Guidelines for Integrative Training in Inter- and Transdisciplinary Research Settings

Hints and Tools for Trainers of Trainers

Karl Herweg
Natalie Schäfer
Anne Zimmermann

Guidelines for Integrative Training in Inter- and Transdisciplinary Research Settings

Hints and Tools for Trainers of Trainers

Karl Herweg, Natalie Schäfer, and Anne Zimmermann

With contributions from
Stella Mukhovi (Kenya)
Mirgissa Kaba (Ethiopia)
Kouassi Dongo (Côte d'Ivoire)
Manigeh Roosta (Bolivia)
Anabel Monterrubio (Mexico)
Thatheva Saphangthong (Lao PDR)
Hung Nguyen-Viet (Vietnam)
Jyldyz Shigaeva (Kyrgyzstan)
Laya Prasad Uprety (Nepal)
Tina Hirschbuehl (Switzerland)
Barbara Vollenwyder (Switzerland)

Citation:
Herweg K, Schäfer N, Zimmermann A. 2012. *Guidelines for Integrative Training in Inter- and Transdisciplinary Research Settings: Hints and Tools for Trainers of Trainers.* Bern, Switzerland: Geographica Bernensia, 64 pp.

Published by:
NCCR North-South and Centre for Development and Environment (CDE)
University of Bern
Hallerstrasse 10, 3012 Bern, Switzerland

ISBN: 978-3-905835-32-8
Geographica Bernensia, Bern

Figures and cartoons:
Karl Herweg (CDE)

English editing and proofreading:
Theodore Wachs (Senior Consultant) and Stefan Zach (z.a.ch GmbH)

Layout:
Simone Kummer (CDE)

Printed by:
Varicolor AG, Bern, Switzerland

Printed on FSC paper

Distribution:
Additional copies may be obtained from CDE, Bern: publications@cde.unibe.ch
An open access version of this publication is available at: www.cde.unibe.ch

Cover photo:
Integrative Training Course in Kyrgyzstan, 2003; communicating beyond disciplinary, cultural, and language boundaries requires an innovative training approach. (Photo courtesy of NCCR North-South)

Table of Contents

Acknowledgements

These Guidelines were developed within the framework of a 12-year programme of research in partnership, the Swiss National Centre of Competence in Research (NCCR) North–South: Research Partnerships for Mitigating Syndromes of Global Change. The NCCR North-South is co-funded by the Swiss National Science Foundation (SNSF), the Swiss Agency for Development and Cooperation (SDC), and the participating institutions. The authors also acknowledge financial support from the Eastern and Southern Africa Partnership Programme of the Centre for Development and Environment (CDE). We would also like to thank all the participants in the numerous courses conducted over the years in a number of countries for their useful feedback and suggestions.

About these Guidelines – Target Groups and Purpose

Research on global change and sustainable development issues requires a special approach to ensure close cooperation both between different scientific disciplines, and between scientists and other societal actors. This, in turn, calls for an appropriate training approach that supports this type of research (Figure 1). The present guidelines offer practical assistance for trainers who wish to design, plan, and conduct training events in complex research settings. In what follows, we refer to this kind of training as "integrative training", i.e. training that enables integration of students from different scientific disciplines, brings together researchers and practitioners, and takes into account different cultures in academic training.

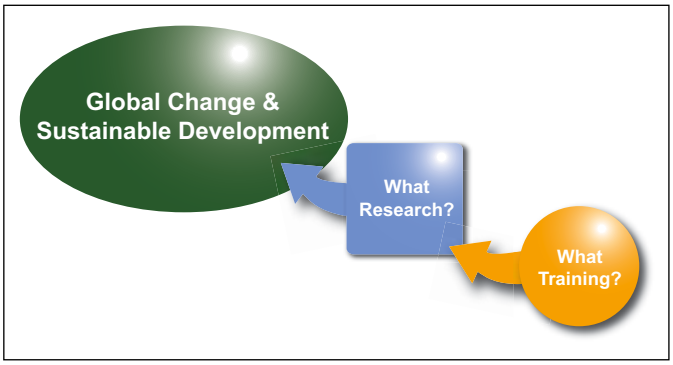


Figure 1: What kind of training supports research on global change and sustainable development?

Potential target groups of the guidelines are:

- Training units at universities and research institutes;
- Trainers (instructors) particularly working in interdisciplinary, transdisciplinary, and applied research settings;
- Research coordinators / managers of research programmes;
- Senior scientists.

The guidelines first briefly take up a number of theoretical issues in order to create a common understanding of research on global change and sustainable development, inter- and transdisciplinary research approaches, and corresponding learning theories and approaches. The main purpose of the guidelines, however, is to offer a "toolbox" which shares practical experience garnered by the authors – mainly members of the education and training team of the Swiss National Centre of Competence in Research (NCCR) North-South programme – during 14 continental and cross-continental Integrative Training Courses conducted as part of the programme between 2002 and 2011. Much of the practical training experience was gained during the annual Master Course "New Approaches to Sustainable Land Management", conducted six times at the Land Resources Management and Protection (LaRMEP) Department of Mekelle University in Ethiopia. Consequently, the "toolbox" is an important part of the guidelines: it consists of a collection of ideas, hints, and tools that the reader should feel free to adapt to his or her own needs when organising and conducting integrative training events.

1 The Context of Global Change and Sustainable Development

Current trends in global economic, social, and environmental development are not sustainable – as frequent reports on climate change, natural hazards, globalisation, financial crises, persistent poverty, and conflicts clearly indicate. We are in a state in which single determinants can cause far-reaching and unpredictable changes. On the one hand, global change (GC) is often characterised by phases of rapid transformation with an increasing hazard of non-linear (catastrophic) consequences. On the other hand, we also observe gradual and subtle processes of change – such as the degradation of natural resources, increasing social and economic disparities, etc. – the effects of which may become apparent only with a considerable time lag. Delayed effects and highly complex society–environment interactions make a clear cause-and-effect attribution impossible. Given such uncertain situations, there is an increasing demand for rapid solutions for adapting to GC impacts. Moreover, we cannot exclude that global life support systems are moving towards critical instability. Immediate corrective action seems necessary, which implies that people and institutions will have to adjust their behaviour. Finally, our approach to and methods for solving human and environmental problems must also change (MEA 2005, Seastedt et al. 2008).

MESSAGE
Global change involves highly complex society–environment interactions, and rapid as well as subtle processes of change with long-term and unpredictable effects.

Sustainable development (SD) is a collective vision that bears great potential for finding possible directions for corrective action, because it is based on a relatively broad global agreement and involves institutional commitments such as the Millennium Development Goals. SD aims to address complex society–environment relationships. Like other socio-political paradigms, it is a normative concept that is discursively constructed based on the convictions of, assessments by, and negotiations between numerous societal actors, from the local to the international level. Visions of SD need to be permanently adjusted through processes of societal learning that involve different actors, including researchers. The construction of SD makes use of all actors' specific knowledge of how the "system" is currently functioning (systems knowledge), where to go (target knowledge), and how to get from the current to the desired state (transformation knowledge) (Pohl and Hirsch Hadorn 2007). Thus, SD is very much related to a specific context, at a specific time, and with concrete stakeholders. For the scientific community the question is what role it wants to play in society's debate about GC, and its striving for SD.

MESSAGE
Sustainable development is a collective vision that must be developed and continuously adapted by numerous different stakeholders.

Cartoon 1: Are we really ready to adapt to global change? (Cartoon: Karl Herweg)

2 Research Approaches to Global Change and Sustainable Development

What are the most appropriate research approaches to address global change and sustainable development issues? Appropriateness here implies the ability of research to contribute to pathways that mitigate negative effects of global change, be it in the form of practical technologies, empowerment of local actors, effective policies, or other means leading to a more sustainable form of development. In complex scenarios which aim to bring about transformation towards SD, the role of science needs to be redefined or at least adapted. Complex human–environment systems that encompass biophysical, economic, social, and political aspects call for research that goes beyond traditional disciplinary science. Accordingly, researchers need to have the skills for communicating and working productively with scientists from other disciplines, as well as with non-academic actors. In the literature, the terms "multidisciplinarity", "interdisciplinarity" (ID), and "transdisciplinarity" (TD) are used for such an approach to knowledge production; they are used widely but not homogeneously. Therefore, let us briefly look at different schools of thought on ID and TD.

MESSAGE
Apart from sound scientific knowledge, research on global change and sustainable development requires social and communication skills.

2.1 Transdisciplinarity – a moral project

Nicolescu's school of transdisciplinarity, understood as a "moral project" (Nicolescu 2002), postulates a decline of civilisation due to the current "proliferation" of highly specialised knowledge. Accumulating new knowledge (or information) seems more important than an understanding of issues. The loss of an overview in a flood of information makes individuals feel powerless to stop this decline. The problem of the "babelisation" of disciplines in science, due to endless specialisation, results in the increasing impossibility of understanding one another. As a consequence, decision-makers become increasingly incompetent, and even a group of specialists is likely to develop "generalised incompetence". Thus, there is a need for building bridges between disciplines, such as:

- Pluridisciplinarity (or multidisciplinarity), i.e. studying a topic simultaneously in several disciplines; the goal here remains limited to the framework of disciplinary research.
- Interdisciplinarity, i.e. transferring methods or concepts from one discipline to another; again, the goal is often limited to enhancing each discipline independently. For example, a transfer of methods from one discipline to another may lead to a new application in a discipline, or a new epistemological development, or even a new discipline.
- Transdisciplinarity, with the goal of understanding the present world between, across, and beyond all disciplines. This includes an ethical dimension.

While disciplinary, multidisciplinary, and interdisciplinary forms of research concern one and the same level of reality, TD research concerns the dynamics caused by the interaction between several reality levels in parallel. The "three pillars" of TD upon which the methodology of TD research is built are the different levels of reality, the "middle" (between, across, beyond disciplines), and complexity (of the world). TD requires "rigour", "openness", and "tolerance". Disciplinarity, multidisciplinarity, interdisciplinarity, and transdisciplinarity are complementary (Nicolescu 2002).

Cartoon 2: The intercourse between the natural and the social sciences is characterised by deep mutual respect. (Cartoon: Karl Herweg)

2.2 Interdisciplinarity

Lélé and Norgaard (2005) state that the shared interests of an interdisciplinary team "do not translate into a research plan with predetermined bridges between the disciplines" because there are a number of barriers to interdisciplinarity (ID). Scientists often experience colleagues' definitions of the problem to be studied as quite different from their own, with each seeking different types of answers. In addition, many feel that the effort to communicate and share knowledge across disciplinary boundaries is too great to be worth it. The barriers to ID are:

- Scientists are reluctant to acknowledge that values are embedded in *all* types of inquiry and at *all* stages, e.g. during the choice of research questions, theoretical positions, variables, and styles of research. This results in turning a blind eye to their own normative positions. Moreover, based on the general assumption that scientific knowledge is value-free, decision-makers expect objective advice from science.

- Different scientists study the same phenomenon but differ in their theories and explanatory models. Maintaining loyalty to one's own school is more important than open exploration. Moreover, researchers often develop simplistic assumptions about the other disciplines in an interdisciplinary team, particularly in a team containing both natural and social scientists.

- There are fundamental epistemological differences between disciplines. For example, some natural scientists and engineers believe that absolute truth can be found, while social scientists question this premise. Perceptions about whether scientific knowledge has a subjective or objective nature differ, and it remains unclear how much we can know through reductionist experiments and models.

- Society does not give equal attention and resources to different disciplines and thus influences institutional arrangements within academia; this creates (dis)incentives for interdisciplinary knowledge production. Superiority is often attached to the natural sciences.

- Trying to solve environmental and societal problems through interdisciplinarity distracts from "pure" research, which fetches the highest academic credits and is therefore more attractive; so there is little motivation for scientists to engage in ID.

