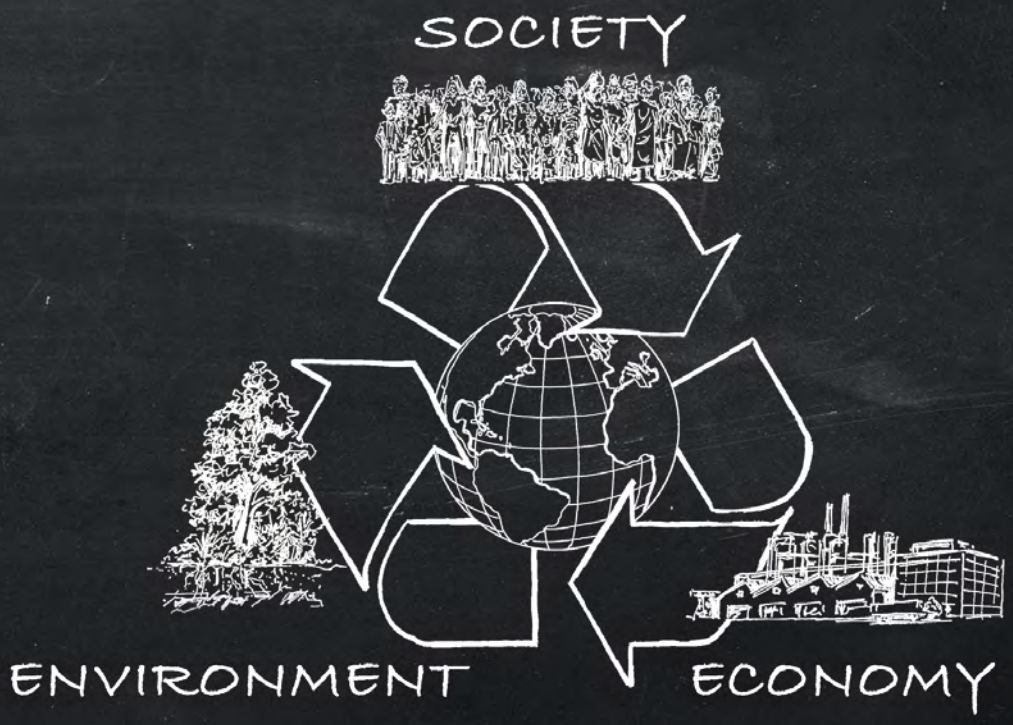
UNIVERSITÄT BERN

GUIDELINES WITH IN-DEPTH MODULES FOR THE UNIVERSITY OF BERN

FOUNDATIONS

Integrating Sustainable Development into Higher Education



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Integrating Sustainable Development into Higher Education is a set of Guidelines aimed especially, but not exclusively, at teaching staff from all disciplines at the University of Bern who wish to take up the cross-cutting topic of "Sustainable Development" in university courses and integrate it into their teaching. It contains brief, basic information on the topics of "Sustainable Development" and "Education for Sustainable Development" *(Foundations)*, as well as practical concepts, tools, guidance, information, examples, links, and slide sets for the integration of these topics into teaching (*In-depth modules 1–4*; only available in German).

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CENTRE FOR DEVELOPMENT AND ENVIRONMENT

Contents

The University of Bern is committed to freedom in teaching and research. It recognises its ethical responsibility and respects the principles of sustainable development in its academic, administrative, and operational areas.

(from the University of Bern's Mission Statement)

Foreword

In its Strategy 2021, adopted on 2 July 2013, the University of Bern set the goal of promoting Sustainability in research, teaching, and operations. We already have two degree programmes dedicated to the topic of Sustainable Development and open to all students at the University: since 2013, the Bachelor Minor in Sustainable Development, and since 2015, the Master Minor in Sustainable Development. Our Strategy 2021 foresees that no student should leave the University of Bern without having studied the links between their major and Sustainable Development. We can reach this goal if all bachelor courses at the University offer at least two lessons on the topic. We thus call on every discipline at the University of Bern to address Sustainable Development in their courses.

In this context, the current Guidelines are an important support for lecturers to integrate Sustainable Development into their teaching, either in two lessons or more comprehensively. The Guidelines were developed in a participatory process that began in October 2014, and they reflect the content/topics as well as pedagogic/methodological experiences of many lecturers. The authors of these Guidelines have developed an approach and put together tools that have been tested in several workshops and consultations, and are continuously being improved. In addition to the present *Foundations* document and the four online *In-depth modules*, lecturers also have access to two short explanatory videos, different kinds of workshops, and personal consultations – and the offers of support available are being continuously expanded. The University's Centre for Development and Environment (CDE) and its Educational Development Unit will continue to provide content support and didactic know-how.

The *Foundations* document is based on the international understanding of Sustainable Development. The authors show why this debate concerns us all as scientists, and how reflecting on Sustainable Development can enrich your own subject. The Executive Board of the University of Bern wishes to offer all lecturers the opportunity of integrating Sustainable Development into their teaching, thus helping ensure that academic knowledge creates forward-looking, ethical value.

We would like to thank the team of authors and all who contributed to the creation and review of these Guidelines. The stimulating discussions with the Deans of the eight faculties, together with heads of study programmes, lecturers, and students, made clear to us how enriching the examples of Sustainable Development integration already are. These discussions also showed which challenges we still have to face, and how diversely the call of our Strategy 2021 to integrate Sustainable Development into teaching can be implemented.

We wish you happy reading, and all the best in putting to use the tools, ideas, and opportunities for consultation offered. We would be very pleased to see new courses, case studies, and further online tools following publication of these Guidelines.

Prof. Dr. Doris Wastl-Walter
Vice-Rector Quality

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1 Aims and contents of these Guidelines

These Guidelines are aimed primarily, but not exclusively, at **lecturers from all disciplines of the University of Bern** who wish to integrate the cross-cutting topic of Sustainable Development (SD) into the university courses they teach.

The Guidelines are in two parts:

Part 1 – the present *Foundations* document – offers summarized information on important aspects of Sustainable Development at university level, with a focus on university teaching. This includes an overview of:

- the United Nations' understanding of SD, on which most national governments, including Switzerland, and international organizations base their understanding of SD;
- the interplay between how science and values are understood within the context of higher education, which arises out of a commitment to SD;
- the mandate given to the University of Bern by the cantonal government to establish SD in research, education, and operations;
- Education for Sustainable Development (ESD) at university level; and
- guidance on the selection of educational content, competences, and suitable teaching–learning arrangements for ESD.

Part 2 – consisting of *In-depth modules* – is available only in electronic form (and mostly in German) at www.esd.unibe.ch, and comprises a growing collection of various aids to integrate SD into university teaching.

- *In-depth Module 1* consists of **concepts, tools, instructions, information, and examples** intended to support university teaching. Lecturers may wish to use this material to identify educational content, SD-relevant competences, and suitable course formats, and can use them to innovatively design individual lessons or entire courses.
- *In-depth Module 2* contains **case studies** of university courses that were taught, developed, and described by lecturers in different disciplines at the University of Bern. They show different ways in which SD has been integrated into courses, in terms of both content and didactics.
- *In-depth Module 3* contains **supplementary supporting material**, i.e. offers of assistance for lecturers, such as a collection of suggested reading, offers of coaching, and links to web-based tools.
- *In-depth Module 4* provides **educational materials** such as short explanatory videos, slide sets, and other material on key aspects of SD and ESD, which lecturers can use for preparation or in their courses.

