view of content and methodology - to the orientation toward specialist subjects and allows to acquire and practise cross-cutting qualifications that help to understand epoch-specific problems: to make relevant decisions, to choose from a comprehensive set of methods, to be capable of complex thinking, to have a basic orientation towards systems analysis, to possess communicative competences - competences that are also important to participate in the private and social creation process.

- The strength of the syndrome approach, on the level of content and methodology, surely lies in its ability to provide a basis for generalisations through the identification of patterns without resorting to oversimplification. The multitude of ways to identify structural elements of global change, to put them into relation and therefore to be able to describe the actual patterns distinguishes the approach from popular systematic essays.

4.2 The methodical way of syndrome learning

The methodical way of syndrome learning follows the logical steps of the syndrome analysis.

The first step consists of formulating hypotheses: Based on expertise and the analysis of case studies, a non-sustainable cause-effect-pattern is described and syndrome-specific interconnections containing the most important symptoms and their interactions are drawn up.

In the second step, a syndrome diagnosis is made, based on simplifying reflections about plausibility (cf. diagram below). In order to be able to derive conclusive, theory-based descriptions, the learners have to examine additional material/ information independently. Three questions take centre stage:

- What regions are susceptible to the syndrome (susceptibility)?
- What factors cause the outbreak of the syndrome (exposition)?
- In which regions the syndrome is active (intensity)?