To avoid the prejudice that natural scientists are "unsocial" and social scientists are "unnatural", ID teams need to acknowledge and respect what each side actually knows, and recognise what it does not. It should be possible to capture the critical social aspects of natural processes and the critical natural aspects of social practices. Indeed, scientific communities are groups that share certain characteristics, such as: the subject focus, assumptions about underlying characteristics of the factors studied and about a larger world outside the study focus, how one's own study focus relates to this world, what models and methods need to be used, and what audience to address. Difficulties in ID occur if scholars have different perceptions about whether or not it is possible to overcome the disunity of science. The gaps between economists, sociologists, and social anthropologists are often more difficult to bridge than those between social and natural scientists. All social sciences ultimately attempt to understand human behaviour but make different assumptions about the key drivers of behaviour, such as material benefits (economy), power (certain sociology schools), and cultural norms and value systems (certain social anthropology schools).

One possibility of overcoming the differences is to accept that all assumed drivers have general validity but in specific cases some may be dominant (human beings have multiple personalities, sometimes driven by economic, cultural, or political factors). Researchers addressing multi-causal phenomena must rely on open debate, taking advantage of different theoretical frameworks and tacit knowledge, and must arrive at a "measured, qualified judgement". Strong scientific communities actively demarcate and defend their boundaries and thus enforce identity and credibility. They weed out those who go astray and promote scholars who best represent the community. This is strongly supported by the prevailing organisational charts of universities. In contrast to this, ID communities work across boundaries; this can only work if ID researchers are both self-reflective and respectful of one another's otherness (Lélé and Norgaard 2005).

2.3 Critical theory and action research

In development-related studies, critical theory (e.g. Chambers 1994) postulates a paradigm shift "from top-down to bottom-up, from centralised standardisation to local diversity, from blueprint solutions to mutual learning". This change results in shifting more responsibility and activity away from outsiders – such as researchers – to local people. The family of approaches and methods commonly known as Participatory Rural Appraisal (PRA) aims to enable rural people to share, analyse, and enhance their knowledge of life and their conditions with a view to planning and acting independently. PRA is based on the assumption that outsiders (e.g. researchers) often consider their own knowledge as superior and local people's knowledge as inferior. Local people's "ignorance" is not an illusion but an artefact of outsiders' behaviour, attitude, arrogance, and their own ignorance. PRA is a reaction to tedious, inaccurate, and time-consuming surveys that only delayed decisions. It enables outsiders to gain information and insights from local people and to find out about local conditions in a cost-effective and timely manner (Chambers 1994).

PRA has roots in Activist Participatory Research, aiming to enhance people's awareness, confidence, and power to act (Freire 1970). Outsiders can play the role of a convener, catalyst, or facilitator. Similar intentions are behind Conway's (1985) agro-ecosystem analysis of systems and system properties, with tools for analysing space and time patterns, flows and relationships, and relative values and decisions. PRA also has roots in applied anthropology, where fieldwork is considered a flexible art rather than a rigid science. Field research on farming systems even considers farmers as experimenters.

2.4 Transdisciplinarity: the NCCR North-South approach

Transdisciplinary research – as it is applied in the NCCR North-South (Wiesmann et al. 2011) – integrates the social and natural sciences in a common approach (interdisciplinarity) and simultaneously includes non-scientific knowledge systems in a participatory and interactive process right from the beginning of the research endeavour. Transdisciplinary research is understood as a new form of learning and problem solving, involving cooperation among different parts of society and academia in order to meet complex social challenges, and involving partnerships between the North and the South (Hurni et al. 2004). Transdisciplinary research deals with empirical questions (systems knowledge); it also aims to ascertain and explain better practices (target knowledge), and to reflect on the practicability of goals and the feasibility of proposed solutions to problems (transformation knowledge) (Pohl and Hirsch Hadorn 2007). Transdisciplinarity is the result of a coordination between all levels of knowledge (scientific and other forms) that are involved in discussing a certain phenomenon.

Research processes focusing on global change – according to the NCCR North-South school of thought – require a transdisciplinary approach with different phases involving disciplinary research, interdisciplinary research, and societal debate on the issues at stake (Figure 2).

- The transdisciplinary approach: the shaded "wave" in the diagram below represents a possible sequence of such phases over time.

- The level of societal debate: in a transdisciplinary approach it is of great importance for the research process to begin with a negotiation of research questions and hypotheses among all researchers and other actors involved (1). At regular intervals, scientists and non-academic actors meet (2) to exchange knowledge and identify collective action (to solve the problem under consideration). Additional opportunities for exchange occur informally during fieldwork (3). After the programme ends, a final workshop is conducted to assess results and implementation, and to prepare future collaboration (4).

- The interdisciplinary level: joint development and continuous adaptation of an integrative conceptual framework and methodology (5), and joint fieldwork (6) help the participating disciplines to build mutual understanding and make it easier to synthesise findings at the end.

- The disciplinary level: at this level individual researchers conduct their specific experiments or studies (7).

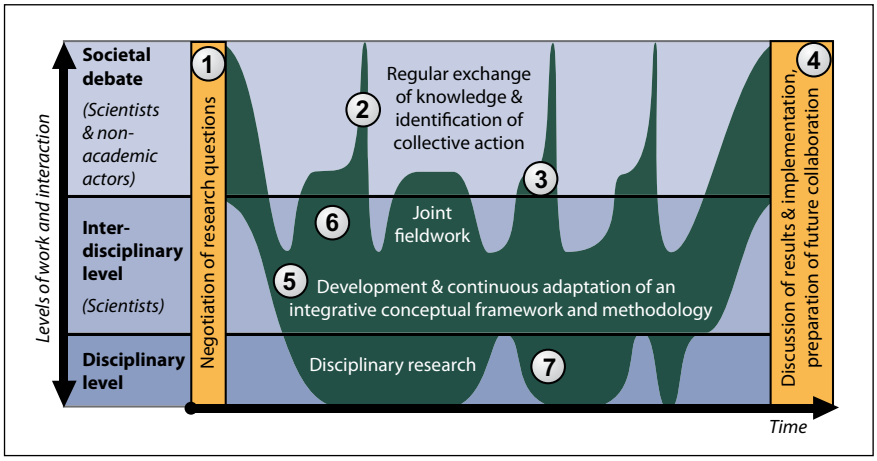


Figure 2: Interlinking of disciplinary research, interdisciplinary research, and societal debate in a transdisciplinary approach (Herweg et al. 2010, adapted from Hurni et al. 2004).

The key concepts in this school of thought are defined as follows:

Disciplinary research

Disciplinary research follows cognitive and practical goals within a clearly defined scientific school and related institutional framework. Disciplinarity serves the objectives of increasingly specialised fields of knowledge related to single disciplines that evolve in isolation from other disciplines. A person may, in fact, study a biology issue and handle it well without having to consider further knowledge related to physics or psychology; but this will remain only a partial aspect of the complex whole to be studied.

Multidisciplinary research

In multidisciplinary research, the different disciplines look at one research object from different perspectives. Multidisciplinary research is based on a combination of several separate scientific disciplines, without implying that continual interaction and negotiation between these disciplines is necessary (as opposed to interdisciplinary research). Each discipline carries out its analyses separately, applying its own approaches and methods. Generally, the final result is a multi-facetted picture of an object of study. No systematic integration or synthesis is made. Results are often expressed in disciplinary reports pasted together (the so-called "bookbinder synthesis").

Interdisciplinary research

Interdisciplinary research integrates two or more scientific disciplines with the goal of advancing understanding of complex cognitive and practical problems. It involves the development of a common conceptual and theoretical framework, along with a methodology that integrates or connects the research methods of the participating disciplines. In research programmes focusing on complex society–environment interrelations, such as the NCCR North-South, interdisciplinary research usually incorporates the natural and technical sciences on the one hand, and the social sciences and humanities on the other hand.

Transdisciplinary research

Transdisciplinary research integrates the social and natural sciences in a common approach (interdisciplinarity), simultaneously including non-academic knowledge in a process of co-production of knowledge and mutual learning. A transdisciplinary research project typically pursues objectives in three social domains: increasing (scientific) understanding of challenging global issues (knowledge), finding solutions to concrete societal problems (development), and supporting the development of researchers and institutions to enable them to continue working in a transdisciplinary manner (academic careers). These objectives are in conflict and difficult to bring together. Indeed, normal academic training only follows two objectives: increasing knowledge and supporting academic careers. In the case of TD, the development objective often conflicts with the academic career objective because academic careers are built on peer-reviewed publications rather than other forms of communication that are essential for the development objective. The disciplinary approach to academic training is not capable of taking up the challenges of preparing students for producing the kind of contribution to knowledge and contribution to development that is expected of them in the case of GC and SD research.

3 Learning Theories and Approaches

As mentioned above, the vision of SD needs to be permanently adjusted through processes of learning and negotiation that involve different actors in a society – including researchers from different disciplines – in a mutual learning process leading to co-produced knowledge. Very few academic institutions prepare their students to conduct research in a way that is open to such processes of interdisciplinary and transdisciplinary knowledge co-production. This requires training that enables learners to cross disciplinary and other knowledge boundaries with a view to contributing to understanding and dealing with complex global change issues.

The question is now: what learning theories and approaches are helpful to design and develop a training approach suitable for supporting research on global change and sustainable development? In this chapter, we present three different learning theories in a nutshell, then briefly explain what elements of corresponding approaches are relevant to developing teaching and learning methods suitable for integrative training (Figure 3), based on a review of the literature.

3.1 Behaviourism

Behaviourism is a learning theory based on the concepts of the psychologist B.F. Skinner. The basic assumption of behaviourism is that behaviour is controlled by cause and effect and not by the mind or reasoning. The key concept in behaviourism is "conditioning", with a distinction between two types: classical and operant conditioning (Dubs 2009). Pavlov's dog is a typical example of "classical conditioning". A neutral stimulus is used to trigger a response. Dogs salivate when they smell or get food. In his experiment Pavlov combined feeding with the sound of a bell (neutral stimulus). After a while, the dog salivated when he heard the sound of the bell. In "operant conditioning", desired behaviour is rewarded, whereas undesired behaviour is punished (Dembo 1994). For behaviourists, learning is always a reaction to a stimulus from the environment and leads to an observable change of behaviour. Teachers provide students with stimuli and reward correct answers. Therefore, contents are portioned in small bits. The learner is seen as the receiver of the information and will – after sufficient repetition – respond with a behavioural change. Wrong answers are the result of insufficient conditioning.

3.2 Cognitivism

The dominant paradigm of behaviourism was replaced in the 1960s by cognitivism. Contrary to behaviourists, cognitivists are interested mainly in how information is processed in the brain. Behaviour is not only a response to environmental stimuli, but the output of mental processes. The learner is often compared with a computer: information comes in, is processed in the brain, and leads to a certain output. From a cognitivist's point of view, learning is the development of mental concepts. New objects are integrated into existing categories or initiate the building of new ones. The goal of instruction is often to communicate or transfer knowledge to the learner. Instruction is characterised by active involvement of the learner; it requires

structuring, organising, and sequencing of information to facilitate optimal processing; it also requires learning environments that allow and encourage students to make connections with previously learned material (Good and Brophy 1990).

3.3 Constructivism

For constructivists, "reality" is determined by the experiences of the learner (Cooper 1993). Every person constructs his/her own understanding and knowledge of the world by experiencing things and reflecting on these experiences. When they encounter something new, learners have to bring this in line with previous ideas and experiences. Maybe they will discard the new information as irrelevant. In any case, everyone is an active creator of his/her own knowledge. Instructors are facilitators of learning. They arrange and design experiences for the learner so that authentic and relevant contexts can be experienced. Real-life problems are presented to the learners in order to maximise learners' curiosity and responsibility. The learner is at the centre of the design activity (Sanjaya 2002).