2 Sustainable Development

How it is understood and what universities can do

2.1 How SD is understood today

Since publication of the Brundtland Report in 1987, the term "Sustainable Development" (SD) has been used as a general guide for global social development. The report, *Our Common Future*, defines SD as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". This understanding of SD was adopted in 1992 by the United Nations Conference on Environment and Development (UNCED – also known as Rio Conference or Earth Summit), and later by numerous organizations and governments – and has since become the most widely used global reference. Like many other countries, Switzerland also represents this understanding both internally and externally. In addition to the environmental, social, and economic aspects, the UN understanding also includes a spatial and a temporal sustainability dimension (Fig. 1). Based on this, on 25 September 2015, the 193 UN member states approved the 17 Sustainable Development Goals (SDGs) with 169 concrete targets. The SDGs form the political basis for efforts towards SD in the coming years (see Chapter 6 as well as *In-depth Module 1*).

Sustainable Development should meet the needs of the present without compromising the ability of future generations to meet their own needs.

SD is a long-term, optimistic model of social development that places people at the centre of their needs, abilities, and actions. Its goal is to achieve inter- and intragenerational sociocultural and economic justice while respecting the environmental limits of natural resource use. This cross-cutting task requires contributions at all levels of decision-making – from the individual, local, regional, national, international through to the global level. Participation is a core principle of this model, with all actors agreeing on their concrete objectives and measures in their professional and non-professional fields of action as an overall vision. In this way, SD is a continuous process of negotiating *trade-offs* or compromises, to balance a wide range of environmental, social, and economic interests, and to regulate conflicts of interest in a just and peaceful way. This in turn means that all actors must possess the relevant knowledge to act – and must be enabled to act – accordingly. In addition to appropriate institutional frameworks, research and education are key factors.

At its core, SD is a democratic *search, learning, and shaping process* that involves all of society (Stoltenberg and Burandt 2014). *Search* refers to the negotiation and development of visions and goals of SD. *Learning* is the continuous acquisition of knowledge and competences as well as the gathering and evaluation of experiences. And *shaping* refers to the transformation, i.e. the implementation of measures to promote SD in all fields of action. In this process, there is not just one form of "sustainable development", but a multitude of possible pathways to SD, whose environmental, social, and economic impacts should continuously be examined, negotiated, and adjusted.

Sustainable Development is a global, societal, and democratic search, learning, and shaping process. In this process, trade-offs are negotiated under consideration of inter- and intragenerational sociocultural and economic justice while simultaneously respecting the environmental limits of natural resource use.

Despite numerous efforts in the past decades, current global development is far from sustainable. Global environmental problems triggered through overuse of natural resources, social injustices, and poverty persist or are even increasing. This means that the efforts to date have not been sufficient. Aggregated indicators such as the "ecological footprint" (Wackernagel and Beyers 2010) show that a significant global decline in energy and resource consumption can only be achieved if the world's largest consumers, the industrialized countries, limit their consumption. This is vital if ecosystem functions are to be available to humans over future generations. In parallel, the Human Development Index (UNDP 2015) shows that the greatest deficits in socio-economic development still occur in the countries of the global South. Here, too, there is an urgent need for action.

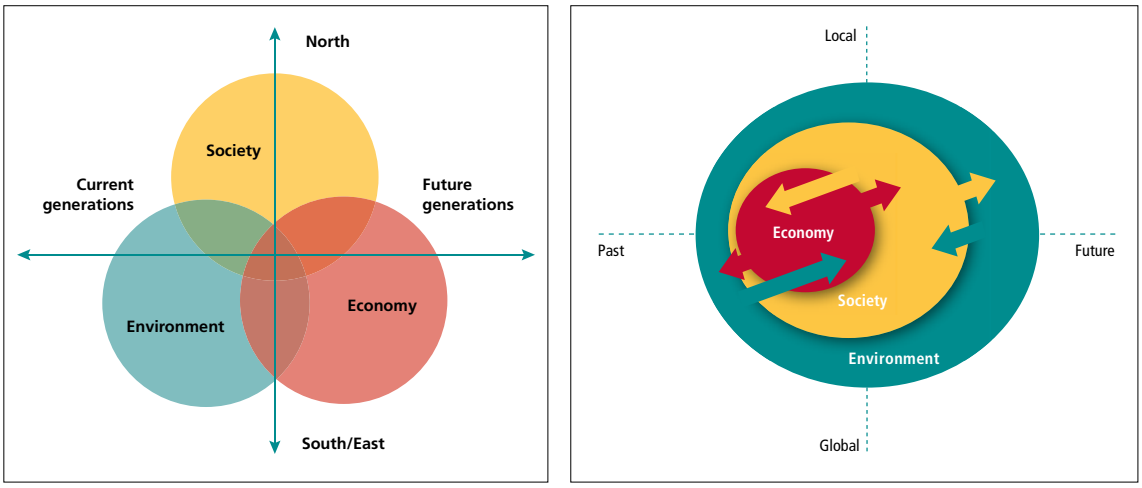

Figure 1: Three dimensions of Sustainable Development (SD): the UN understanding (left) and a modification of this understanding in the position paper of a group of Swiss environmental education organizations (Fachkonferenz Umweltbildung 2010, right). In efforts to achieve transparent negotiation of trade-offs, the weighting of the SD dimensions will not always be the same. Models of SD with three dimensions are easy to understand and therefore widespread. In a university environment, however, they could give the impression that important aspects such as culture, technology, and health have been forgotten. It is therefore important that these absent but implicit components are made explicit in further work with the models.

There is an urgent need to improve socio-economic conditions in developing countries, while a significant reduction in energy and resource consumption must be achieved primarily in industrialized countries.

2.2 How can a university contribute?

These facts are not new. Since they are based largely on scientific research, one may ask why published research results and existing knowledge have not yet led to a significant improvement of the situation. Put in a forward-looking way: how can science contribute more effectively to SD through research, education, and application (Fig. 2)?

Despite global efforts to achieve more sustainable development – and while much of the knowledge is at hand – global environmental, social, and economic problems are worsening.

Phenomena such as climate change, loss of biodiversity, poverty, and social injustices can be viewed from different disciplinary perspectives. Overall, however, they can only be explained by a multitude of biophysical and socio-economic processes which influence each other and whose interlinkages and dynamics are intensified by increasing globalization. Accordingly, one-sided or merely national political steering instruments are unable to control or reverse negative developments, and often lead to new problems such as violent conflict and uncontrolled migration. For example, predominantly economically oriented structural adjustment programmes of the World Bank in the 1990s (market liberalization, deregulation, etc.) intensified poverty among broad population sectors in many developing countries, as well as social conflicts and environmental degradation. Without a major rethink, the same or similar approaches will continue to be propagated – with only moderate success – while alternative approaches will never even begin to be considered.

The scientific study of complex social-environmental interrelations requires an intensification of inter- and transdisciplinary science.

Figure 2: Often, research results indicate massive global problems ahead. What do we as scientists do with these findings? Do we leave it to policymakers and other actors to interpret our findings and work out solutions? Or do we take on more responsibility ourselves?

SD requires us to understand and get to grips with complex social-environmental interrelations, at the same time as these interrelations are continuously changing. Accordingly, attempts to study SD holistically often result in rough estimates with large errors and uncertainties. Accepting and optimizing this is a major challenge for a predominantly disciplinary form of science and university structure. On the one hand, interdisciplinary cooperation between various scientific disciplines is of fundamental importance for research on and analysis of complex connections. On the other, SD also needs to be action-oriented and thus requires a transdisciplinary approach to achieve close cooperation between science and society. If universities and science are to play a more active role in SD, they must integrate various interests and values (see Chapter 3). But working in an inter- and transdisciplinary way should not be seen as a silver-bullet solution that will solve all problems. Instead, it should be viewed as a pragmatic approach to be used by SD-oriented science.