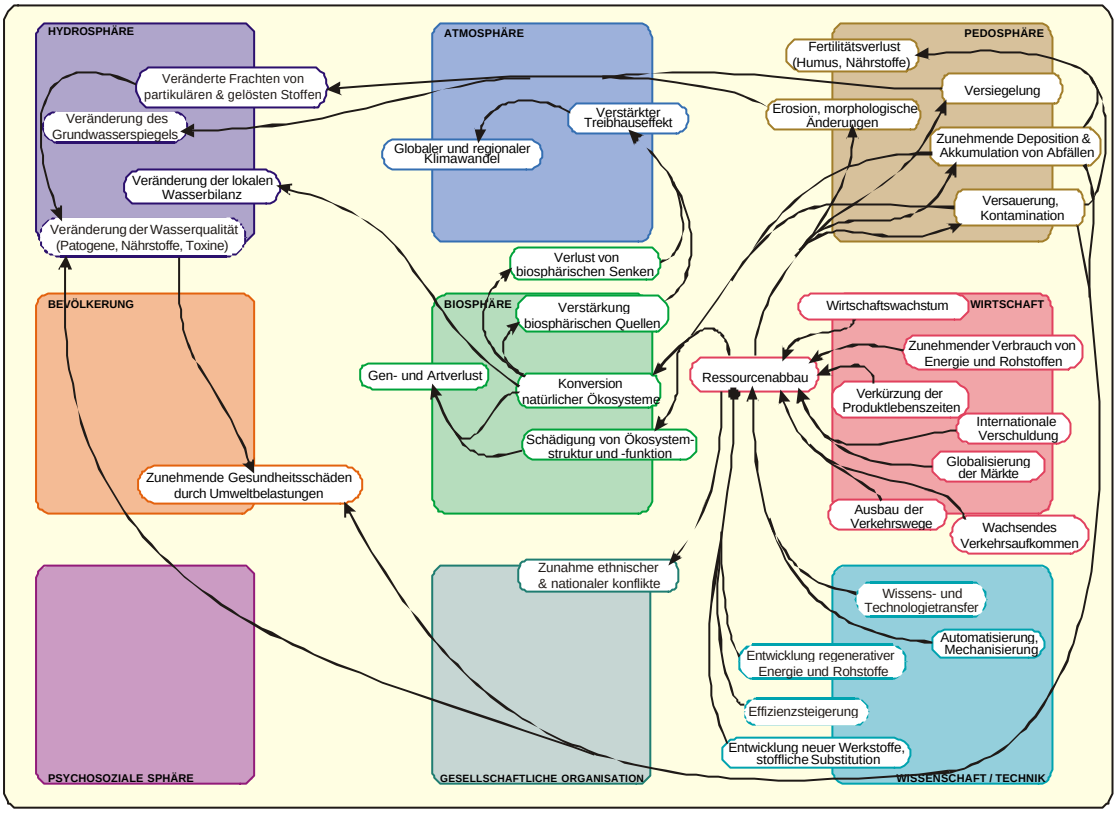

Diagram 1: Syndrome-specific interconnections of the Katanga Syndrome

The third step is a syndrome prediction which is also based on reflections about plausibility. The fourth step consists of assessing the syndrome, including the predicted development(s) and preventive as well as curative recommendations for action are formulated.

4.3 The didactic model of syndrome learning

The image of the so-called T-Intelligence, created by Hans-Peter Dürr, is used as didactic model for the design of syndrome teaching (cf. Petschel-Held/ Reusswig/ Cassel-Ginz et al., 2001). The vertical bar symbolises the qualifications in a subject area, while the horizontal bar stands for the inter-professional, cross-cutting qualifications. To be intelligent in the sense of Dürr, a person has to embrace both aspects.

Hydrosphäre	Hydrosphere
Veränderte Frachten von partikulären und gelösten Stoffen	Change in load of particulate and dissolved substances
Veränderung des Grundwasserspiegels	Change in groundwater table
Veränderung des lokalen Wasserbilanz	Change in local water balance
Veränderung der Wasserqualität (Pathogene, Nährstoffe, Toxine)	Change in water quality (pathogens, nutrients, toxins)
Atmosphäre	Atmosphere
Verstärkter Treibhauseffekt	Enhanced greenhouse effect
Globaler und regionaler Klimawandel	Global and regional climate change
Pedosphäre	Pedosphere
Fertilitätsverlust (Humus, Nährstoffe)	Loss of fertility (humus, nutrients)
Versiegelung	Soil sealing
Erosion, morphologische Änderungen	Erosion, morphological changes
Zunehmende Deposition & Akkumulation von Abfällen	Increasing deposit and accumulation of waste
Versauerung, Kontamination	Acidification, contamination
Bevölkerung	Population
Zunehmende Gesundheitsschäden durch Umweltbelastung	Increasing health damage caused by environmental pollution
Biosphäre	Biosphere
Verlust von biosphärischen Senken	Loss of biospherical sinks
Verstärkung biosphärischer Quellen	Increase in biospherical sources
Gen- und Artverlust	Loss of genes and species
Konversion natürlicher Ökosysteme	Conversion of natural ecosystems
Schädigung von Ökosystemstruktur und -funktion	Damage to structure and function of eco-systems
Ressourcenabbau	Decline in resources

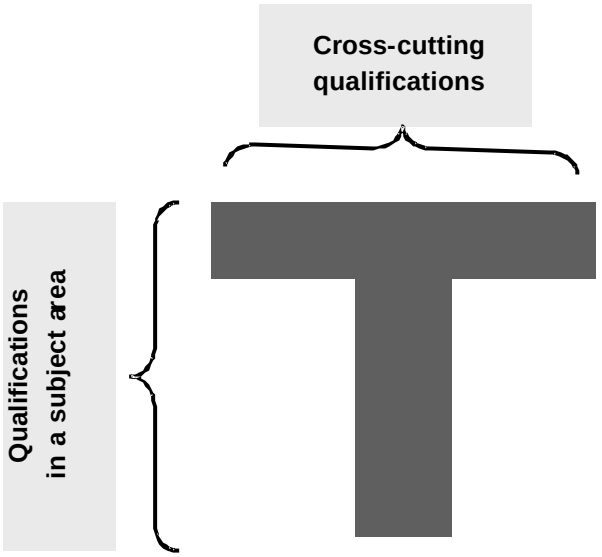

Diagram 2: Basic Idea of T-Intelligence according to Hans-Peter Dürr

As a problem-oriented, systematising and integrative approach syndrome learning shows the following strengths:

- Complementation and classification of knowledge about a certain subject: The knowledge about a certain subject is newly created in the interdisciplinary dialogue, because it has to be communicated beyond the subject.
- Interdisciplinary bridging knowledge: The necessity for bridging knowledge is especially distinct in view of methodological information. Problem-oriented research and teaching require the creation or learning of new methods.
- Transdisciplinary syndrome knowledge: The category of transdisciplinary knowledge includes in particular the capability to actively shape the dialogue with decision-makers and interested parties.
- That fact that besides structural patterns feedback loops (vicious circles) can be identified also speaks in favour of this approach.