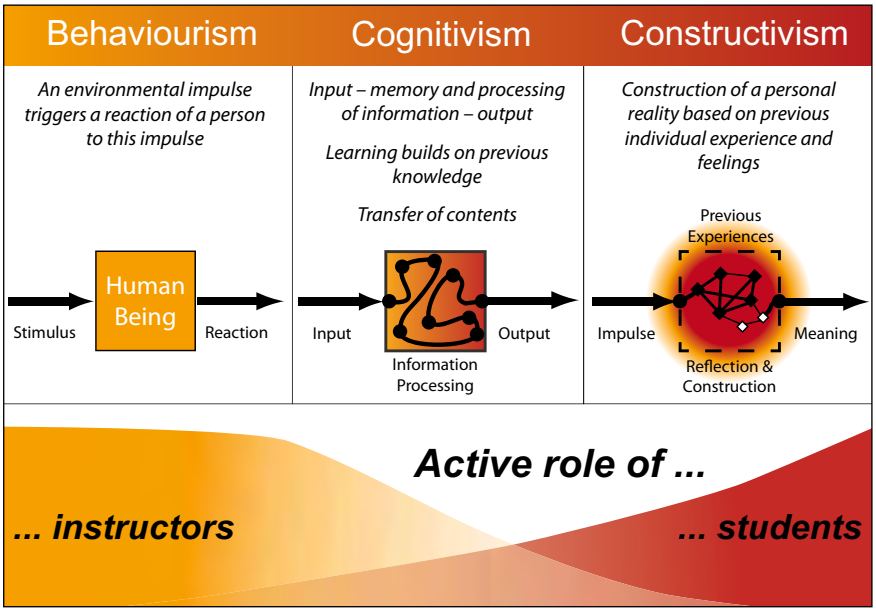


Figure 3: Learning theories and the roles of instructors and students. (Design: K. Herweg)

3.4 Learning approaches

Our literature review helped to shed light on which learning theories and corresponding learning approaches might be the most appropriate for integrative training. Behaviourism and cognitivism, two objectivist learning approaches, separate the learner from an outside "reality"; "reality" is thus external to the learner. The mind acts as a processer of information coming from the outside. Jean Piaget, a famous cognitivist, postulated that the development of skills such as thinking and rea-

soning is a process that lasts from childhood to adolescence. What is typical of both objectivist approaches is the aim of transferring knowledge to students in the most efficient manner. Therefore, the matter to be learned is divided up into clear portions and students receive it piece by piece (Cooper 1993, Braungart and Braungart 2011, Keating 2011). Constructivists, by contrast to objectivists, consider the learner as part of his/her environment and typically challenge learners with complex, open-ended questions. Since inter- and transdisciplinary research deals with complex society–environment settings, a constructivist approach to learning seems to be more appropriate for supporting students in their efforts to develop the required skills and knowledge to deal with the complex problems of such settings (Hmelo-Silver 2004).

At first glance, two constructivist learning approaches appear particularly useful for our setting: Problem-Based Learning (PBL) and Inquiry-Based Learning (IBL). Both approaches are student-centred (Figure 4), deal with complex, real-world problems, and are goal-oriented, flexible, and creative; moreover, it is legitimate to make mistakes and learn from them. Both learning approaches provide an introduction to the research process and focus not only on gaining knowledge, but also on building the skills needed for working in a team and communicating, thus promoting interdisciplinarity.

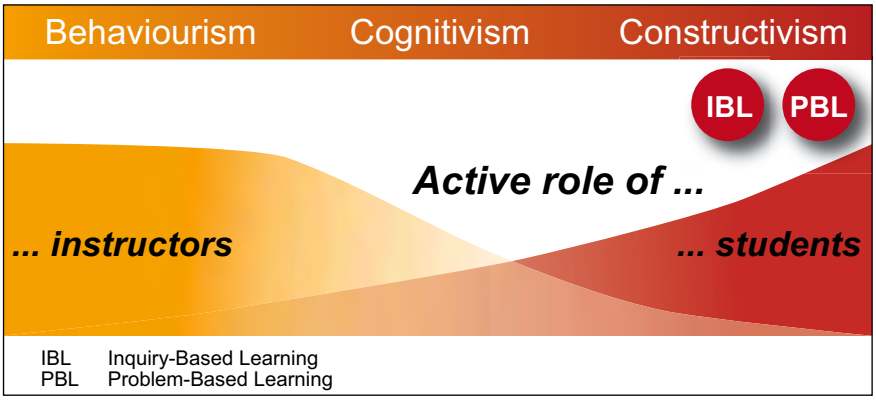


Figure 4: Positioning of Inquiry- and Problem-Based Learning approaches. (Design: K. Herweg)

While PBL was introduced in medical education, IBL arose from the practices of scientific inquiry (Pawson et al. 2006, Savery 2006, Hmelo-Silver et al. 2007). In IBL contents relevant to answering the driving question are provided before and during the course. E.g. the theory dealt with in class is taken up again in an inquiry-based lab course. In PBL, by contrast, the problem comes first, meaning that the problem itself defines what has to be learned. Students have to identify, first, what they do *not* know and second, what they *need* to know in order to find answers to the problem. Figure 5, presenting the Problem-Based Learning Cycle after Hmelo-Silver (2004), gives a brief overview of a PBL process (Hmelo-Silver 2004, Pawson et al. 2006).

Some authors criticise PBL and IBL approaches for their lack of proper guidance, allowing an arbitrary reality to emerge, which easily leads to messiness. Critics underline that this loss of security can be stressful and disorienting for students, because it

produces no "right" answers and clear solutions (e.g. Kirschner et al. 2006). Hmelo-Silver et al. (2007) disproved this critique. Nonetheless, applying the described constructivist learning approaches in a university environment – where lecturing is the predominant form of teaching – brings to light some practical challenges:

- A shift of the training paradigm and a change in attitude and mind-set of both the learner and the trainer are required. Lecturers have to work as facilitators and mentors rather than as the source of solutions. Students become more actively involved in the learning process and have to assume responsibility for themselves and their group.

- To provide optimal support for the small learning groups and appropriate guidance during the learning process, more tutors are needed as compared to lecturing.

- To use PBL or IBL in a course, constant access to information – e.g. via the internet, libraries, or resource persons – is necessary. NCCR North-South training events often took place in locations where this access could not be guaranteed and it was therefore difficult to provide students with the optimal learning environment for the described learning approaches. However, such remote locations also allowed visiting and working together with local actors in their surroundings, which is a fundamental element of transdisciplinary research. Consequently, we had to further develop a learning approach – based on PBL and IBL components – that was applicable to the above-mentioned circumstances. We call this Case-Study-Based Learning (CSBL), see chapter 4.1.

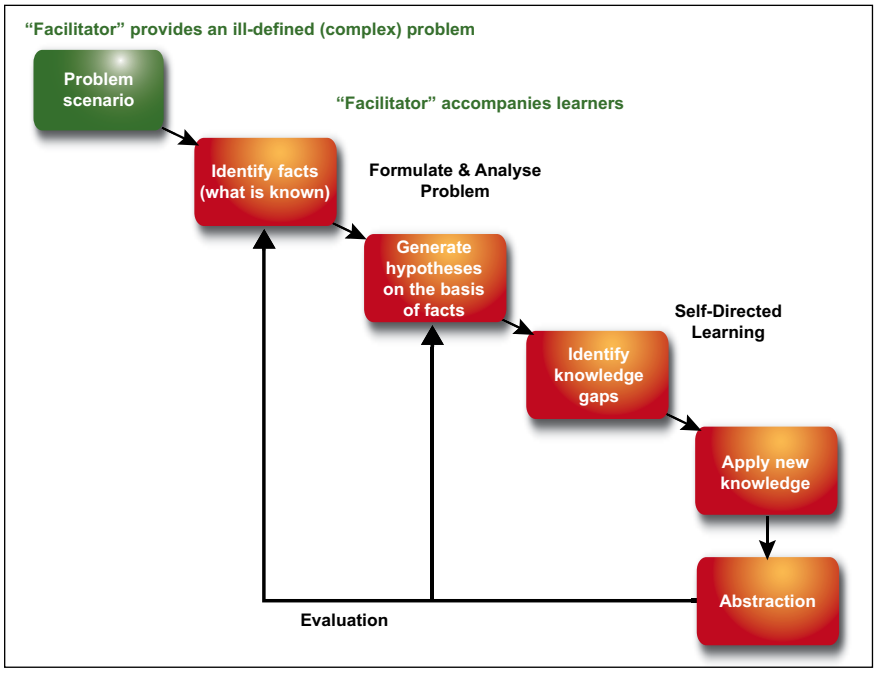


Figure 5: Problem-Based Learning Cycle (after Hmelo-Silver 2004).

MESSAGE
Integrative training must be an active form of learning.

MESSAGE
Constructivist learning approaches allow students to play a more active role, which is important to develop social and communication skills along with sound scientific knowledge.

Cartoon 3: Learning by reading alone may not always lead to practical results. (Cartoon: Karl Herweg)

4 Integrative Training

Based on our preliminary reflections on global change and sustainable development research (GC/SD, Chapter 1), we asked two questions: what research approach is appropriate for addressing GC and SD issues (Chapter 2), and consequently, what learning theories and learning approaches are suitable for supporting this type of research (Chapter 3)? In Chapter 4 we answer these questions from our point of view and based on 12 years of experience with training within the framework of the NCCR North-South programme (Figure 6). Box 1 summarises the main messages regarding GC/SD, derives the major requirements for a corresponding research approach, and proposes appropriate training elements – and training approaches – to support this research approach.

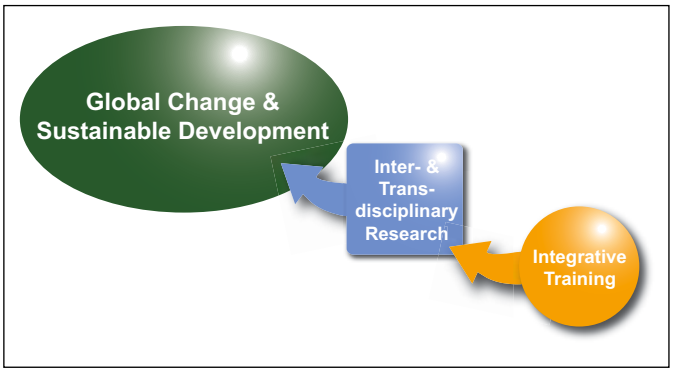


Figure 6: Integrative training supporting inter- and transdisciplinary research on global change and sustainable development (Design: K. Herweg)

In our understanding, the term "integrative training" refers to training in complex research settings, for example in the context of GC/SD. It comprises several layers of integration:

- Students of different disciplines work as a team in one training event (ID), in which everybody works to achieve a jointly defined goal in a common case study;
- PhD candidates are confronted with non-academic actors during joint fieldwork on a case study, which helps to see problems through different actors' eyes and to formulate ID/TD research questions and methodologies;
- The boundaries between the traditional roles of instructors and students become fuzzy. Depending on the "case" or "theme" under consideration, each researcher is often in the position of a layperson, whether he/she is a student or an instructor. Integrative training provides a platform for mutual learning, giving students more responsibility and opportunities for being active.

MESSAGE

Integrative training is designed to support inter- and transdisciplinary research on global change and on sustainable development.