"Business as usual" or limiting our actions to minor adaptations and behavioural change – also in science – will not lead to Sustainable Development. Instead, we need high-quality transformations that are achieved through a pan-societal search, learning, and shaping process.

So far, we have not managed to conquer the global problems we face. This means that a "business as usual" approach as well as limiting ourselves to minor adaptations or behavioural changes will not lead to SD. This is why, for example, the scientific advisory board of the German Advisory Council on Global Change (WBGU) is discussing a "social contract" for a "great transformation" to tackle so-called global megatrends such as climate change, the inadequacy of poverty reduction, increasing drinking water scarcity, etc. WBGU postulates an urgent need for a leap in technology, new welfare concepts, multifaceted social and institutional innovations, and an unprecedented level of international cooperation. Future Earth, the global platform for international scientific cooperation pushing for knowledge generation for SD, argues that there can be no such transformation towards SD without cooperation. WBGU and Future Earth thus propose that sustainable solutions must be developed in an explicitly democratic search, learning, and shaping process involving all of society, ideally involving everybody. To kickstart such a process, individuals acting as "Change Agents" need to play a key role.

Science and universities can play an important role here. An inter- and transdisciplinary form of science, which takes on complex, interdisciplinary connections, still seems most likely to anticipate detrimental developments, prevent crises, and provide decisive impulses for transformations. Sound, disciplinary knowledge remains the basis for inter- and transdisciplinary work. Therefore, as a first step towards clarifying the role of science in SD, we propose that individual disciplines identify and further develop their specific links to SD-related topics (Chapter 6). Subsequently, different inter- and transdisciplinary links can be defined and existing ones further developed, depending on the topic and level of practical relevance. In parallel, Sustainability Science generates, integrates, and links the inter- and transdisciplinary basic and use-inspired knowledge in participatory, deliberative, and adaptive processes and scenarios (Wiek et al. 2011).

An important first step towards Sustainability is to identify disciplinary anchoring points to Sustainable Development.

3 Value orientation and scientific understanding

A challenge for science

Sustainable Development (SD) is not a scientific concept but a normative principle based on the values underpinning societies as well as a legal norm in international law and national legislation. Accordingly, the debate on Sustainability is characterized by different values and societal interests. Scientists interested and involved in SD are confronted with different values that must be reconciled with their own scientific understanding. An example is the personal decision on whether or not to engage in research or teaching for SD and actively participate in transformation processes.

Sustainable Development is a normative principle and not a scientific concept.

In-depth knowledge is a central basis for decision-making in the negotiation process around SD. Through existing (disciplinary) research and teaching, many foundations have already been laid which contribute to the understanding of the environment, society, and the economy. The various disciplines have developed research approaches, tools, and measures that are of direct or indirect importance to SD, such as methods to record development trends, improve analysis and communication, or enable early detection of problems. These also include models and forecasting scenarios, technologies for use of renewable energies, understanding of motivation and decision-making, and recognizing the importance of cultural diversity and biodiversity. Thus, the disciplines play an important role in highlighting clearly defined problem areas and provide important contributions to solving them. They also stimulate SD-relevant innovations, which are then implemented in industry, society, politics, or culture. But the results of scientific work can be used by different actors for a wide range of purposes – including actions with an unsustainable impact.

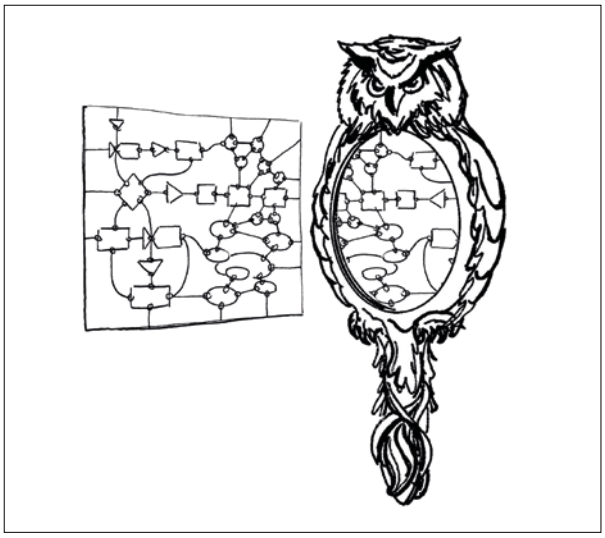

Figure 3: Research on complex social-environmental interrelations deals with value systems and scientific understanding of a range of actors and disciplines – this also includes reflection on one's own position.

Each discipline has its specific, evolved importance for society, and thus also for SD. How pronounced or obvious the relation is can vary. A first step towards SD – and an important signal to society – is for universities to clearly state the importance of these diverse implicit references to SD. A key approach for research and teaching for SD is a reflection on one's own ontological and epistemological foundations, on how one's own discipline is delimited from other disciplines, and on the potential for interdisciplinary cooperation. This involves asking fundamental questions, e.g. which values are the basis of the respective scientific disciplines, how a discipline is positioned in relation to the normative orientation of SD, and how it can contribute to the pan-societal search, learning, and shaping process. What is the discipline's position on the value of nature for humans, justice, and human rights, the postulate of economic growth, technology development, and the responsibilities of ethics and science for the future?

Science already contributes to Sustainable Development – but it can do more. While its importance for innovation is broadly acknowledged, its importance for Sustainable Development is only just being developed.

Once the disciplinary connections to SD are clarified, further steps can be taken, such as the development of *inter- and transdisciplinary research* in the field of complex social-environmental interrelations. Interdisciplinary cooperation requires efforts in integration. To record, analyse, and assess complex changes and trends requires integrative measurement and data collection concepts, methodologies, and analytical processes. A prerequisite for this is for all participating groups to have a minimal basic understanding of the other scientific traditions, epistemologies, methods, procedures, etc. This is hardly possible without having first reflected on one's own disciplinary understanding and the relation of one's discipline to SD (Fig. 3). Such an effort opens new perspectives for all disciplines involved, which can help them strengthen their innovation potential and their respective understanding of science.

Examining Sustainable Development, reflecting on values, and using inter- and transdisciplinary approaches opens new perspectives for science.

4 Sustainable Development at the University of Bern

In 2010 the government of the canton of Bern declared Sustainable Development (SD) an explicit target for the University of Bern. The University Law foresees an effective contribution to SD, and the University Mandates of 2010–2013 and 2014–2017 call on the University of Bern to engage in SD in research, teaching, and operations. For 2014–2021, the University's Strategy 2021 made Sustainability one of five main focal points:

> *The University of Bern includes sustainability among its focuses. It conducts excellent disciplinary, interdisciplinary, and transdisciplinary research and teaching with an international focus on topics such as the climate, responding to global change (north–south relations), and the regulation of world trade. The issue of biodiversity and research into resources, particularly water and energy supplies, are also focal points.*

The University of Bern thus intends to assume a leading role in research and teaching for SD. Important milestones have been the establishment of various university centres or units with research and teaching mandates in the field of SD: the Oeschger Centre for Climate Change Research, the World Trade Institute, the Interdisciplinary Centre for Gender Studies, and the Centre for Development and Environment. Through the "Blue University" initiative, SD is being implemented in relation to water as a resource and a human right. By adapting procurement procedures, the University has taken up SD in its operations more strongly than before. A platform for broad, explorative exchange is provided by the "Sustainability Day" in Bern, with the participation of all higher education institutions in the canton. In addition, the University of Bern is supporting student projects in the field of Sustainability.

