Sustainability science and learning in transdisciplinary settings

*Inception Symposium on Sustainability Science. UNESCO Paris, 5-6 April 2016*

**PANEL 5: Sustainability science involvement in different sectors**

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Taking a stroll round the Castle of Brake in Lemgo...
Le temps déloyé. - Yves Charnay (2006)
Anamorphosis of Brake Castle
Adomßent / PANEL 5 Sustainability science involvement in different sectors
»We went to explore the Moon, and in fact discovered the Earth.«

Eugene Cernan, Commander Apollo 17, Last astronaut on the moon (1972)
Figure 1 | Beyond the boundary. The inner green shading represents the proposed safe operating space for nine planetary systems. The red wedges represent an estimate of the current position for each variable. The boundaries in three systems (rate of biodiversity loss, climate change and human interference with the nitrogen cycle), have already been exceeded.

Source: Rockström et al. (2009)
Economic dimension
- caring economy; recycling economy;
- material flow management;
- environmentally friendly, innovative technologies; eco-design (operating life, disposability, aesthetics);
- prices reflecting ecological and social costs;
- polluter pays principle;
- regional and local marketing networks;
- fair trade

Ecological dimension
- efficient use of resources;
- nature’s rhythms (regeneration, “proper time”);
- biodiversity;
- ecological lifecycle systems; regenerative energy;
- precautionary principle;
- avoiding ecosystem degradation (reducing pollutants, emissions, waste)

Sustainable Development

Social dimension
- promoting human health;
- equal rights to the use of natural resources and to development; intrasocial justice;
- accounting for the interests of future generations;
- democratization; participation of all population groups in all areas of life, networks, livelihood through work

Cultural dimension
- ethical verification; sustainable lifestyle;
- holistic perception of nature; aesthetic perception of sustainable development;
- local cultural diversity of paths to sustainable development;
- traditional knowledge; experience of time; material culture; consumer awareness; local community; international exchange; global responsibility; cosmopolitan culture

Lüneburg Approach
Quality criteria in science

Necessary, …

- **Objectivity**: the extent to which a test result cannot be influenced by the principal investigator with regard to implementation, evaluation and interpretation; or if several/many researchers are producing matching results.

- **Reliability**: an investigation / a measurement method is described as reliable if a repetition of the measurement under the same conditions and at the same objects comes to the same conclusion.

- **Validity**: quality criterion that indicates the degree of accuracy with which a test records what it’s supposed to record (e.g., personality traits or behaviors).

…but no longer sufficient conditions in order to guarantee validity of knowledge.

- **Accountability of research**: more than ever science has to take its own implications and limitations more into account.

- **Responsibilisation** of researchers: social control through (self-) control and (self-) ascription of responsibility.
Core elements of knowledge production within research for sustainability

- **Problem orientation:** Translation of existing societal problems into ensembles of scientific problems.

- **Actor orientation:** Consideration of actors’ constellations and their possible ways of action // proactive design of problem horizons instead of repairing damages

- **Problems of integration** form the focus of interest.

- **Self-reflexivity:** Making substantial normative premises and interests transparent // Reflexion of knowledge boundaries / limits.

- **transdisciplinary, participative model / understanding of science**

*Source: Jahn (2001)*
Modes of knowledge production in transdisciplinary sustainability research

<table>
<thead>
<tr>
<th>Science type:</th>
<th>traditional ideal of science</th>
<th>formative and evaluation research</th>
<th>problem and solution oriented research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position of observant:</td>
<td>non-participating observant</td>
<td>participating observant</td>
<td>observing participant</td>
</tr>
<tr>
<td>Construction of reality:</td>
<td>independent from observant</td>
<td>varies according to understanding of science -</td>
<td>observable world is dependent on observant</td>
</tr>
</tbody>
</table>
Higher Expectations: Universities have to rethink their self-image as „ivory towers“

- Engine for innovation
- Centers of regional knowledge clusters
- Think tanks for the challenges of the 21st century
- Drivers of change in politics, business and civil society
### Staged social and educational responses to sustainability

<table>
<thead>
<tr>
<th>Sustainability transition</th>
<th>Response</th>
<th>State of sustainability</th>
<th>State of education</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Very weak</td>
<td>Denial, rejection or minimum</td>
<td>No change (or token)</td>
<td>No change (or token)</td>
</tr>
<tr>
<td>2 Weak</td>
<td>'Bolt-on‘</td>
<td>Cosmetic reform</td>
<td>Education <em>about</em> sustainability</td>
</tr>
<tr>
<td>3 Strong</td>
<td>'Build-in‘</td>
<td>Serious greening</td>
<td>Education <em>for</em> sustainability</td>
</tr>
<tr>
<td>4 very strong</td>
<td>Rebuild or redesign</td>
<td>Wholly integrative</td>
<td>Sustainable education</td>
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*Sterling (2004)*
Leuphana University’s leadership has worked out a clear strategic framework.