With the aid of the syndrome approach, the learners are able to

- acquire theoretical foundations of the issues of sustainability,
- get to know interdisciplinary working methods in problem- and practice-oriented teaching offers,
- develop and use strategies and instruments in order to achieve sustainability via concrete projects,

- extend their social and communicative capabilities,
- get to know and apply prediction techniques (future workshop, scenario-technique).

Furthermore, the approach offers a methodological basis to examine all interconnections that take into account the ecological, economic and socio-cultural aspects of social change. The learners get the opportunity to organise their knowledge in a multidisciplinary, systems-based manner and to update it continuously.

4.4 How syndrome learning contributes to an education for sustainable development

The aim of an education for sustainable development is to allow the participants to shape their own behaviour in a sustainable way. In a rapidly changing world this requires to continuously restore and actively help create an equilibrium between economic, ecological and social interests. In this context, the commitment and new forms of participation of as many social groups as possible are needed.

This participation in or self-organisation of communication and decision processes presupposes a multitude of competences: independent acquisition and assessment of information, capability to communicate and co-operate, foresighted planning, thinking in integrated systems etc. Syndrome learning requires and promotes these competences. Its strengths lie in a future-orientation with no fixed outcome, in a problem-orientation as well as in its way of dealing with insecurities and incomplete knowledge stocks.

Based on a risk- and/ or crisis-prone development of the relation between humankind and nature, trends of global change are analysed in an exemplary way, various future scenarios are modelled and acceptable solution corridors are developed. The learners acquire the necessary problem solving competencies that allow them to describe networks of cause and effect and thereby taking into account feedback and synergy effects. This goes far beyond the mere description of chains of cause and effect that form the basis of numerous conventional methods.

The syndrome approach is not based upon secure knowledge stocks and unambiguous connections, but upon the limited predictability of the development dynamics of complex systems. Accordingly, syndrome learning is based upon scenarios in which decisions have to be made even though there are insecurities and risk, the facts are uncertain and the values are controversial. Here we come full circle to sustainability that allows openness and insecurity instead of referring to the completeness and unambiguity of knowledge stocks.

Experiences with syndrome learning

As mentioned above, syndrome learning was tested - in the framework of the BLK-Programme 21: Education for a sustainable development – at the beginning of 2000 in the classes of comprehensive schools in Berlin and Schleswig-Holstein. The resulting teaching sequences were documented in the series “Werkstattmaterialien”.

As an illustration, one of these projects that deals with the environmental degradation through depletion of non-renewable resources, the so-called Katanga Syndrome, is outlined below.

5.1 Brief description of the syndrome

The KATANGA-SYNDROME is closely linked to mining and describes the environmental degradation through depletion of non-renewable resources. Since the Iron Age, the depletion of non-renewable resources below and above ground has been part of the economic activities of humankind that leads to local and regional destruction of eco-systems. The name of the syndrome is derived from the model region for the syndrome mechanism, the Katanga Province in the south-east of the Democratic Republic of Congo. This region is considered to be one of the richest mining areas of the world with vast deposits of copper, cobalt, tin, uranium, manganese and coal. The exploration of these natural resources is conducted predominantly above ground and leads to a mostly irreparable destruction of the eco-systems involved.

There are widespread examples for the occurrence of this syndrome. Among others, the brown coal mining in Niederlausitz or the surface coal mining in the eastern part of the USA (Appalachian Mountains) have to be mentioned. Further examples are the centres for ore mining such as Carajás in the Brazilian state Pará (iron ore, aluminium), Bougainville in Papua New Guinea (copper) and Bingham Canyon in Utah, USA (copper). In general, mining is only conducted temporarily for some decades. However, it almost everywhere leaves behind permanent damage to the environment.