Box 1: Global change/sustainable development: proposed research and training approaches

Global change & sustainable development	**Requirements for research on GC/SD**	**Corresponding training elements** (as supplement to continued strengthening of the disciplinary skills of each researcher)
GC involves complex society–environment relations and interactions	Interdisciplinary approach – close cooperation of natural and social sciences	• Student-centred approach – group exercises: learning ID cooperation and communication by doing • Communication exercises – elaborating joint research concepts and presentations • Presenting and discussing own methodologies/methods in ID groups • Scientific writing exercises
SD as a normative concept to address a societal concern involves convictions of, assessments by, and negotiations between numerous different societal actors from the local to the global level. SD requires permanent adjustment through processes of learning involving different societal actors – including researchers – in the process of societal learning.	Transdisciplinary approach – close cooperation between interdisciplinary teams of scientists and non-academic stakeholders	• Student-centred approach, case-study-based learning • Group exercises and fieldwork that enable encounters between scientists and non-academic actors • Exercises on communication with non-scientific actors and the media • Discussion of ethical issues related to GC/SD research
GC involves phases of rapid transformation, uncertain contexts, and an increasing demand for more rapid solutions to adapt to GC; classical disciplinary and basic research is rather slow and fails to respond to this demand for rapid action.	A new way of thinking in sciences, flexible research approaches, methodologies, and combinations of qualitative and quantitative methods	• Student-centred approach, case-study-based learning • Designing ID research projects; elaborating and conducting mixed methods approaches • Presenting and critically discussing methodological experiences, error estimation • Joint fieldwork • Drafting of joint, interdisciplinary article projects

4.1 Development of integrative training in the NCCR North-South

Integrative training as described in these guidelines was gradually developed in the NCCR North-South programme as of 2002. It was continually confronted with a number of challenges:

- The heterogeneity of disciplinary thinking involves different agendas and ways of thinking. This diversity can be a very fruitful ingredient for conducting innovative research but it may also reveal existing prejudices. The challenge for trainers is how to cope with the heterogeneity of academic fields, motivations, methodological experiences, and the status of previous disciplinary training of participants.

- Cultural differences in academic training in Asia, Africa, Latin America, and Europe are reflected by ongoing discussions about what kind of training methods are expected and should be used. The constant evaluation of training events shows that participants and lecturers require a wide range of formats, from formal lectures to participatory workshops and joint fieldwork.

- The contents of training events are under continuous development when research enters new territory. This means that contents are neither canonised knowledge, nor are they well-elaborated units for training purposes.

- Training and experience in networking is absolutely essential for achieving collective scientific progress. The different disciplines and stakeholders involved in the NCCR North-South require intensive and time-consuming networking, which is neither an academic field of training nor a practice that can rely on broad experience, standard protocols, and effective procedures. In addition, intensive general networking in the programme limits the time and energy that can be invested in training.

When the NCCR North-South began, education and training (E&T) was still dominated by highly heterogeneous demands and training contents. Besides sound basic academic and disciplinary training through coursework and supervision, the NCCR North-South gradually developed regional (continental) and integrative (global) training events and modules with a focus on training in inter- and transdisciplinary, methodological, and communication skills, mainly through a case-study-based learning approach.

MESSAGE

The major challenge of integrative training is to accommodate great heterogeneity in terms of disciplines, languages, training cultures, and expectations.

The goal of making research contributions that help society to move towards more sustainable development requires a major shift in the way researchers think. Consequently, trainers who support this type of research cannot be satisfied with a mere transfer of knowledge and information (Herweg et al. 2008). In the NCCR North-South, E&T was basically guided by a four-step learning model: "information/comprehension – attitude – intention – behaviour change". **Information and comprehension** are only the starting points for developing a positive **attitude** towards societally relevant research, as well as towards inter- and transdisciplinary approaches. This is a precondition for developing and expressing the **intention** to finally **change** one's own **behaviour**.

MESSAGE
Integrative training follows the four-step learning model:
information/comprehension – attitude – intention – behaviour change.

Research for sustainability does not emerge from academic debate alone but from confronting unsolved societal problems. In the real world, both problem-identification and problem-solving skills are needed. But in order to overcome the constraints of inquiry-based learning (IBL) and problem-based learning (PBL) as well as to incorporate transdisciplinary aspects through encounters with local actors, a Case-Study-Based Learning (CSBL) approach was gradually tailored to the needs of NCCR North-South students. Students also encounter uncertain ground in CSBL: The situation is often unclear, the information incomplete, and there are actors with hidden agendas. Students require new skills for problem diagnosis and there are no blueprint solutions at hand. Thus, CSBL also requires tutors who accompany students throughout the case study, and who are in a position to spontaneously provide different kinds of assistance (Figure 7). This fact forced us to work with a mixture of instructors and senior (PhD) candidates who were in a very good position to provide good tutoring. The most obvious difference between CSBL and PBL/IBL is that reading material had to be organised beforehand. Limited access to libraries and the internet did not sufficiently permit learners to search for material as part of the course.

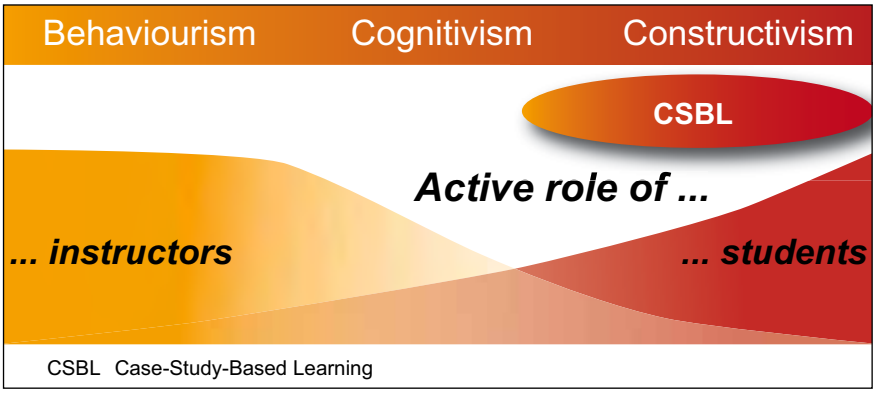


Figure 7: Positioning of Case-Study-Based Learning as the selected scope of integrative training. (Design: K. Herweg)

4.2 Sharing our experience

The experience shared through these guidelines is based on education and training courses and modules developed and implemented in the NCCR North-South framework. Such integrative training is closely linked with constructivist learning approaches. However we would like to underline that our development of integrative training was not greatly influenced in the beginning by theoretical considerations. It was influenced rather by practical circumstances, necessities, and demands, such as the availability of trainers, long travel distances, specific training needs, working conditions in remote places, very different institutional requirements, and the like. For example, the strong focus on Case-Study-Based Learning is a compromise that meets the need to accommodate a great heterogeneity of disciplines and the opportunity to explore GC/SD issues on various continents, and takes account of the fact that only a limited number of instructors can find the time to spend 10 to 14 consecutive days for training.

Consequently, in what follows, we do not present our experiences and materials as a textbook, i.e. as solutions for all training situations and needs related to research on global change. We prefer to provide them in the form of a toolbox that leaves the final decision regarding what to use and how to use it, to the reader. It should be clear that the material must be adapted by the user to his or her specific training situations.

MESSAGE

These guidelines aim to share practical experience and training material related to integrative training; however, they need to be adapted to the reader's situation.

Cartoon 4: Playing your own instrument well is not enough – all solo parts must be harmonised in a concert! (Cartoon: Karl Herweg)

5 Toolbox – Best Practices

This toolbox provides ideas and material that can be used to conduct and organise Integrative Training Courses and components. We focus primarily on skills and topics needed for inter- and transdisciplinary research in the context of global change and sustainable development, such as teamwork, joint development of research concepts and research questions, joint fieldwork and application of mixed (quantitative and qualitative) methods, ethical issues in fieldwork, academic and non-academic communication, and time management. Some of these skills and topics are regularly neglected in conventional university education, while others seem to be taken up occasionally, but not as a standard programme in all curricula, as experience with our students clearly shows. Many of these skills require learning by doing rather than a theoretical debate about them, which is one of the reasons why we favour a student-centred approach.

One premise to be kept in mind, however, is that focusing on inter- and transdisciplinary skills requires that all participants have a sound disciplinary basis, but it is beyond the scope of these guidelines to address this issue here.

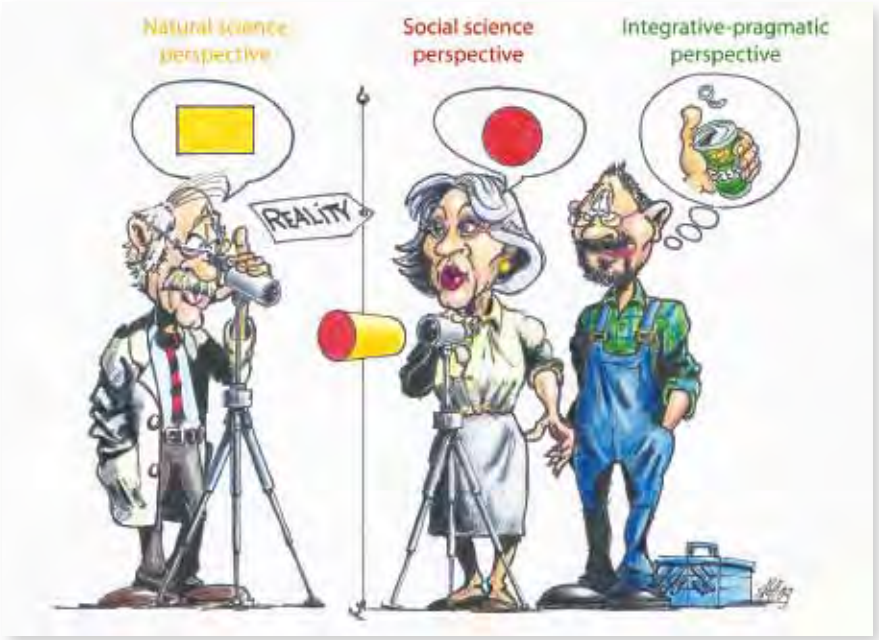
The training material has been tested, evaluated, and adapted in a number of different courses. In addition, information on how to organise an integrative training event is based on long-term experience, gained both within the NCCR North-South programme as well as in other international training events.

MESSAGE

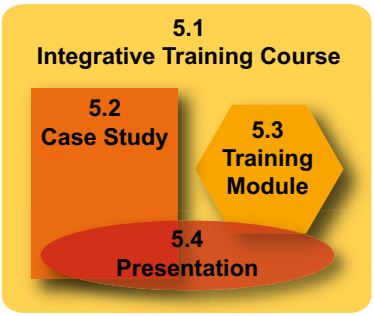
To provide the reader with hints regarding whether or not this material may suit his or her situation, we specify the context and conditions in which we applied and tested the different components. Nonetheless, the reader should adapt all the materials provided here to his or her specific topics and training needs.

The toolbox contains four components:

- The first component is an overall *Integrative Training Course*, for which we focus on describing preparation and implementation. Such a course can include all of the following components.
- The second component is an in-built *case study*, which can be the core component of an Integrative Training Course. We emphasise the organisation and implementation of such a case study, including fieldwork.
- The third component is a *training module*. We provide information on how to develop and conduct a half-day training module.
- The fourth component is *presentation*. You will find selected information on communication skills needed for working in inter- or transdisciplinary groups, such as presenting an issue to an interdisciplinary audience in the form of a poster or through oral presentation, and some hints on scientific writing in relation to careers.



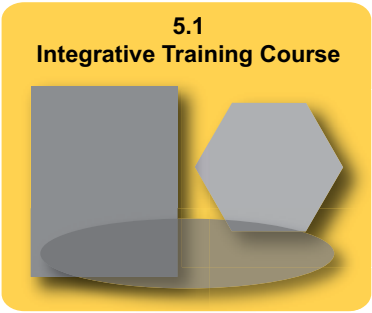
Cartoon 5: Integrating different perspectives … (Cartoon: Karl Herweg)



Each component is structured as follows:

- Objectives and brief description of the training component – what is the purpose of the component, what characterises this component?
- Skills to be developed – what aptitudes and capabilities does one expect to develop?
- Investments and prerequisites – how much time and what inputs are required?
- Context of application – under what circumstances did we apply or conduct this component?
- Steps and procedures – what needs to be done and when?