1) Policy & planning
   Foundation for operational & cultural changes
   (history, key principles, master planning, etc.)

2) Institutional arenas
   - Research
   - Education
   - Partnerships/outreach
   - Campus & facilities management/administration

3) Vision / final goal
   Enduring sustainable university

Policy & planning

Institutional arenas

Vision / final goal

Enduring sustainable university
Underlying profile and academic focus:
- „A university for civil society in the 21st century”

Sustainability is one of the key principles for Leuphana University

- **Humanistic university**
  - Education through scholarship.

- **Sustainable university**
  - Transformation competence for sustainable development.

- **Action-oriented university**
  - Analysis, creativity and reflexivity with regard to practical problems.

**Education:** Education for Sustainable Development is one of Leuphana’s key principles.

- Educational orientation towards sustainability is the **president‘s special concern** in order to assign top priority to educational matters.

- Three of the five members of the presidential board are **vice-presidents of Leuphana‘s three academic schools** (College, Graduate School and Professional School).

- Leuphana’s idea is that, apart from specialist knowledge, academic education needs to support competency acquisition and the development of personal capabilities. Thus, the objective is to educate reflective, critical and active societal members (agents of change).
Education: Higher Education for Sustainable Development has been integrated in the form of a general studies mandatory component for all Bachelor students and different degree programmes.

**General studies** for all Bachelor students:

1. **Leuphana Semester** covers the first semester of all Bachelor study programmes and is mandatory for all first semester Bachelor students, independently from their major studies.

   Module “Science and Responsibility“ accounts for 1/3 of the Leuphana Semester and covers sustainability issues and illustrates ethical behaviour.

2. **Complementary studies** accompany all Bachelor study programmes and cover several sustainability seminars.

**Specialisation options:**

3. **Bachelor studies:** Major Environmental Sciences
   Minor Sustainability a) in Humanities and b) in Natural Sciences

4. **Master studies:** Sustainability Sciences

5. **MBA:** Sustainability Management

6. **PhD:** Sustainability Sciences

7. **Extra-occupational:** Certificate in “Sustainability and Journalism”
Leuphana College offers a unified model of study for all subjects. The various preceding undergraduate programs are completely replaced by one model.

- Familiarity with an interdisciplinary perspective and multiple disciplines; exploring foreign languages as key to culture(s); Participation in a practical (social) project
- Work ethics and methodology for both team-oriented and autonomous settings
- Exemplary in-depth knowledge and general overview in the sense of an ordering matrix; Autonomous, comprehensive academic work in the chosen field of specialization
- Additional subject field or further specialization in a Major-related area of study
- LEUPHANA BACHELOR

CP = Credit Points
The first Semester: Helping lone warriors to become a durable community of learners. Teamwork and peer learning create transdisciplinary learning successes.

- Emotional identification with degree program and university
- Acceptance into the scientific community of learning
- Creating a welcoming social atmosphere on campus
- Mentoring to ensure productivity and success from the start

Conference Week

“Science imparts understanding”
for perspective and reflexion

“Science and Responsibility”
with Conference Study

“Science uses Methods”
qualitative & quantitative

“Science knows disciplinary boundaries”
specialization/Major

Freshman Week with Case Study

LEUPHANA SEMESTER

http://www.leuphana.de/en/study/bachelor/leuphana-semester.html
The module „Responsibility in Science“ asks:

Which questions arise from the problems of tomorrow?

Interdisciplinary introduction to science
Change of roles and perspectives

University for the Civil Society
Challenges of sustainable development

Learning by research
Participation in science as an open process

Learning objectives: scientific inquiry, arguing, cooperative research, target group-oriented presentation

Focus: Opportunities and limits of societal shaping of the future
→ How does change work?

Project groups present their first ‘research results’ at the conference week
Structure of the Module “Responsibility in Science“: Forms of learning and teaching

(1) Knowledge transfer

Lecture series

(2) Knowledge generation

Study document „Sustainable Development“

Project seminar 1
Project seminar 2
Project seminar 3
...
Project seminar X

Tutorials

(3) Knowledge presentation

70 interdisciplinary project-oriented seminars

Final student conference
## Development of the project seminars

<table>
<thead>
<tr>
<th>October</th>
<th>November</th>
<th>December</th>
<th>January</th>
<th>February</th>
<th>March</th>
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<tr>
<td>Introduction</td>
<td>Project work</td>
<td>Feedback, preparation for the conference</td>
<td>Paper</td>
<td>Presentation for the students of the seminar</td>
<td>Conference Week</td>
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- **October**: Introduction
- **November**: Project work
- **December**: Feedback, preparation for the conference
- **January**: Paper
- **February**: Presentation for the students of the seminar
- **March**: Conference Week
The project seminars: some examples