Plans for integrating SD into teaching are also in place. Building on its Strategy 2021, the University's Sustainable Development Senate Committee formulated a vision and a corresponding implementation concept, which includes goals for Education for Sustainable Development (ESD) (Fig. 4). For years, the University has already been offering a specialized continuing education course (CAS) in SD, strengthening its relationship to implementation in various professional fields and in policy-making. In 2013, a Bachelor Minor in Sustainable Development was introduced, open to all students at the University. This was followed in 2015 by a Master Minor in Sustainable Development. Since 2010, the International Graduate School (IGS) North-South has been offering courses for doctoral students in the global South and North. In addition, the University aims to offer all bachelor's students at the University of Bern at least two lessons in Sustainable Development.

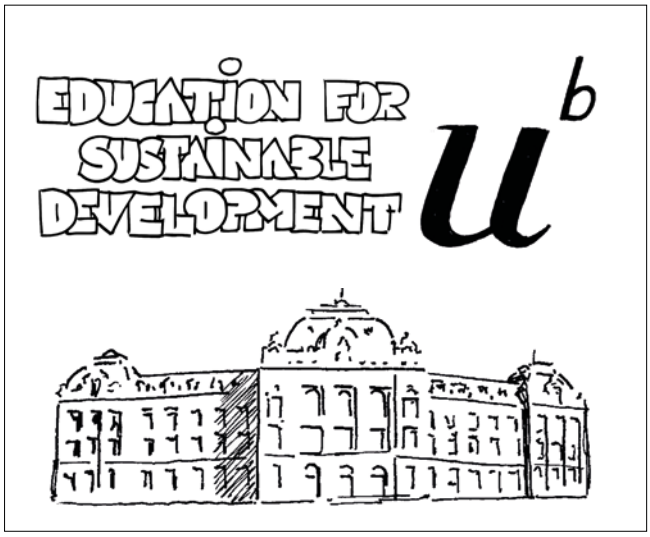

Figure 4: Efforts to integrate SD into teaching are underway at the University of Bern.

With its Strategy 2021, the University of Bern is committed to integrating and implementing Sustainable Development through numerous activities in research, teaching, and operations.

The University's Executive Board commissioned the Centre for Development and Environment (CDE) to implement its ESD implementation concept. CDE together with the Vice-Rectorates Quality and Teaching, the Educational Development Unit, and the Support Center for ICT-aided Teaching and Research have carried out various projects funded by the Swiss Universities Conference (SUK, now called "swissuniversities") and the University of Bern. The present Guidelines for lecturers and further materials such as explanatory videos, slide sets, workshops, and consulting on SD and ESD are products of these activities.

5 University Education for Sustainable Development

"Sustainable Development is a value-led, open concept [with] which [we] must search for innovative paths and make unconventional decisions; correspondingly, the processes of Sustainable Development are necessarily also learning processes" (Stoltenberg and Burandt 2014: 568). As researchers and teachers, we can support these learning processes – not by propagating SD as a behavioural code but by sensitizing students to the importance of science for society and its future. In doing so, we are taking part in the societal project of "Education for Sustainable Development" (ESD). ESD serves to enable all of society's actors to participate in this individual and societal search, learning, and shaping process, as set forth by the United Nations in 2015 in SDG 4, target 4.7.

Education for Sustainable Development enables all stakeholders in society to participate in the individual and societal search, learning, and shaping process of Sustainable Development.

Tertiary education can play an important role here. After their studies, university graduates take on positions of responsibility in research, teaching, administration, private industry, civil society, and politics. This means that they can help shape SD in many areas. Focusing on SD is therefore not just about having "informed citizens" who know what SD is. Rather, it is about achieving a learning society and assuming responsibility, with reflective, innovative, forward-looking "Change Agents" (WBGU 2011; Miller et al. 2014). At the University of Bern, ESD is intended to enable students to think in terms of networks and connections, to understand complex society–environment interactions and processes, and to come up with hypotheses about causes and possible effects of such processes. This approach also makes it possible to formulate and justify sustainability goals, to develop appropriate measures for their implementation, and to review their effectiveness. Seen this way, ESD is "categorial education" in the dual sense that learners learn (i.e. access) reality through their own efforts at the same time as they empower themselves to understand and shape this reality through these very efforts (Klafki 2003). This is why, in the discussion on ESD, the development of competences plays a key role.

University graduates can play a decisive role in shaping Sustainable Development after their studies, as they take on positions of responsibility in research, teaching, administration, private industry, civil society, and politics.

In tertiary education, it is first of all necessary to determine which disciplinary knowledge and methodologies students need to acquire to succeed in their discipline and in their subsequent profession. But to more actively help shape SD, additional qualifications are required. ESD is intended to enable scientists to participate in shaping present and future development in a creative, responsible, interdisciplinary, and communicative way – on the basis of sound knowledge of complex future questions in the context of SD. SD requires trade-offs between ecological, social, and economic interests. For a transparent negotiation of these trade-offs, scientifically robust basic principles are indispensable. At the same time, ESD works at the tertiary level in the knowledge and responsibility that scientific analyses are always subject to great uncertainties due to the complexity and dynamics of current problems.

There are several ways to develop SD-relevant competences in university teaching. Sterling and Thomas (2006) describe various levels of intensity of integrating SD into teaching – from incorporating it into individual lessons to offering entire courses or even redesigning entire study programmes (Fig. 5). The present Guidelines mainly address the first two scenarios, aiming to support a broad integration of SD into teaching at the University of Bern.

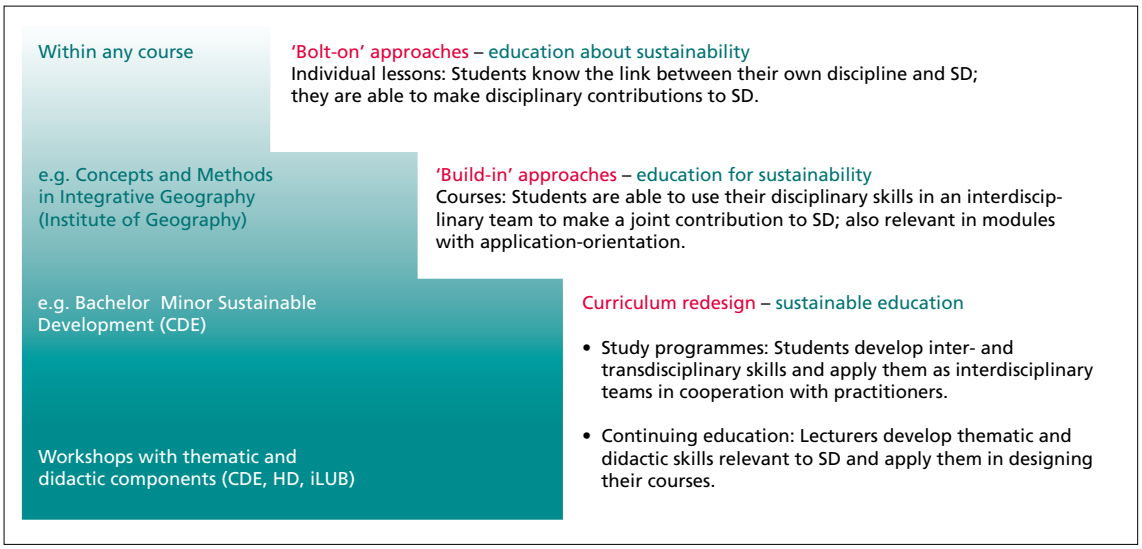

Figure 5: Levels of intensity of integrating Sustainable Development into teaching – using examples from the University of Bern (adapted from Sterling and Thomas 2006); CDE: Centre for Development and Environment; HD: Hochschuldidaktik; iLUB: ICT–gestützte Lehre und Forschung)

As a university with a large spectrum of faculties and synergies between research and teaching, the University of Bern is in a position to build up a national and international focus on this topic.