5.1 The overall Integrative Training Course (ITC)



5.1.1 Objectives and challenges

The main objective of an Integrative Training Course (ITC) is to build interdisciplinary teams of researchers, with a view to enabling them to conduct research in complex and uncertain research settings such as those involving global change and sustainable development. Integrative training seeks to build a fundament of interdisciplinarity based on which students and instructors can foster mutual understanding, knowledge exchange, and constructive teamwork to achieve a common goal. Essential components are reflection on one's own discipline and its epistemology and methodology, a basic knowledge about other disciplinary epistemologies and methodologies, and effective communication. An important precondition for interdisciplinarity in this respect is sound disciplinary knowledge, as found at the levels of PhD and – to a certain extent – advanced Master studies.

Interdisciplinarity cannot be based on theoretical considerations alone – it must be achieved through learning by doing. Consequently, the number of top-down lectures should be reduced to a minimum for the sake of creating sufficient time and opportunities for interaction and communication, such as exercises, debates, and presentations by the participants.

When conducted in an international programme, the overarching challenge of integrative training is to accommodate a large number of nationalities and cultures with heterogeneous educational backgrounds, different expectations with respect to academic training, and this on top of representing several different scientific disciplines. Often, researchers meet for the first time. What problems and interests do they share as an interdisciplinary group in the framework of sustainable development research? Certainly, one course alone cannot guarantee good interdisciplinary cooperation in future, but it can help participants to trust each other and build the confidence necessary for further collaboration, be it face-to-face or by electronic means of exchange.

An important issue here is that both students and senior researchers start from entirely different levels of training and knowledge. All of them are specialists in a specific field of research and laypersons when it comes to all other topics and methods. This fact somewhat modifies and equalises the roles of students and instructors, and encourages students to assume greater responsibility for their topics and methodologies.

MESSAGE

Since the thematic and methodological foci of integrative training may vary considerably, we limit this chapter to organisational aspects of planning and conducting integrative training. Further thematic and methodological aspects are described in chapters 5.2 and 5.3.

5.1.2 Skills to be developed

Since the range of topics in the context of GC and SD is rather wide, integrative training emphasises to a large extent the strengthening of general methodological skills, specific social skills to support team-building and communication. Before focusing on interdisciplinary skills it is certainly recommendable for participants to meet in disciplinary groups to present their methodological experiences, reflect on their own disciplinary methods, and to critically assess these disciplinary procedures.

Cartoon 6: Terminologies – talking about the same thing without running the risk of understanding each other … (Cartoon: Karl Herweg)

As a result of their disciplinary training and methodological premises, researchers within the same discipline develop a common view of the "world". They apply a common terminology to analyse and describe an object of research. This specialised language makes communication within one discipline clearer, faster, more efficient, and more coherent. It allows correct assessment of research results achieved by colleagues and enables their appropriate application within the same discipline. Disciplinary language makes it possible to focus on common research topics, and makes it easier to be at the cutting edge of research.

The advantages of disciplinary research, however, can pose challenges for interdisciplinary research. What is obvious in disciplinary research needs clarification in interdisciplinary cooperation. Thus interdisciplinary work requires more time, greater social competence, and better communication skills than disciplinary work. Preconditions for interdisciplinary work are:

A reflective and critical attitude towards one's own discipline. This means:
- Identifying the characteristics of one's own perspective, including its blind spots;
- Recognising and accepting the limitations of one's own disciplinary concepts;
- Defending and justifying the validity of one's own disciplinary concepts; and
- Being willing to explain one's own disciplinary perspective patiently.

A tolerant, respectful attitude towards other disciplines. This means:
- Accepting that other ways of thinking are possible and worth being studied;
- Being willing to understand them and curious to learn about them;
- Realising that the relation between disciplinary concepts has to be clarified; and
- Being willing to search for and use a common terminology.

An open and dependable attitude towards other researchers. This means:
- Assuming that their intentions are good;
- Showing confidence in their competence;
- Being willing to engage in communication training; and
- Agreeing that conflict management is necessary and possible.

Interdisciplinary cooperation, above all, requires the ability to put oneself in somebody else's shoes and to develop effective communication. International courses at the PhD level will inevitably struggle with degrees of fluency regarding the language of communication. Translation is rarely affordable, but usually participants are in a position to help themselves, provided that there is ample time and opportunity to practise the language in discussions and presentations. Language problems can definitely help to build the team, provided that silent participants are encouraged by the others to speak!

HINT

Our ITCs have shown the importance of social events, such as a cultural performance presented by the host country, ice-breaking opening and closing parties with music and dancing, joint spare time, and even extended breaks to make personal contacts. Such opportunities help participants to socialise and develop an atmosphere of mutual trust and confidence. This, in turn, is not only the best precondition for professional teamwork during the training. It also considerably facilitates sound collaboration after the course via mail, in electronic discussion groups, writing joint papers, etc.

5.1.3 Investments and prerequisites

An Integrative Training Course ideally lasts 10 to 14 days, including a one-day break in the middle. Depending on the complexity of the course, preparations should start 12 to 15 months before. Since an ITC usually involves university staff, the timing should be within the semester break.

It is important to guarantee appropriate facilitation and supervision of students, which means that an interdisciplinary course requires supervisors who represent the major disciplines related to the course topics, and, most importantly, who are interested in interdisciplinary cooperation. Besides making selected input presentations, the supervisors should be able to flexibly react to spontaneous demands related to their subject matter and to methodological questions.

HINT
An ideal working group size is about 10 to 15 students, which also makes it easier for reticent students to talk. Thus, in large courses, participants should split up into subgroups. The more groups there are, the more tutors or facilitators are needed. In the frequent case of shortage of instructors, senior students with good communication skills should be selected and be given responsibilities to work as tutors and assist the instructor in organising the work.

The venue should provide one large room for plenary sessions and a social event, and a sufficient number of rooms for group work, as well as openly accessible areas where groups or individuals can meet spontaneously and informally. Rural venues have the advantage that participants spend spare time with each other and build up trust and confidence, which are essential for teamwork. Such venues may offer cheaper accommodation but transport costs from the main airports to the course location may be higher. Urban venues provide many other opportunities to spend the evenings; they may thus be suitable for socialisation, but can be less fruitful when work extends into the evenings.

HINT
As a complement to theoretical discussions and classroom exercises, fieldwork offers opportunities for other ways of learning, thanks to encounters with the local population and first-hand experience of the environment. This, however, requires special preparation, which is discussed in Chapter 5.2.

Figure 8: Integrative Training Course 2010, Bahir Dar, Ethiopia. (Photo courtesy of the NCCR North-South)

5.1.4 Context of application

So far, the NCCR North-South has conducted six ITCs, accommodating between 60 and 140 PhD candidates from four continents representing more than 20 disciplines, and lasting 10 to 15 days. The courses took place in Switzerland (twice), Kyrgyzstan, Lao PDR, Costa Rica, and Ethiopia. In addition, we organised eight continental training courses with 20 to 40 participants (in Africa, Asia, and Latin America) lasting 7 to 9 days each.

In order to better understand and improve the conditions of research in the context of sustainable development, it was essential to conduct a number of courses in locations close to where local problems and potentials of global change had been identified. However, selecting venues in different partner countries in the South and East, combined with the international composition of participants, involved considerable costs due to intercontinental travel. For example, many African participants can only travel to Latin America or Asia through Europe. Consequently, visa procedures took a lot of time and effort, particularly because not all nationalities are equally welcome in all countries. Nonetheless, this approach allowed a number of North–South and South–South partnerships and networks to emerge.

HINT

If different presentations are planned on one topic, it is helpful to collect them in advance. This helps to resolve misunderstandings and minimise repetitions in individual courses.

MESSAGE

Personal encounters with other colleagues in a training course are important triggers of long-lasting alliances because they help to build sufficient mutual trust and friendly relationships for the long term. After such initial encounters, cooperation through electronic channels becomes much easier.

5.1.5 Steps and procedures

First steps

Organising an Integrative Training Course requires 12 to 15 months' preparation time. This includes designing and seeking consensus on the course outline, selecting participants, preparing the budget, making travel arrangements, issuing visas, arranging facilities such as hotels, study sites, and transport, contacting interviewees and other non-academic actors for the field trips, etc. Depending on how many partner institutions are to be involved in preparing and conducting the training, the first step must be agreement on the purpose, topic, date, budget, and location of the course. In what follows, we discuss issues regarding the contents and organisation of the course; both aspects must be dealt with simultaneously.

Concept and outline of the course

The concept and outline of the course is the most important document at the beginning. It addresses all participants and people involved in organising the course, such as programme managers, students, and instructors (facilitators), and needs to be continually improved. The outline provides information on the objectives of the course, what is expected of the participants and facilitators, and the benefits for each group. When preparing such an outline, the following points should be kept in mind:

- Determining the target group(s): PhD candidates, senior researchers, trainers of trainers, extension staff, etc. with different disciplinary backgrounds.
- Defining general objectives and outcomes of the course for each target group. This will provide the focus for further development of the course outline.
- Defining tasks for each target group for the following phases: preparation, duration of the course, and follow-up. For example, PhD candidates will have to read several articles or prepare a presentation of their work. Facilitators will prepare their inputs or bring along material needed during the course.
- Defining expected outputs (immediate results) and outcomes (expected effects).
- Preparation of a tentative programme for the course, including the main programme parts, which will later be subjected to comments and improvements. Listing of all training components (modules, sessions, fieldwork, etc.). Provision of a short paragraph with more detailed information on each training component and a list of the objectives/goals for each component of the course.

HINT

As soon as participants are selected, we suggest collecting information on their experiences in the form of written profiles (name/institution, country, experience, topics, methods, expectations of the course) and disseminating them among all participants. These profiles will help participants to identify peers who share similar challenges. We also found it very useful to provide a pinboard during the entire course which serves as a peer learning exchange platform ("bazaar") for demands and offers relating to participants' needs for thematic and methodological support.

Harmonising course content and organisation

The major challenge is to harmonise a multitude of interests in the form of a limited number of training modules, sessions, and fieldwork. If the course is held abroad, its preparation must involve one person with overall responsibility and at least one assistant at the venue site to manage things on location before, during, and after the course. Furthermore, the organisers will have to accommodate not only lecturers and students; local actors also have to be contacted and asked to give interviews or provide access to sites, data, organisations, etc. Modules and sessions have to be adapted and tailored to the needs of participants.

HINT

We recommend working with a "screenplay" that makes the preparation schedule transparent for everybody.