- Professional Excellence in Living Companies - An Approach towards more Sustainability
- The importance of forest multi-functionality in the context of sustainability
- Sostenibilidad y diversidad lingüística
- Internet Power and Human Reason
- Creators of the Future - Visionary Business Projects in the Context of Sustainable Development
- Health, social (in)justice and sustainability: questions and challenges in global and local contexts
- The Cultural Dimension of Sustainability
- Migration, segregation, parallel society: residential districts and the formation of neighbourhood
- Sustainable natural resource management - using the example of soil and water
- Sustainability: a matter of doing gender? - Creating commercials on the relationship between gender and sustainability
- Responsible Decision - Unconditioned Criticism. The Relationship between Practice/Praxis and Science
- Peak Oil - End of prosperity or change to sustainable wealth?
“Involving representatives of all those who might have a vested interest in a particular systematic review helps to ensure that it is a relevant and useful piece of research.”

EPPI Centre / IoE
Evidence for Policy and Practice Information and Co-ordinating Centre
https://eppi.ioe.ac.uk/cms/LinkClick.aspx?fileticket=hQBu8y4uVwl%3D&tabid=88
Minor «Sustainability science»

- **Mi05**  
  Shaping the Future: Transdisciplinary project work I

- **Mi03**  
  Inter- and transdisciplinary cooperation

- **Mi06**  
  Shaping the Future: Transdisciplinary project work II

- **Mi04**  
  Developing sustainability-oriented scenarios  
  Methods of futurology

- **Mi02**  
  Analysing complex systems

- **Mi01**  
  Specific approaches to sustainable development
Minor »Sustainability Science«: Goal and line of action

Socially relevant problem complex → Systematic analysis: Syndrome Concept → Practical application – a case study → Scenario development → Mapping out projects → Synthesis projects
## Aims of the Syndrome Concept

<table>
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<tbody>
<tr>
<td>systematic, functionally oriented overview of the global change processes</td>
</tr>
<tr>
<td>Identification of functional patterns (“disease patterns”) of global change</td>
</tr>
<tr>
<td>Reconstructing these problems, in order to create explanatory models for their emergence and previous development</td>
</tr>
<tr>
<td>Disclosure of non-sustainable trends of development patterns, allowing to identify safety fences for sustainable development</td>
</tr>
</tbody>
</table>
Overview of Global Change Syndromes

“Utilization” Syndromes
1. Overcultivation of marginal land: Sahel Syndrome
2. Overexploitation of natural ecosystems: Overexploitation Syndrome
3. Environmental degradation through abandonment of traditional agricultural practices: Rural Exodus Syndrome
4. Non-sustainable agro-industrial use of soils and bodies of water: Dust Bowl Syndrome
5. Environmental degradation through depletion of non-renewable resources: Katanga Syndrome
6. Development and destruction of nature for recreational ends: Mass Tourism Syndrome
7. Environmental destruction through war and military action: Scorched Earth Syndrome

“Development” Syndromes
8. Environmental damage of natural landscapes as a result of large-scale projects: Aral Sea Syndrome

9. Environmental degradation through the introduction of inappropriate farming methods: Green Revolution Syndrome
10. Disregard for environmental standards in the course of rapid economic growth: Asian Tigers Syndrome
11. Environmental degradation through uncontrolled urban growth: Favela Syndrome
12. Destruction of landscapes through planned expansion of urban infrastructures: Urban Sprawl Syndrome
13. Singular anthropogenic environmental disasters with long-term impacts: Major Accident Syndrome

“Sink” Syndromes
14. Environmental degradation through large-scale diffusion of long-lived substances: Smokestack Syndrome
15. Environmental degradation through controlled and uncontrolled disposal of waste: Waste Dumping Syndrome
16. Local contamination of environmental assets at industrial locations: Contaminated Land Syndrome
Syndrome Approach (German Advisory Council on Global Change - WBGU, 1997)

The Global Network of Interrelations (Source: WBGU 1996: 108)
Syndrome-specific network of interrelations of the Sahel Syndrome. The three sub-networks from which the complexes of issues are derived are marked red, green and blue.

Source: WBGU (1996: 135)
Central mechanism of the *Sahel Syndrome* (*vicious circle*).
Source: WBGU (1996: 134)
A hierarchy of learning as a starting point?