6 Educational content, competences, and teaching–learning arrangements of Education for Sustainable Development

There are numerous approaches and possibilities to implement Education for Sustainable Development (ESD). This chapter contains a selection of tools and frameworks whose application in our experience has proven useful in the academic field. It is not our aim here to discuss learning theories, pedagogic approaches, or competence models – rather, our aim is to offer a pragmatic approach, based on "best practices" with which we have already worked in the field of university teaching (see also *In-depth Module 2*, *Case Studies*, at www.esd.unibe.ch; in German). We do not claim to be complete.

To implement ESD we suggest the following steps:

Identify *educational content* (Chapter 6.1), i.e.:
- the thematic links between a discipline and SD and the resulting scientific contributions to SD, and
- the specifics of these contributions by differentiating them into systems, target, and transformation knowledge.

Decide what *competences* (Chapter 6.2) the students should acquire during the courses on SD, through
- a rough definition of the focus of education (knowledge – skills – willingness), and
- differentiation between disciplinary and cross-disciplinary competences.

Design SD-relevant *teaching–learning arrangements* (Chapter 6.3), by
- identifying the desired intensity of learning processes (conformative, reformative, transformative), and
- using tips to develop corresponding teaching–learning events.

For the following chapters 6.1, 6.2, and 6.3, a number of further explanations and examples can be found in *In-depth Module 1*, *Concepts, Tools, Guidance, Information, and Examples for Lecturers* (at www.esd.unibe.ch; mostly in German).

6.1 Educational content – links between SD and your discipline

Possible course contents relevant to SD result from the connection between the thematic and epistemological focus of a scientific discipline on the one hand and SD on the other. In some disciplines such links are obvious; in many the reference is implicit but not named; and in yet others the connections still have to be identified. In the following, we present possible ways of establishing these links (further details can be found in *In-depth Module 1, Concepts, Tools, Guidance, Information, and Examples for Lecturers*; mostly in German).

A suitable entry point in the search for thematic links is offered by the *Doughnut Model* (Fig. 6), which describes concrete international debates and focal areas of sustainable or unsustainable development. The model describes an environmentally safe and socially just space of sustainable economic development for humanity. This ring-shaped space is encircled on the outside by an "ecological ceiling" – planetary (environmental) boundaries which should not be crossed – and, on the inside, by "social foundations" – socio-economic basic requirements which humanity must negotiate as worthwhile. Different paths to SD are possible between the ecological ceiling and social foundations. These are not predefined, but result from a continuous search, learning, and shaping process involving all of society (Chapter 2).

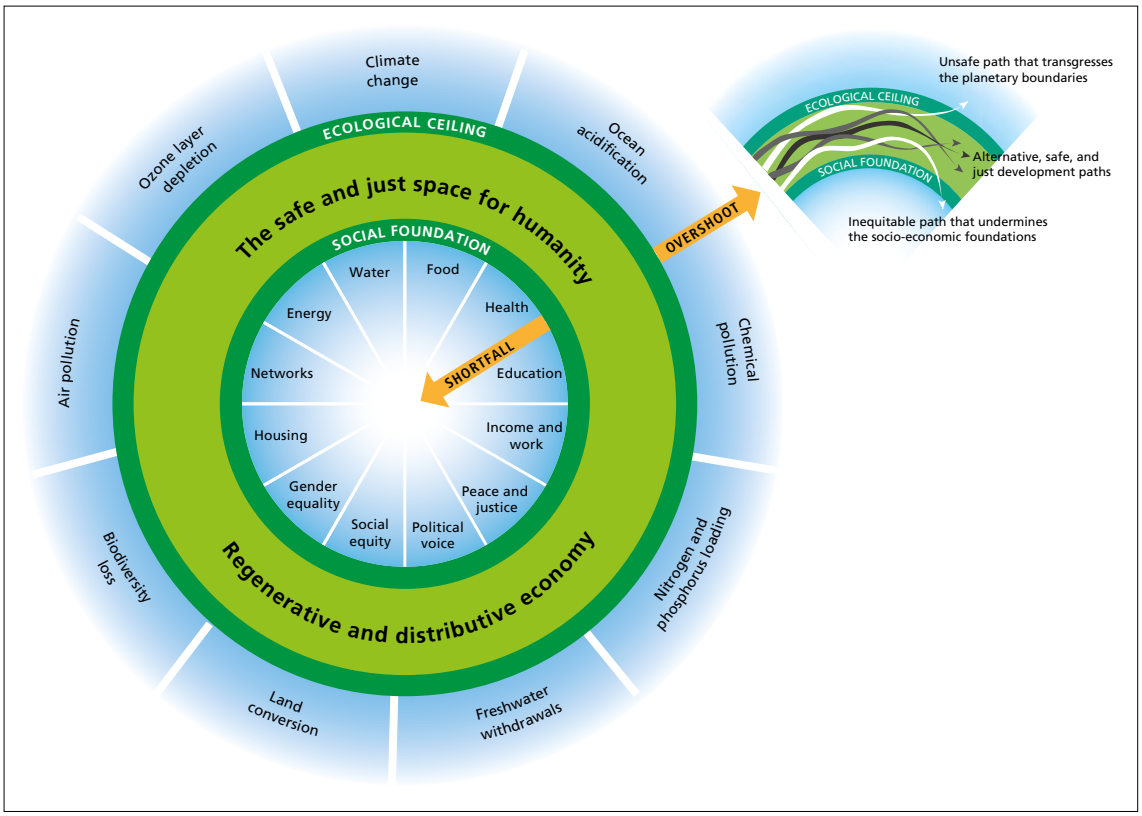

Figure 6: Doughnut Model of Sustainable Development (Raworth 2017). The outer circle encompasses the nine planetary boundaries considered central (Rockström et al. 2009). The inner circle represents the internationally debated socio-economic minimum requirements for human well-being. In the upper right-hand corner, we illustrate the idea of different development paths.

The planetary boundaries mark the threshold of environmental pollution: if we overstep them, the resulting environmental damage may be irreversible. Specifically, the model addresses nine different problem areas: climate change, ocean acidification, chemical pollution, nitrogen and phosphorus loading, freshwater withdrawals, land conversion, biodiversity loss, air pollution, and ozone layer depletion. These are juxtaposed with 12 socio-economic minimum requirements for human well-being in the fields of water, food, health, education, income and work, peace and justice, political voice, social equity, gender equality, housing, networks, and energy. In the search for thematic links to one's own discipline, not all disciplines will find their links in the Doughnut Model. It is therefore important to expand the model by topics that are not included but are relevant to SD, e.g. faith, cultural sustainability, technology.