Box 2: Summarised "screenplay" for preparing an Integrative Training Course

Timing (months before course)	**Issues regarding content**	**Organisational issues**
15–12	Define training purpose, topic, date, and location	• Define the budget • Identify potential participants and facilitators, as well as the tentative number of attendants to pre-select accommodation • Identify potential course venue
11	Prepare a first course concept and outline for approval by the programme management	• Prepare the budget for the course • Prepare administrative tools for the course (list of participants, checklists, task lists, address lists, etc.) • Disseminate the first course outline (theme, goals, dates, location) to facilitators and collect feedback for adapting the outline • Identify a local responsible for preparing and implementing the course, and for accounting • Collect feedback from facilitators and prepare a revised course outline • Disseminate revised course outline and definitively select participants • Book hotel rooms and course venue

continued next page

Box 2, ct'd: Summarised "screenplay" for preparing an Integrative Training Course		
Timing (months before course)	**Issues regarding content**	**Organisational issues**
10	Prepare detailed outlines of sessions, modules, etc.	• Adapt budget
8	Prepare more detailed arrangements for the sessions, desired observation sites, and interviewees for the fieldwork	• Select accommodation for fieldwork • Contact potential interviewees and local actors to be included in parts of the course • Decide upon compensation for them • Collect participants' profiles
6	Definitively arrange field trip • Route and programme • Maps, figures, hand-outs	• Make visa arrangements (check requirements of the respective embassies, prepare invitation letters) • Ask participants to make travel arrangements and get tickets (prepare list of participants, including arrival and departure dates) • Budget allocations • Recruit and assign local staff – Secretarial assistant – Purchaser/driver/translator • Organise field trip (hotels, cars, drivers, stops, interview partners; allow ample time for driving, observation, interviews by larger groups)
5–4	Preparation of opening • Select speaker	• Contact speaker for the opening • Plan course sessions • Inform participants about the course location, conditions (weather, clothing, vaccinations, etc.), final version of the programme, participants' preparatory tasks; make participants' profiles available • Prepare social events (ice-breaker, sightseeing, music, etc.) • Send out invitation letters to corresponding embassies and organisations
3–1	• Arrange overall facilitation • Define the final programme • Collect facilitators' presentations or summaries • Prepare evaluation; go back to the targets defined in the outline	• Confirm Terms of Reference with local staff and all resource persons • Prepare courseware (event folders with documents, information, etc.) • Organise office equipment (beamers, projectors, printers, copiers, PCs, internet access, pinboards, flipcharts, etc.) • Organise consumables (name tags, paper, markers, folders, scissors, glue, CD ROMs, etc.) • Organise transport • Contract with local clinic/doctors for med care during the course

HINT
Look for accommodation that provides internet access – some participants may not want to come if they cannot regularly check their mailbox.

Monitoring and evaluation

Evaluation of the modules, sessions, and overall course framework is an important instrument for gradual improvement of the courses and must be considered already at the planning stage. Prior to implementing a module or course, instructors should decide how they will monitor and assess training and what they want to monitor, for example: a general rating of the course/module, its comprehensibility, its relevance to participants' work, how much and what was learned, the quality of facilitation, etc.

Different forms of evaluation can be taken into consideration, depending on the purpose:

Course exam

An exam, a report, or a poster presentation provides information on the quality, immediate comprehension of contents, and adequacy of the subject matter provided. Whether oral or written exams are taken has to be clarified in advance and communicated to participants before the course.

End-of-course evaluation

A typical evaluation at the end of a course provides direct feedback from participants on contents and organisational issues for the whole training event (Figure 9). The evaluation may cover participants' overall impressions of the course, but we recommend also collecting feedback on selected details. To improve future training events, it is useful to get participants' ratings, but at the same time it is important to ask them why they were satisfied or dissatisfied with a certain element of the course, and what the highlights and weak points of the course were in their opinion. This can be done orally or anonymously. An evaluation right after the training event is important to obtain feedback while impressions are still fresh. This also provides a chance to check and enquire immediately if one sees that ratings, comments, and criticisms are unclear. If necessary, ratings can also be clarified in smaller groups. This type of evaluation refers to the outputs – i.e. the immediate results of the training event – be these outputs opinions or concrete products such as presentations, reports, etc. In most courses, we evaluated both the course as a whole and all its modules.

Figure 9: Anonymous general evaluation and evaluation of modules conducted at the Integrative Training Course in 2010; participants complemented this overview with comments and suggestions. (Photos: N. Schäfer)

Outcome monitoring

A general drawback of evaluations that take place immediately at the end of a course is that participants are not yet in a position to know what they really learned. An evaluation a few months or a few years after the training event can bring to light the course's mid-term effects – the so-called *outcomes* of the training event. *Outcomes* imply the transformation of an output – e.g. applying what one learned in one's own work after the training event. For example, it is relevant to find out whether researchers changed their style of work or their methodology, or what concrete training elements they incorporated into their daily work. Outcome monitoring is an instrument for ascertaining whether the targets – not the outputs! – of a programme have been achieved or not. To this purpose, we asked participants during the final evaluation of the courses what elements of the training they intended to incorporate in their daily work and what they intended to change. After a year or two, these outcomes can be monitored. Participants will then be asked how many of the intended changes actually took place, which ones did not and why not, and what unplanned changes occurred, triggered by the training course.

Box 3: Possible questions for outcome monitoring …	
… immediately after the course	**… one or two years after the course**
Are you already currently doing your (applied) research in an ID/TD team? If yes, describe what scientific disciplines and other actors are part of your team.	Did you conduct parts of your research in an ID/TD team? If yes, describe how you worked together and what challenges and advantages you faced.
Based on, or initiated by, this integrative training, what kind of changes do you plan regarding … • your research set-up? (e.g. approach, methodology, methods) • your cooperation with other researchers? • your cooperation and communication with other actors?	Based on, or initiated by, the Integrative Training Course, what kind of changes did you implement regarding … • your research set-up? (e.g. approach, methodology, methods) • your cooperation with other researchers? • your cooperation and communication with other actors?
	(Compare these changes with what you planned in your proposal) • Which of the intended changes did not take place and why not? • What unplanned changes occurred, triggered by the training course?

HINT

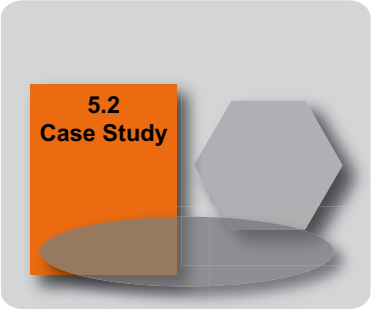
Outcome monitoring is a promising tool for capturing what was really learned and implemented after the course. But it must be announced during the training and the person carrying out the outcome monitoring must ensure that participants and course organisers will also find the time for sound feedback and analysis of a training event that took place two years before!

If, in addition, programme coordinators wish to seriously assess the appropriateness of the training programme, the following questions may be of help:

- How many people were invited to attend the courses or take the modules?
- How many training events were offered?
- Were trainees given the opportunity to develop the skills required?
- Did trainees develop the skills required?
- Did they complete the exercises successfully?
- What support did they get from their peers, their supervisors, the instructors?
- …

HINT
The crucial point regarding these questions is that formulating them already at the planning stage should make it more likely that the programme is organised in such a way that these questions will be answered positively at a later stage.

5.2 The in-built Case Study



5.2.1 Objectives and challenges

The main objective of a case study is to build up transdisciplinary competence in research, i.e. to work as an interdisciplinary team of researchers together with other, non-academic actors, for example in a complex society–environment context. A course cannot be called transdisciplinary as long as only scientists debate about TD. Indeed, although research on global change and sustainable development must, on the one hand, be grounded on a sound theoretical, epistemological, and methodological foundation, on the other hand, a component of applied research is required as well, so as to identify pathways towards more sustainable development. Transdisciplinarity cannot be achieved through theoretical debate alone. Exposing researchers to, for example, local stakeholders and the environment they live in, the livelihood options they have, etc., opens many additional paths for researchers to understand processes of sustainable and unsustainable development. At the same time, the transdisciplinary approach requires involvement of local actors in the co-production of knowledge for sustainable development: it is therefore necessary to expose researchers to a situation where they become aware of what this may imply.

Thus a transdisciplinary exercise requires a combination of classroom exercises (preparation and synthesis) and a trip to the real world. A case study helps researchers to get a "feeling" for – in addition to "knowledge" of – the complexity of a subject and the potentials, needs, and visions of people.

MESSAGE
Researchers claiming to work for the benefit of society must develop a "feeling" for people and their environment, and be open to communicating with people.

The second objective of the exercise is to help students to meet one of the major challenges faced by young researchers, i.e. formulating research questions that are relevant to science and society. This is done, for example, by asking, "if I were to do my research here, what would be my hypotheses/questions as an individual researcher, and as a team?"

The case study is seen as an exploratory field survey with the aim of formulating research questions that are relevant to the people and that address real development potentials and problems. It is not possible to consider all the steps of the research process within seven days, but participants will gain insight into the whole procedure. We do not claim to carry out sound research in three days of actual fieldwork; instead, we rely mostly on so-called "rough methods", such as observations, participatory transect walks, informal discussions, selected interviews, etc. Moreover, as is explained below, encounters with other actors require ethical considerations: it is important to avoid using people as mere informants, without thinking about how they could benefit from participating in the training.

5.2.2 Skills to be developed

We recommend the case study approach in order to train skills needed in inter- and transdisciplinary research. The case study approach brings together students from different disciplines who will probably be meeting for the first time. This approach fosters different interdisciplinary skills, such as the ability to:

- Distinguish between one's own and other actors' views;
- Integrate the knowledge and views of different disciplines into team considerations; envisage other actors' agendas;
- Develop a joint conceptual framework and identify research questions with societal relevance;
- By applying different interview and observation techniques, carry out joint fieldwork and thus implicitly and explicitly learn about other epistemologies, methods, and argumentations;
- Formulate research questions and hypotheses and a joint research strategy as an interdisciplinary team capable of considering other actors' views;
- Design a methodology considering qualitative and quantitative methods;
- Present summarised group findings in the plenum; and
- Engage in conflict management, as it is likely that there will be many agendas and several individuals who will try to dominate the group.

Not many participants are used to working in a transdisciplinary team. For many students it may be the first time they try to get non-scientific actors involved in formulating research questions. In this respect, the case study is meant to:

- Practise communication between scientists and non-academic actors;
- Create awareness of ethical issues, social norms, and values that emerge when research interferes with other actors' life worlds;
- Work with non-academic actors, e.g. by formulating development potentials and limitations, and jointly develop mitigation strategies and measures.

HINT
In research, non-academic actors as interviewees often play the role of information providers. In transdisciplinary research, non-academic actors are actively involved in the entire research process; the aim must be to involve them as equal partners and not just as a source of information.

5.2.3 Investments and prerequisites

A case study ideally lasts about 7 days. Because the study requires time and active involvement of other actors, planning should start about half a year before the course. If the case study is embedded in an overall course, needless to say its focus must be aligned with the overall programme of the course. The timing and thematic focus of the case study needs to be defined first. The date of the study should be determined not only with regard to the availability of the students and facilitators, but also taking into account the availability of the most important actors to be interviewed. A knowledgeable resource person (e.g. a senior researcher, an advanced PhD candidate, someone from an NGO, etc.) is needed to provide students with an overview of the area and issues, and pre-select possible reading material and information for students to prepare their fieldwork. He/she will select study sites suitable to the thematic focus of the case study, as well as interview partners, maps, transport, and accommodation during the time in the field. Ideally, about 10 students from different disciplines should form one group. At least one facilitator is needed per group. Knowledge about the case study area is advantageous but not compulsory. Facilitators should have a backstopping function during the entire case study. They will support students in developing research questions, selecting and applying research methods, and analysing, integrating, and interpreting their findings.

HINT
Conducting a case study requires the presence and experience of several senior researchers. In most cases, these persons do not have to prepare lengthy inputs, but they have an important backstopping function. A lot of flexibility is required to work in a team and react mostly spontaneously to students' demands for support!

Study sites should be within easy driving distance from the ITC venue, in order not to lose too much time for travelling. Depending on the quality of roads, this is between 50 and 100 km. If this is not possible, travelling time can be used to make observations and prepare questionnaires.

5.2.4 Context of application

So far, we have conceived of and conducted the case studies as the central part of Integrative Training Courses, with a thematic focus on "local and regional implications of global change: case-study-based learning". With a division into three field study groups per course, we reached the limits of our capacity to prepare and manage travelling, accommodation, interview partners, and observation stops. While in Costa Rica in 2008, each group consisted of about 20 participants, the higher number of participants in Ethiopia in 2010 forced us to increase the number per group to 30. This was manageable but not ideal. Moreover, about one third of the fieldwork time had to be used for travelling rather long distances. But this time was effectively used to observe, prepare questionnaires, or discuss findings (apart from taking naps, of course).