Two manifestations can be distinguished: On the one hand, the mining of huge quantities of resources (especially above ground) has morphological consequences and leads - through the displacement of large masses of material - to mine subsidences on the surface. This in turn has a considerable impact on hydrological processes such as the surface run-off, the sediment impact of rivers and groundwater table, but also on the soil erosion. On the other hand, the release and accumulation of toxic substances (e.g. heavy metal and radionucleids) have negative consequences for the environment. Both mechanisms lead to an extensive destruction of natural eco-systems and arable soil (loss of fertility). The negative consequences for the local population range from health damages to forced resettlement.

The mining of non-renewable resources (coal, oil, gas, ore, precious stones etc.) also contributes to the destruction of forests. On the one hand, the "interfering" forest above the resources can simply be cleared and the eco-system therefore completely destroyed, whereas the profit from the wood sale partially appears as a by-product in the balance sheet of the companies involved. As a consequence, an unregulated agricultural use of the regions that have been opened up for the exhaustion of resources takes place - especially in those developing countries that have a high portion of impoverished rural population. As this usually takes place in marginal locations in tropical forest regions, these patterns serve at the same time as an example for the SAHEL - and the DUSTBOWL-SYNDROME.

In addition to the ecological consequences, a strong dependence from economic and social determinants is characteristic for the KATANGA-SYNDROME. Particularly in developing and emerging countries obsolete mining techniques are used because there is not enough money and environmental standards are often inexistent. The level of debt in these countries and the often huge dependence of their economy from export and foreign investments aggravate the problem. Most of the time, these countries have an imbalanced economy oriented towards the extraction and export of raw materials. State-run conglomerates that are charged with the exploitation of local raw material are part and parcel of these "economic monocultures". The thus characterised economies are particularly strongly subjected to fluctuating world prices and foreign conglomerates. As a result of their increasing consumption of energy and raw material (especially of primary energy sources), the industrialised countries on their part have little interest in the diversification of these countries. Once the resources are depleted or can no longer be offered at competitive prices, entire regions or countries are threatened with impoverishment. For these reasons, the KATANGA-SYNDROME has a distinct development dimension (geo-political dimension). Similar patterns, however, can also be found in structurally weak regions of industrialised countries whose economy is based on the exploitation of non-renewable resources. The interest in reducing one's own dependence on energy imports (security of supply) constitutes another important factor. However, a growing ecological awareness leads to higher standards for environmental protection and obligations, for example for the renaturation of areas of surface mining in industrialised countries which in turn leads to less environmental damage caused by the exploitation of resources.

(cf. BLK-Werkstattmaterialien, No. 8)

5.2 A school project

The 11th grade of the “gymnasium-branch” of the Lise-Meitner-Schule in Berlin-Neukölln, a school that has the main stress on natural sciences, carries out the so-called “Lausitz-Project”. In an interdisciplinary project focussing on natural and political science, the students examined the effects of brown coal mining from the point of view of sustainability: soil degradation, water pollution, changes in the structure of society, minority conflicts, economic problems etc.

The project is divided into the following phases: During the first two to three weeks, the students deal with the various aspect of the above mentioned issues. Their subject specific reflections are consolidated and analysed with the aid of the syndrome approach. Having finished this theoretical work, the students visit the brown coal mine “Lausitz” in order to study the consequences on the spot. As a conclusion, the project is analysed together.

The three natural science subjects physics with laboratory tutorial (PHL), chemistry with laboratory tutorial (CHL) and biology with laboratory tutorial (BIL), political science – divided into economy (WI) and politics (POL) – as well as German (DE) were involved. The following table reflects the content of the individual subjects acquired in the framework of the project.