The UN SDGs provide a concrete political entry point to identify thematic links between the various scientific disciplines and SD (Fig. 7, the comprehensive international agenda for SD: *Transforming Our World: The 2030 Agenda for Sustainable Development)*. The advantage of this entry point is that the SDGs were approved in 2015 by the 193 member states of the UN and will thus form the global political basis for decision-making in the coming years. The goals encompass the following 17 areas: no poverty; zero hunger; good health and well-being; quality education; gender equality; clean water and sanitation; affordable and clean energy; decent work and economic growth; industry, innovation, and infrastructure; reduced inequalities; sustainable cities and communities; responsible consumption and production; climate action; life below water; life on land; peace, justice, and strong institutions; and partnerships for the goals. In using this model it is important to address aspects of SD that are not explicitly mentioned, and to formulate possible goals.

The international discourse, which builds on scientific and political insights and the UN consensus, offers anchoring points for each discipline to identify links to SD.

Figure 7: The Sustainable Development Goals (SDGs) of the United Nations (UN 2015).

Finding out how and where your discipline is connected with the Doughnut Model or the UN SDGs can help you position it with respect to SD. These are starting points to highlight existing references your discipline has to SD and identify possible anchoring points. Once the thematic links are made, they can be further concretized by asking which forms of knowledge are important in that particular discipline with respect to SD (Fig. 8):

- Systems knowledge – Understanding how the environment, society, and the economy function, either individually or as complex interactions;
- Target knowledge – Scientific contributions to decide the direction in which these relations can be steered towards a sustainable form of development; and
- Transformation knowledge – Scientific contributions to implementation, e.g. in the form of rules, solutions, measures, or technologies to promote SD; this includes monitoring and a review of goal achievement with disciplinary and interdisciplinary scientific methods.

Concretizing the links in this way requires an examination of, or reflection on, one's understanding of science with regard to one's own discipline (Chapter 4). While systems knowledge is the core business of many scientific disciplines, target and transformation knowledge are normative, value-laden categories (Chapter 3). To capture as many of their entry points to SD as possible, every discipline should try to identify contributions to all three forms of knowledge. Note that this distinction is heuristic, i.e. it is not the final allocation in itself which is decisive, but the process of reflecting on the relation between scientific work and SD.

Using this analytical framework has several advantages. It was set up in the late 1990s by an influential group of Swiss scientists in the spirit of self-commitment, specifically for the purpose of characterizing the contribution of sciences to SD (ProClim/CASS 1997). The framework is known and proven, and is used by networks with a focus on SD, such as td-net (Network for Transdisciplinary Research of the Academies of the Swiss Academies of Arts and Sciences, td-net 2015), and also in the three Future Earth research topics (FE 2015). In addition, the framework prevents the misconception that science can only promote SD through systems knowledge, i.e. only through a better understanding of the world as a system: it is just as possible to contribute by determining Sustainability goals or by proposing transformative measures to promote SD (technologies, laws, forms of participation, etc.).

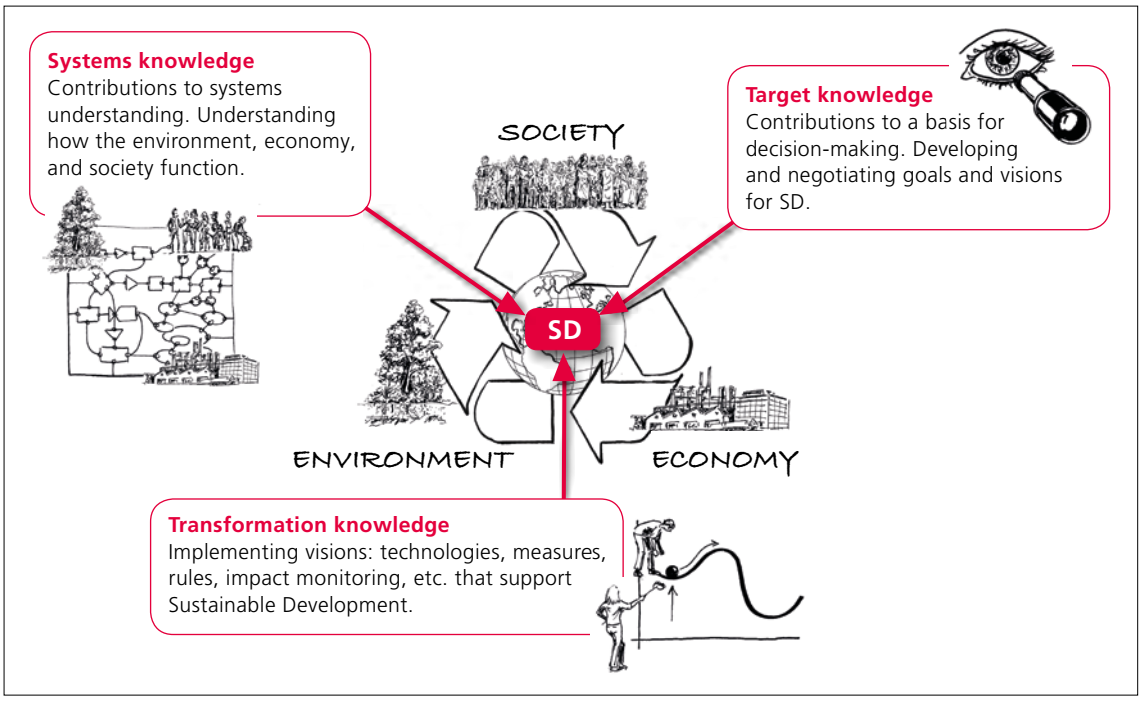

Figure 8: Heuristic distinction between forms of knowledge for Sustainable Development, based on ProClim/CASS (1997) and Pohl and Hirsch Hadorn (2007).

In addition to thematic links, methodological and methodical links are of central importance to SD. Data collection, an important task in many disciplines, not only serves to improve systems knowledge – it can also be used to define goals and thresholds, or to help develop systems to comprehensively monitor a transformation. This will enable an assessment of whether the social-environmental context is moving towards SD or not, and, building on this, which measures could effect the desired change.

Each discipline can clarify its contribution to Sustainable Development through systems, target, and transformation knowledge.

6.2 Competences – identifying SD-relevant competences for university education

Knowledge is an important contribution to SD. The Swiss government's Strategy 2016–2019 also emphasizes Sustainable Development (p. 31) in its long-term vision of the importance of acquiring competence within Education for Sustainable Development (ESD). This means promoting independent thinking and action that strengthen resilience – individual as well as societal – recognizing the importance of SD, and taking an active and reflective role in shaping it.

University teaching can also promote skills, attitudes, and values for Sustainable Development.

In the understanding of ESD presented here, we rely on the definition of "competence" by Weinert (2002: 27–28; in the English translation of Weinert's work, the original German term "Kompetenz" is translated as "proficiency"; but we have decided to keep the word "competence" to ensure consistency), according to which competences are "cognitive abilities or skills which individuals have or can acquire to solve specific problems, as well as the related motivational, volitional (conscious, deliberate), and social willingness and abilities to apply solutions in variable situations successfully and responsibly". Having "competences" can thus be seen as a prerequisite for action on the one hand; on the other, this very action may be necessary to

make the competences visible (Schubiger 2013). In view of SD, it is not only the potential for action but also action itself and the conditions under which action takes place that are important. SD and social cohesion are crucially determined by the competences of the whole population, and at university level it is useful to have a comprehensively defined concept of "competence" that includes knowledge, skills, attitudes, and values (Rychen and Salganik 2003; Stoltenberg and Burandt 2014).