5.2.5 Steps and procedures

Planning of a case study should begin a minimum of half a year in advance. First, a specific thematic focus or motto needs to be determined, unless the case study is part of a larger training course with an overall motto.

To be more specific in explaining the procedures of planning and implementation, we shall now focus on the concrete example of the ITC in Ethiopia in 2010. The selection of the case study themes and sites is an iterative process that takes into consideration – in our example – (1) the overall orientation of the training course in which it was embedded ("local and regional implications of global change"), (2) relevant development issues (actor groups, potentials and problems, etc.), and (3) manageable conditions (travelling distances, availability of interview partners, etc.). We finally split into three groups emphasising central issues in the Ethiopian highlands: "people and protected areas", "urban development", and "sustainable land management"; specific explanations below focus on the third group.

Selection of the theme, area, pre-selection of interview partners, and observation sites

- The study area, with its actors and observation sites, must reflect a situation that is relevant to an inter- or transdisciplinary research focus, i.e. a society–environment context.
- The case study can be conducted in one location where different sites and actors can be visited within a short time (less than an hour). Alternately, it can cover a wider area where locations and interview partners are visited as during an excursion. In general, if it takes more than half a day to reach the area from the course venue, an extra day should be planned for travelling.
- The topic of "sustainable land management (SLM)" required locations that were suitable for observing land degradation and conservation issues such as soil ero-

sion, water issues, soil and water conservation technologies, etc. At the same time, we had to determine in advance who were the most relevant actors in relation to SLM, such as male and female farmers, extension workers, representatives of local and regional authorities, researchers, land use planners, etc.

- Once these basic components have been roughly clarified, it is necessary to integrate the observation sites and potential interviews in an overall time schedule and route. This is best done during a reconnaissance field visit where potential observation sites can be visited and actors contacted personally. Sufficient time must be allowed for observations, interviews, and travel, in order to be flexible enough to accommodate unplanned interesting discussions or observations, flat tyres, etc. Ideally, one member of each actor group should be identified who will be available for an interview or discussion during the study. In order to have some flexibility in arranging the route at the beginning, it is recommended to foresee several alternative appointment dates with each interviewee and select observation sites tentatively.

- It is generally difficult to answer the question whether interview partners should be compensated in cash or kind for their participation. We adapted to the practices of researchers in the area, in order not to hamper their relations with local partners. If possible, we recommend inviting actors who have provided their time and knowledge to the final presentation and discussion of the case study results.

Box 4: Planning and implementation of the case study	
Planning (at least 6 months before the course)	• Selection of the theme, area, pre-selection of interview partners and observation sites • Integration of interviews and observations into a field programme
Implementation	• Familiarisation of participants (1.5–2 days), including input presentation, reading, and preparation of questionnaires and observable indicators • Fieldwork (3 days), including interviews, discussions, and observations • Analysis (2 days), including synthesis and preparation of the presentation • Presentation of a synthesis (0.5 day), including discussion • Evaluation of the transdisciplinary training approach

A major challenge during planning is the cross-continental communication related to the case studies. On the one hand, it is a good communication exercise to properly transmit first vague ideas and illustrate the purpose of the studies in the framework of the entire course, so that local partners can adequately select interesting sites and contact relevant actors and incorporate these in a three-day programme and study route. On the other hand, it is difficult to judge the first proposal for case study routes without having seen the locations and talked to the people. Starting preparations several months ahead and having lengthy Skype sessions will help to eventually end up with satisfactory results.

HINT
If the case study is conducted abroad, we recommend employing or contracting a local partner and/or resource persons to prepare and attend the case study, as well as to do a reconnaissance of the field study site(s).

Integration of interviews and observations into a field programme

The field programme should cover the observation sites and allocate time for walking and observation, determine the location of the interviews and the time for interviewing, as well as indicate distances and travelling times between observation and interview sites. In our example, we selected a village and its surroundings where we spent the entire second day of the fieldwork in two groups, one conducting interviews with farmers, extension workers, and local administrators, and the other observing indicators representing ecological, economic, and socio-cultural aspects of SLM. While travelling from the course venue to the village and back on the first and third days, we visited additional sites and interview partners.

The integrated field programme serves several purposes. (1) It informs participants about what is expected of them during the case study. (2) It is the basis for asking a local resource person (e.g. a researcher, planner, knowledgeable person) to give a presentation on the area and its people at the beginning of the case study. Ideally, this person will accompany the group during the entire case study, providing critical feedback to the group at the end of the case study. (3) It facilitates the pre-selection of supplementary information material for the participants, such as articles, books, reports, newspapers, films, etc. (4) The field programme will assist participants in preparing their observations and interviews immediately before the fieldwork.

This concludes the preparation of the case study. In what follows, we focus on its implementation.

Familiarisation and preparation of questionnaires and observable indicators

Before starting the case study with a plenary input presentation followed by reading of supplementary materials, each group should get to know and understand the purpose of the case study and obtain their tasks in writing.

Our experience shows that most students struggle to integrate their disciplinary knowledge and agenda into an interdisciplinary team's work. Some try to convince others of the seeming superiority of their scientific realm, others are more cooperative. Dominance by certain individuals within the group is a persistent challenge for the facilitators. In the SLM case study in Ethiopia, it was helpful that each group chose selected members as chairpersons and reporters at the beginning. These jobs should rotate every day. Nonetheless, particularly at the beginning, instructors/facilitators may need to remind the group to accomplish the task in the time allotted, let them struggle with it, and regularly interfere if the group has difficulties organising

itself. It is an art in itself to determine when to interfere and when not to. Team-building and integration are not a trivial undertaking for scientists who have been trained to compete rather than collaborate with each other. Peers are usually in a position to solve these challenges and manage conflicts that arise on their own. However, there is no guarantee that all members will ultimately harmonise as a group, and this is where the facilitators' experience and social skills have to come in.

Box 5: Task lists

Senior researchers/supervisors

- are facilitators for the groups;
- help students to maintain their focus and manage time;
- provide methodological backstopping whenever needed;
- evaluate strengths and weaknesses of integrative training:
  - what is the added value of this type of training?
  - what was successful and why?
  - what needs to be improved and why?

Needless to say, things rarely happen as planned; therefore, facilitators and selected chairpersons from among the participants should be prepared to improvise quite a bit!

Participants' tasks

Main task: Come up with a transdisciplinary research framework (strategy and studies) that would be appropriate to support more sustainable development in the study area. Formulate relevant research hypotheses and questions and develop a methodological framework, including appropriate research methods.

Groups organise themselves:

- After you receive and discuss an input presentation, study the supplementary background information that has been provided (documents, regional information, thematic papers, etc.).
- Construct/develop a tentative "model" or "situation analysis" of your area, including main actor groups, possible development challenges and potentials.
- Formulate tentative research questions and hypotheses with a view to promoting more sustainable development: if you were to conduct your research here, what would be your hypotheses/questions as an individual researcher on the one hand, and as an inter- or transdisciplinary team on the other?
- Adapt the list of 'Guiding questions for fieldwork' to your setting.
- Prepare a checklist of potentially observable indicators of (un)sustainable use of natural resources covering the ecological, economic, and socio-cultural dimensions of sustainability.
- Prepare guiding questions for informal interviews.
- Consider ethical issues, such as potential risks of your research for actors, how to share the benefits of research with stakeholders, etc.

Divide the fieldwork among group members: decide on

- Who will observe what?
- Who will introduce the team and the task to interviewees?
- Who will ask which questions?
- etc.

Introducing ethical issues

So far we have talked about actors primarily as pre-selected informants for the time of the fieldwork. For practical reasons, it is difficult to involve these actors in the preparation of the case study, as must be the case, however, in a full-blown transdisciplinary research project. Nonetheless, since researchers interfere with people's lives and livelihoods, even if it is only for three days, ethical issues deserve special consideration. They should be considered a central aspect by the participants during preparation, fieldwork, and analysis. Ethics is a major branch of philosophy; it is significantly broader than the common concept of analysing right and wrong. A central aspect of ethics is life, be it "a good life", a life just worth living, or a life that is simply not satisfying (Singer 1993). Researchers can start by asking themselves how a research project and the way it is carried out might contribute to "the good life" of those who are addressed and/or participating, or whether participating in the study might be politically, socially, and economically risky for these actors.

MESSAGE

Actors are not just a source of information: in a transdisciplinary project they are partners in solving development problems. We must find ways to actively involve them in research and training and must at least ensure that what we find out is made available to them.

Box 6: Guiding questions regarding ethical issues

Key questions to ask ourselves when using other scientists' findings, and when interfering with other people's lives in the context of research (or training):

- Whose research results (knowledge, technology, etc.) am I using? Am I quoting properly? Do other researchers face any risks or negative effects from my research? Can they benefit?
- Whose knowledge am I using? Am I acknowledging it properly in my publications?
- What actors bear risks or might face negative effects caused by my research? Are there any benefits? How can I share these benefits with them?
- What kind of development might result from my research for society at large in my study area?
- Might I come across ethical issues, dangerous data, etc. in my work and how should I solve these problems?

Box 7: Preparing fieldwork (case study example: "Sustainable Land Management")

General observations

- Characterise the climate zone and the prevailing ecological zone.
- What land use types do you see (cropland, pasture, forest, etc.)?
- What are the main farming systems?
- Do farmers have livestock or do they have crops? Or do they have both?
- What kinds of crops and/or livestock can you see?
- Relate the farming practices to the landscape (slope, soil type, water resources, etc.).
- Can you see agricultural machinery (tractors, ploughs)?
- Can you see any degradation of natural resources (soils, water, vegetation, biodiversity, etc.)?
- Can you see any efforts to conserve natural resources (soils, water, vegetation, biodiversity, etc.)?
- What potentials and constraints can you see in the farming systems?
- What opportunities and constraints seem to depend on the local people's culture?
- Do you see any differences between gender roles? (What are boys/girls doing, what are men/women doing?)
- Can you see any off-farm income-generating activities?
- Are there any markets? What kinds of goods are sold on the market?

- What kind of wildlife can you see? Do livestock and wildlife interact?
- What wild plant species prevail in forests or on grassland?
- Do you see dogs? If yes, where?
- What kind of infrastructure can you observe (roads, villages, towns)? Describe accessibility features.
- Do you see hospitals, health centres, schools, industry, workshops, abattoirs, water treatment plants, and drinking water tanks?
- …

Observations and questions related to actors/stakeholders

- Who are the different actors in the study area?
- What is their demographic composition (sex, age, etc.)?
- Which interests are represented and by whom?
- How are their interests mirrored in their daily activities and decisions?
- What are the social, economic, and environmental consequences of their activities?
- …

Observations and questions related to households

- What sizes do households have?
- How are households defined? One family, several families living together (compound)?
- What is the land tenure system?
- How is livestock kept? Single animals, tens, hundreds of which species? What is the average herd size of each species?
- What is the proportion of livestock keepers in a given village?
- Is there communal grazing, i.e. do the animals of several households or villages graze together on the same pastureland?
- How are animals watered? What kinds of rules exist for watering animals?
- Do children go to school and how long?
- …

Preparing observations

- What are your (research) questions/hypotheses, what exactly do you want to know?
- Prepare a "field book" to write down everything you observe or hear. The book will later help you to establish links between your observations, the statements you have recorded, your photos and sketches, etc.
- Prepare a map or sketch to indicate where you observed the main features that you write about.
- Be prepared to take photos; ask people's permission before you take pictures of them.
- Observations and photos can be misinterpreted at a later stage, so always support them by information; distinguish between your interpretation of a scene ("this seems to come from …") and what local people or other stakeholders tell you ("Farmer X mentioned that this was because …"). Complete your documentation during or immediately after the fieldwork!
- …

Preparing interviews

- What are your (research) questions, what exactly do you want to know?
- Who do you need to interview in order to answer your research questions?
- How many people do you need to interview?
- How do you select them and why? Are sex-disaggregated data necessary?
- How do you approach your potential interview partners?
- Which qualitative methods do you need to use and why?
- Who will conduct the interviews, focus group discussions, etc.?
- Which ethical aspects need to be considered during data collection?
- How would you record the interviews?
- …

Fieldwork

One of the purposes of *joint* fieldwork is that every researcher learns some basic things about the epistemology, approaches, and methods of other scientific disciplines. For example, a sensitive issue in the field is how to treat non-academic stakeholders and how to communicate with them. Participants who are not familiar with interview situations must be briefed by social scientists about the code of conduct in the field, such as introducing the group, explaining the purpose of the training/research, coordinating who asks what and when, respect for the rules of other cultures, etc. In turn, natural scientists can explain their approaches, methods, and challenges during transect walks and observations in the field.