Materia	Main focus	Keyword
CHL	Analysis of water quality	Limit values/ estimation of pH-value/ conductivity/ ion detection (photometry; quick tests)/ remedial actions
BIL	Analysis of soil quality	Lime concentration/ acidification/ measurement of pH-value/ buffering/ soil respiration/ Al-release/ test sticks/ indicators /titration
PHL	Efficiency analysis	Photovoltaic/ doped semiconductors/ electrical power/ irradiance/ energy conversion chain/ coal-burning power plant/ calorific value/ supply and demand/ waste heat utilisation
POL	Population development/ migration	Cause and effect/ minorities/ resettlement/ resistance/ political decisions and legal basis/ migration/ unemployment
WI	Economic structure	Performance benchmarks/ factors of production/ monopolies and their development (Vattenfall)/ brown coal mining – agriculture – tourism/ ecological rucksack/ energy consumption/ production conditions
DE	Text composition	Life in the Lausitz/ text production: haiku, sonnet, fable, rap/ metamorphosis: standard language → jargon/ prose → poetry/ illustrations→ comics

Source: Werkstattmaterialien No. 8, p.16

Sceptical forecast and perspectives

In active learning processes that provide a basis for sustainable behaviour change the following goals take centre stage: Promoting the development of the subjects in interaction with their environment and dealing with the development of society - that considerably influences this interaction. In this context, connected thinking plays an important role. Will it be possible to develop and live an adequate interdisciplinary behaviour adapted to these connections? The syndrome approach is not plain sailing:

- In principle, it is based on the assumption that instruments to solve the above mentioned problems can be developed based on thorough analyses.

- The equation of "problem" and "clinical profile" contained in the approach is questionable, because the aspired creating competences are focused on preventing critical conditions and not on creativity. The syndrome approach mass tourism is thus characterised as a "disease", even though this development also contains the hope of an improved economic and social situation.

- In general, it has to be clarified whether the syndrome approach is not too complex to structure teaching/ learning processes. (And: Do the projects that are carried out under the label of syndrome learning really correspond to the ideas outlined above?)

- From a pragmatic point of view one has to check whether the time and effort necessary for syndrome learning is not disproportionately high.

Despite these critical remarks, the syndrome approach is very fascinating, because it shows that the scientific community tries to face the complexity of current social developments and perception of problems and to do this accepts the risk of abandoning the methodologically safe ground of traditional doctrine. This opens up new possibilities, but also holds risks and unanswered questions:

- **Challenge and opportunity:** No matter how the discussion about sustainability continues, this development will have to be included into the educational work. Because it will not be able to avoid the current social discourse on sustainability. The educational institutes have to recognise that the debate on sustainability is a challenge as well as an opportunity to enable topical and forward-looking learning processes.

- **Curricular debate based on sustainability:** Active learning processes should not be oriented towards a one-dimensional functionalistic social and economic theory. They have to assimilate political, economic and ethical perspectives. In a period of pluralistic values, moral self-determination and a collective self-restraint have to be promoted.

- **Necessary curricular debate**: The contents of the learning processes have to satisfy the requirements of reality and science. Therefore, from a curricular point of view, the interdisciplinary approach takes centre stage in the debate.

Its aim is to replace the fragmented specialist subject teaching by an open, relatively flexible and connected curriculum. Obsolete ideas and rituals in the teaching process – and therefore the rigid structuring of learning content and the still dominant ex-cathedra teaching – have to be challenged.

- **Educational aim specialised generalists:** Active learning processes contribute to the promotion of qualifications and competences that are important for a "specialised generalist". In consideration of the emerging changes in the professional world, learning processes are primarily aimed at developing the capability to communicate and co-operate as well as the individual performance, flexibility and self-reflection. Because the reorganisation of the occupational systems amounts to an universalisation of the qualification profiles that can be found in terms such as key qualifications, holism and autonomy.

- **Islands of sustainability as a status quo:** The claim of socio-politics, educational theory and didactics that they enable sustainable, interdisciplinary learning is at the moment to a large extent limited to few projects. They are islands in the educational course of life. The dream of an interdisciplinary approach is still far away from the disciplinary reality.

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