Knowledge, skills, willingness

To actively participate in societal transformation, students need not only knowledge and skills but also a corresponding attitude (mindset, values) and the willingness to change (Schubiger 2013) (Fig. 9). While knowledge and skills can be formulated, built up, and tested within the framework of lessons as learning outcomes, attitudes, values, and willingness often only manifest themselves in actions outside of, or after, one's studies. But the dimension of "willingness" is essential in a search, learning, and shaping process. According to Hattie (2009: 254), "Education is … never neutral, and its fundamental purpose is intervention or behaviour change. This is what makes teaching a moral profession." The "willingness" – or, more precisely: wanting to implement knowledge and skills – cannot be tested in a course, but it can be stimulated, by discussing attitudes, mindsets, and values with the students. If systems knowledge is built up at the same time, concern is triggered, a sense of responsibility is promoted (I want to do something myself), and realistic options for action are demonstrated and developed (Haversath 2012; Schubiger 2013) – subsequently, the chances improve that knowledge and skills are also implemented.

Besides knowledge and skills, willingness is an important prerequisite for contributions to Sustainable Development.

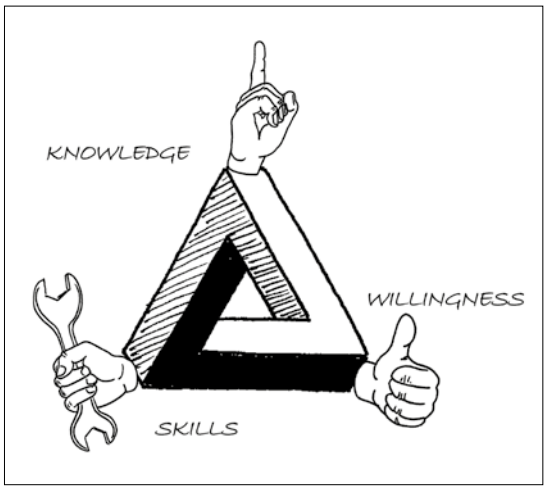

Figure 9: Prerequisites for contributing to Sustainable Development.

Disciplinary and cross-disciplinary competences

Questions on SD are complex and therefore often best solved through inter- and transdisciplinary teamwork. Accordingly, a disciplinary approach to SD should be supplemented by a cross-disciplinary perspective. In ESD, both disciplinary and cross-disciplinary competences are considered essential (Fig. 10).

Inter- and transdisciplinary research and teaching must be able to draw on competences from within and beyond your subject.

Disciplinary competences

- The basis for any interdisciplinary work in SD is what all courses of study at universities do anyway, which is to build up disciplinary, specialist knowledge and the corresponding methodological competences.

Cross-disciplinary competences

- To work on issues beyond your own discipline, inter- and transdisciplinary knowledge and methodologcal competences are necessary, i.e. a basic understanding of theories, approaches, contents, and methods of other disciplines. To work on questions of SD, networked thinking in linear and non-linear connections, foresighted reflection, interdisciplinary monitoring and evaluation, as well as participatory approaches are important.

- Finally, personal and social competences and the ability to act ("Handlungskompetenzen") are required (following Erpenbeck 2009), to be able to work and communicate efficiently and effectively within a team. These competences include e.g. critically questioning values, assuming responsibility, social and communicative skills in negotiation processes with various actors, teamwork and team-conflict management, and the willingness to implement and shape things.

Whether a competence is disciplinary or cross-disciplinary will depend on the discipline. For example, many disciplines will view "communication" as a cross-disciplinary competence, while for the field of media and communication studies it is a disciplinary competence.

Disciplinary and cross-disciplinary competences are regarded as complementary; they allow us to work successfully for a sustainable form of development only through their interaction. In the literature, SD-relevant knowledge, skills, attitudes, and values are also described as "transformative competences" ("Gestaltungskompetenzen") (de Haan 2010; Stoltenberg and Burandt 2014). The guiding principle is that a transformation of society towards SD first calls for a critical examination of existing knowledge and processes, but ultimately requires people who change and reverse unsustainable conditions and trends. University ESD plays an important role in this regard, by educating potential candidates for key positions in SD.

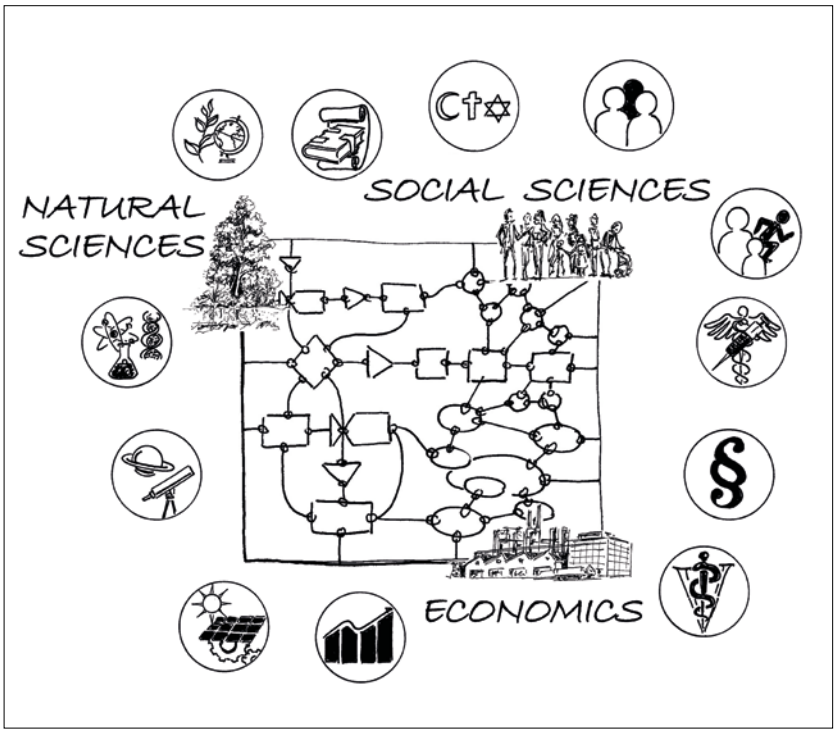

Figure 10: Sustainable Development requires disciplinary, interdisciplinary-, and transdisciplinary research, and therefore also knowledge from your subject area and beyond.

6.3 Teaching – learning arrangements – Education for Sustainable Development at universities

Conformative, reformative, and transformative learning

Sustainable Development can only occur through conscious change (i.e. through change triggered by reflective action). Good scientists are needed to help bring about a transformation process. But how intensively can students already now be prepared for this challenge? In other words, how intensive should the learning process be when it comes to SD at university level? The following steps by Sterling (2001, based on Bateson 1972) – conformative, reformative, and transformative learning – help lecturers determine the desired intensity of the learning process.

- Conformative learning *(first-order learning)* describes the classic process of teaching theory, i.e. the transfer of abstract factual knowledge, processes, concepts, etc. – a fixed and important component of many university courses. Existing rules of the discipline are not questioned; changes and improvements only exist within the self-imposed limits of a discipline. Learning is about improving something that exists, and becoming more efficient and more effective.

- Reformative learning *(second-order learning)* comes into play when dealing with SD. The focus is not just on knowledge transfer, but also on the critical questioning of knowledge, questioning and changing processes, values, and assumptions. The students relate to the topic and show personal concern for it. Learning is about recognizing "better" solutions for SD.