- **Awareness** of sustainable development, as well as the range of views of interpretations of sustainable development and the implications for these differences

- **Process** - encourages to begin to question (and analyse) how the principles of sustainable development can be made to work;

- **Integration** - beginning to use the principles of sustainable development extensively in assignments and other class-work linking to real world issues in the community

- **Transformative** – without direction, students operate as critically reflective practitioners of sustainable development.

☞ „At this level, the curriculum becomes an expression of the cultural change that is sought.“

Sterling/Thomas (2006)
Characteristics of a Community-of-Interest in contrast with those of a Community-of-Practice (after Fischer & Ostwald, 2005)

<table>
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<th>Characteristic</th>
<th>Community-of-Practice</th>
<th>Community-of-Interest</th>
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<tbody>
<tr>
<td><strong>Nature of problems</strong></td>
<td>Different tasks in the same domain</td>
<td>Common task across multiple domains</td>
</tr>
<tr>
<td><strong>Members</strong></td>
<td>From the same domain (novices and experts)</td>
<td>From different domains (stakeholders)</td>
</tr>
<tr>
<td><strong>Knowledge development</strong></td>
<td>Exchange of knowledge within the practice; refinement of domain-specific knowledge system</td>
<td>Exchange of knowledge between domains; integration of multiple knowledge systems</td>
</tr>
<tr>
<td><strong>Learning</strong></td>
<td>Growing from novice to expert</td>
<td>Reaching shared understanding</td>
</tr>
<tr>
<td><strong>Major objective</strong></td>
<td>Growth in domain-specific knowledge</td>
<td>Resolving a complex problem</td>
</tr>
<tr>
<td><strong>Threat</strong></td>
<td>group think</td>
<td>No real communication</td>
</tr>
<tr>
<td><strong>Opportunity</strong></td>
<td>Fast progress due to shared background</td>
<td>Creative and robust solutions by making all voices heard</td>
</tr>
</tbody>
</table>
Recommendations

- cultural dimension of sustainability is conceptually and strategically indispensable, both for research and education

- valuing and deliberately addressing the regulative core of sustainable development and its implications for education are an asset for (science) education

- interrelatedness of science and sustainable development deserves educational attentiveness by every professor and lecturer and his/her students

- To this end, it is essential to make (sustainability) science a tangible experience for students (to familiarise with and practice value-laden conflicts, tensions and incompatibilities of knowledge etc.)
Without u there's no sustainability.
Ohne Dich keine Nachhaltigkeit.

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Der regulative Kern nachhaltiger Entwicklung und seine Implikationen für Bildung

nachhaltige Entwicklung ist als regulative Idee anzusehen

- lässt sich niemals endgültig und abschließend operationalisieren
- ist in den jeweiligen gesellschaftlichen und historischen Kontexten immer wieder neu zu definieren (vgl. Menschenrechte)


- Sie lassen sich gewissermaßen als „Prä-Konzepte“ verstehen, „ohne die keine angemessenen Fragen gestellt oder Probleme definiert werden können“ (ebd.).
In der Idee der nachhaltigen Entwicklung ...

- ... spielen verschiedene gesellschaftliche Visionen wie die von der Gerechtigkeit, der Freiheit und der Selbstbestimmung, des Wohlergehens aller Menschen oder der Zukunftsverantwortung mit jeweils unterschiedlicher Gewichtung zusammen.


- Und es sind gerade derartige Aushandlungsprozesse, die im Kontext nachhaltiger Entwicklung Räume für Bildung und Lernen zu öffnen vermögen:

  „Bezogen auf Nachhaltigkeit bedeutet dies, dass Widersprüche, Dilemmata, Zielkonflikte in einem Diskursprozess zwischen allen involvierten Personen und ihren Meinungsbildern, Interessen, impliziten und expliziten Wertvorstellungen sowie in jeder konkreten Situation neu verhandelt werden müssen.“ (Rauch 2005, S. 28)
Goal and line of action

Overall topic:

- Sustainable development as a challenge for society

Aim of the Minor:

- Förderung wissenschaftlich fundierter Handlungskompetenz (Denkweise und Methodenwissen)
- Systemwissen: Wissen über Strukturen, Funktionen und Prozesse und Wirkungszusammenhänge
- Systemwissen wird verbunden mit Bewertungen, mit ethischen Orientierungen zum Verhältnis von Mensch und Natur, mit Denken in Alternativen, vorausschauendes Denken, Umgang mit Komplexität…
- Orientierungswissen: Ableitung von Handlungsmöglichkeiten

Characteristics:

- Interdisciplinary teaching and learning
- Projektorientierung und eigenverantwortliches selbstgesteuertes Lernen
- Kompetenzerwerb und Persönlichkeitsbildung