- Transformative learning *(third-order learning)* is important when unsustainable patterns of thought and problematic effects have to be replaced by something new. "No problem can be solved from the same consciousness that created it. We have to learn to see the world anew" (A. Einstein). In this case, students' own world-view, perceptions, and prevailing paradigms of their own disciplinary self-understanding may have to change. They are therefore encouraged to see things in a new way or differently, to develop a personal sense of responsibility and an intention to act, with a view to becoming actively involved in SD.

Sustainable Development means change, also in research and teaching. Transformative learning questions the existing and opens up new paths.

More transformative competences – less inert knowledge

To assess the extent to which current tertiary education is SD-compliant, i.e. practice-oriented, ask yourself the following questions: if you have a bicycle accident and find that you can no longer move your shoulder, who would you rather consult – a doctor who qualified a month ago or an experienced orthopaedic surgeon? If you're seeking information on legal protection in the event of a car accident, who do you feel more comfortable speaking to – the intern at the law firm or the head? It is most likely that in such situations you would choose the person with more experience. Why? Because you know that while new graduates are well equipped with knowledge and theoretical foundations, they have little or no experience in problem-solving practice. During one's studies, listening does not equal understanding, and information is not yet knowledge – and it is certainly far from the competence to act. They are worlds apart, which has long been well documented by research (cf. e.g. Renkl et al. 1994; Gruber et al. 2000).

Even if many lecturers, when asked, confirm that they are aware of this fact, how many of them will draw serious consequences for their teaching activities? Here, too, there is a big gap between knowledge and action. If we seriously want to develop transformative competences at universities, this will have corresponding consequences for the teaching–learning culture. The following information and tips show how learning arrangements can be organized with the potential of closing the gap between knowledge and action.

Sustainable Development requires transformative competences whose development starts with simple adaptations to the teaching–learning culture.

The descriptions in this chapter are as brief as possible. You can find more detailed information as well as practical examples and guidance on innovative, didactic methods that promote learning in *In-depth Module 1, Concepts, Tools, Guidance, Information, and Examples for Lecturers* (mostly in German).

Empirical evidence and the "TAFEL principle"

The research literature mentioned in this regard is very comprehensive (cf. e.g. Wahl 2006; Ambrose et al. 2010). In his book "V*isible Learning*", John Hattie presents the findings of a meta-analysis of 52,000 studies conducted over twenty years (in the meantime, more than 60,000 have been collected). Hattie ranked 138 factors that influence learning success, based on their effectiveness (Hattie 2009). Focusing on university education, he put forth three central claims ("three claims for higher education"; Hattie 2011):

1. Transparent expectations: Successful teachers define precisely what students should be able to do after a lesson. They specify learning outcomes and base their assessment criteria on these. In this way they communicate right from the start which tasks the students are expected to have mastered by the end, and to what level of expertise. Key to this is that the tasks are challenging but achievable for each target group.

2. Activating teaching strategies: Experienced teachers use a broad spectrum of activating learning methods. Students learn better when they actively work on issues based on real-world problems. In addition, learning effects are enhanced when meta-cognitive strategies are applied, i.e. when the students also examine how they learn and work.

3. Feedback, evaluation, learning scenario: Students learn better when they obtain prompt feedback on their learning progress. Not praise, criticism, or reward – but information on their achievements and the way they got there. It is notable that informative feedback on correct answers is much more effective than insistent highlighting of mistakes. Good teachers also display "adaptive teaching competence". They are able to apply different methods to obtain a picture of their students' current level of learning and, if necessary, adapt their teaching.

Transparent learning outcomes, active involvement of students in courses, and regular feedback on students' achievements are important building blocks of innovative teaching–learning arrangements.

These three central points can be understood as empirically well-substantiated claims, and must be concretized for the respective application context. If they are embedded in a comprehensible learning scenario, an important foundation is created, significantly improving the chances for in-depth learning processes. The above-mentioned components – Transparency, Activation, Feedback and Evaluation as well as Learning scenario, "TAFEL principle" – form the central and empirically substantiated pillars of effective learning (Tribelhorn 2016).

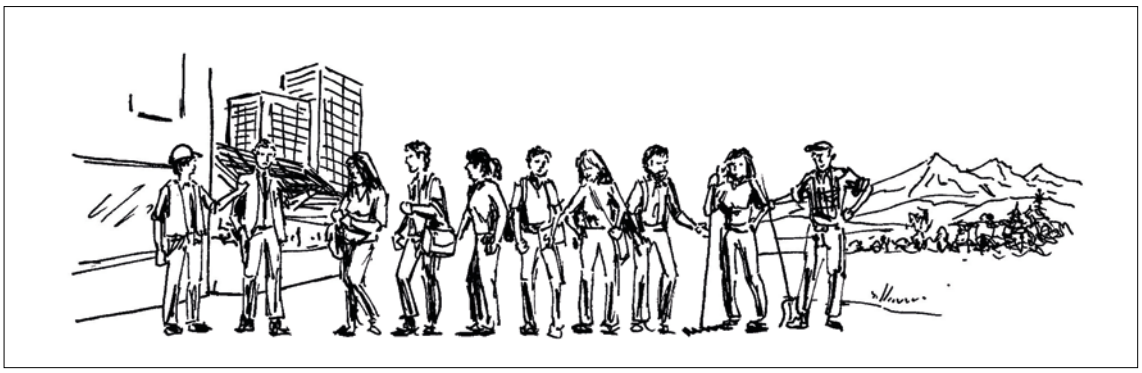

Figure 11: Education for Sustainable Development brings students face-to-face with actors from politics, administration, and other professional fields in their respective work environments.

In addition to being embedded in a holistic concept of a teaching–learning arrangement, individual courses can be optimized. SD-relevant competences include less passive consumption by students and more active involvement, i.e. through a varied mixture of presentation and student activities – individually or in groups. Active participation could include half- or full-day excursions in which students visit actors from politics, administration, or other professional fields in their place of work – and interview them and make further observations (Fig. 11). *In-depth Module 1* (at www.esd.unibe.ch; mostly in German) contains a selection of methods, divided into cognitive activation in lectures, activating seminar methods, and didactic scenarios for higher education.

Many examples of innovative courses already exist – make use of these experiences!

The possibilities described above should not be seen as set-in-stone specifications. Their basic principles should be understood and adapted by the lecturers to their context, so that they are brought to life within their subject-specific teaching–learning culture (Fig. 12). Experience has shown that not everything "works" smoothly the first time – it is worth giving it a second or third shot, as colleagues who have tried this will no doubt confirm. The pedagogic support departments in your institution will be happy to assist you in any teaching development project.

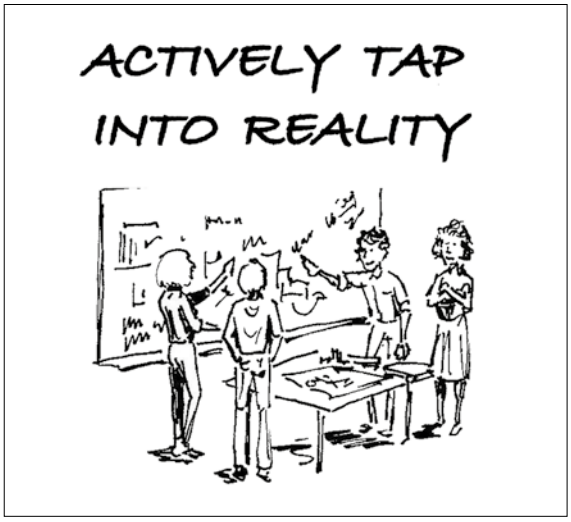

Figure 12: Actively tap into reality – in teaching–learning arrangements.

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