Box 8: Guidance for fieldwork (general questions)

- If you were to conduct your research here, what would be your hypotheses/questions as an individual researcher on the one hand, and as an inter- or transdisciplinary team on the other?
- What influence do the interactions between the research team members have on your topic?
- Think about and discuss already during fieldwork how you want to analyse the information you gather and how you want to present it later to the whole group.
- Think how your initial model or situation analysis needs to be revised on the basis of your field experience.

Figure 10: Fieldwork in rural Ethiopia: a real encounter with the problem of runoff. (Photo: K. Herweg)

Groups should organise themselves in the field. They will interview, observe, and document the information they get in a field book. While doing this, they will face a number of unplanned incidents, meet new people to talk to, make interesting observations that require revision of the indicator list, and face time shortages, flat tyres, conflict situations, etc. This is part of the game, and participants will have to manage the situation. Again, facilitators must develop a feeling for when to interfere. They can make notes of mistakes that are made by the trainees and decide whether to confront the group members with criticism on the spot or after fieldwork. They will also observe patterns in teamwork, who tries to dominate in the group, who tends to take the lead, which decisions are made by whom, etc. This information will be important later on, when the inter- and transdisciplinary approach is being evaluated by the group. Apart from that, facilitators have to make sure that the group is always pursuing their main task.

In the SLM case study we had an overwhelming experience in and around a village in rural Ethiopia. Most students did not feel comfortable with being exposed to heavy rainfall. However, at the end of the day, many things had been learned without lengthy lecturing; they had been seen, heard, smelled, and felt outside the classroom. All the social scientists had understood the basics of soil erosion processes while walking on slippery ground, seeing where water and soil were flowing, where erosion took place and where not, and other issues of natural resource management. Simultaneously, all the natural scientists and engineers had understood the hardship of subsistence farmers, their struggle for their livelihood, the economic challenges, and the social and political conflicts in the village. Basic fieldwork by no means replaces the usual disciplinary data collection; but it is a great chance for an interdisciplinary team to understand the importance of different disciplinary perspectives and the need for integrating them in one common conceptual framework.

Figure 11: Fieldwork in rural Ethiopia: discussing issues with the local population. (Photo: K. Herweg)

Analysis

Again, groups should organise themselves. They will start analysing the results of their interviews and observations. From time to time they should gather to exchange their experiences, views, and preliminary conclusions. Thus, the groups will gradually synthesise their findings, oriented towards the main task and the presentation they will have to prepare.

Box 9: Task list for analysing fieldwork findings

- Revise your initial "model or situation analysis" of the site.
- Discuss your findings according to the following guiding questions:
  - What development challenges and potentials did you identify?
  - What visions of development do the different actors have (common perceptions, differences, conflicting issues)?
  - What are your own visions of development as researchers?
  - What transdisciplinary research framework (strategy and studies) would be appropriate to support more sustainable development in this area?
  - Formulate relevant research hypotheses and questions.
  - Construct a joint methodological framework and list specific research methods.
  - Discuss ethical issues (potential risks, benefit sharing).
  - Integrate an appropriate dissemination and communication strategy.

Team members will by now hopefully be working in an atmosphere of mutual respect. But this does not mean that facilitators are dispensable. An ambitious timetable of analysing findings, making a synthesis, and presenting this synthesis to a critical audience may still require some (careful) guidance. To balance different levels of language fluency in the group at least partly, we tried not to exclusively rely on the

use of text for communication, but increasingly visualised findings, using any suitable formats such as flow charts, diagrams, mindmaps, etc. We also experimented with a box containing various objects made of different materials (wood, cardboard, paper, metal), symbols, as well as plasticine to create free forms (see photo below). This tool was helpful to "construct" a joint model or system of the area under consideration. Preparing a common output (presentation, poster) revealed quite different qualities among the team members. Some who were more fluent in English certainly dominated the debate; some came up with remarkable skills for visualising models by sculpturing; others were experienced in designing digital designs, maps, etc. Although the SLM group was rather large and took some time to find and establish their internal agreement procedures, we did not observe longer periods of dissatisfaction: people remained interested and hardworking throughout the case study period. It was easily confirmed that well-motivated people produce results of good quality while also having a good time together. Keeping a good working atmosphere in the group is perhaps one of the most important tasks of the facilitators.

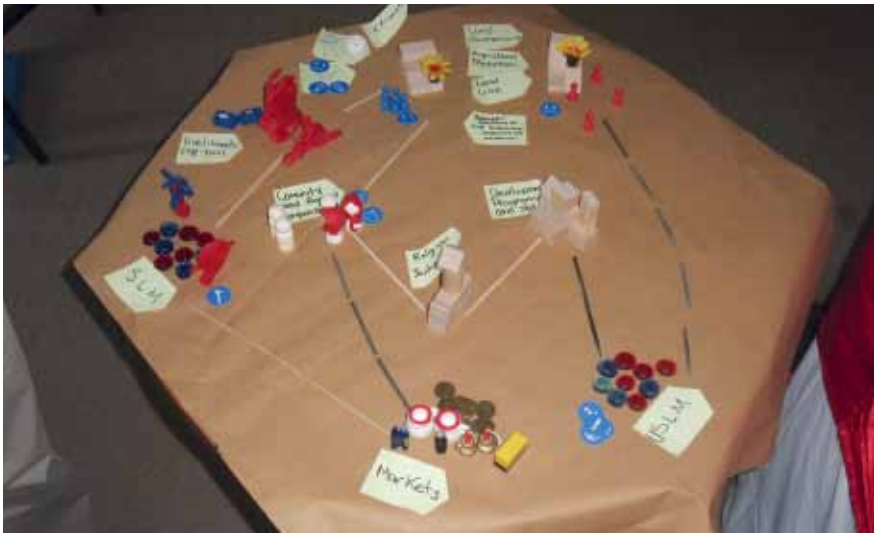


Figure 12: Visualising the conceptual framework of the planned case study. (Photo: K. Herweg)

Presentation of results

If there is only one case study, the group will present it to an audience of supervisors, instructors, and facilitators. If there are more case study groups, there will be an even larger audience to share the groups' findings. We had a good experience with all team members presenting specific parts in English, the common language. Even if the level of English was very different, every speaker had to overcome his/her own inhibitions and the audience listened patiently and appreciated everybody's efforts to communicate.

Box 10: Fieldwork outputs

- Prepare a (PowerPoint) presentation compiling your proposal for a joint research project structured by the guiding questions you used during analysis (development challenges and potentials; development visions of different actors; a transdisciplinary research framework; relevant research hypotheses and questions; a joint methodological framework and research methods; ethical issues; an appropriate dissemination and communication strategy).
- Present and discuss main findings.

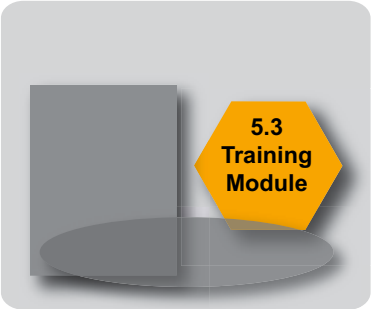
Evaluation

We think that the working circumstances during the SLM case study quite realistically represented the situation faced by a professional scientist on a team: large groups, time pressure, conflict management, lack of experience, limited information, the challenge of communicating with people who do not share the same knowledge base, and production and presentation of a common output. To us, this is a good setting for training in TD cooperation – as far as this is possible at all in a training course, because no training can adequately simulate a TD project. Students' evaluations showed that an attractive aspect of the case study is the diversified mode of learning, which includes (a limited amount of) lectures, reading, (many) exercises, fieldwork, analysis, model building, and presentation. It involved mutual learning through many "channels" (reading and conceptualising, seeing, listening, smelling, feeling, etc.). Despite some signs of exhaustion, students stated later that intense work over a longer period on a personal basis helped to create mutual respect. The feeling of having contributed something that was useful to the team in turn helped to appreciate other ways of thinking. As one of the Southern trainers put it, the course was a peace-building process. The majority of students finally confirmed that with this approach research questions are more relevant to society.

In particular, the fieldwork made students more sensitive regarding their role and power position in front of local actors. Afterwards, there was broad awareness of situations that could be critical in the field, and of the appropriateness of students'/researchers' behaviour. The encounter with local actors in their own life context created respect for people's situations and efforts. It initiated a process of thinking among the group, leading to the realisation that researchers' mere presence can create expectations that may not be met, or that research can have both positive and detrimental effects on the local population.

In spite of such promising feedback, we feel that the case-study-based learning approach can be improved. We have no blueprint solutions but we feel that our experience is illustrative and rich enough to encourage readers to implement and further develop this approach by themselves.

5.3 A Training Module



5.3.1 Objectives and challenges

The main objective of a training module is to bring the members of a rather heterogeneous inter- and transdisciplinary team to a similar level of comprehension, and to develop a common knowledge base on a specific topic. This topic can be a theory, research approach, methodology, selected methods, a case study, scientific realm, thematic area, disciplinary or interdisciplinary subject matter, etc.

In a training module, small groups develop a first overview and work out basic knowledge regarding the specific topic under consideration, using a mix of lectures, group work, and presentations. This mix creates a certain real-life situation of …

- limited previous knowledge;
- limited additional information;
- a multitude of participants with different skills, potentials, and perspectives;
- limited time;
- output orientation; and
- the need to communicate.

Such a situation is often found when experts in different professions meet and are supposed to come up with a concrete product, such as a problem analysis, a solution for a given problem, etc.

5.3.2 Skills to be developed

Apart from knowledge on the topic under consideration, the training module – with its mixture of lectures, group work, and presentations – helps to build the skills required in a real-life situation such as efficient management of time and effective use of human resources and potentials, appropriate communication, and team spirit.

5.3.3 Investments and prerequisites

Ideally, a training module addresses up to 15 participants who may split up into three subgroups of five for exercises. The size of the subgroups should be sufficient to bring in various personalities and perspectives, and small enough for participants

to manage the given task in the given time. Three subgroups can comfortably present their results within 45 minutes, including a brief clarifying discussion. Larger groups require adaptation to the number or length of the presentations, and more discipline among the team members to manage the group work.

5.3.4 Context of application

We applied half-day training modules on many occasions, e.g. in Integrative Training Courses with a variety of thematic sessions, in a Masters programme on sustainable land management at Mekelle University in Ethiopia, in the Bachelor programme of the Swiss College of Agriculture, and during the regular semester schedule at the Institute of Geography, University of Bern. This half-day mode was originally developed for a course that lasted three days, including eight hours per day, where a strongly input- or lecture-based approach could not be meaningfully implemented.

So far, we have implemented a variety of concrete modules on inter- and transdisciplinarity, outcome monitoring, scientific writing and publishing, communication with the media, qualitative and quantitative research methodologies, stakeholder involvement, gender, as well as various thematic sessions on sustainable land management.

Inter- and transdisciplinarity are new approaches for most researchers and should therefore be dealt with as the foundation of integrative training. Scientific writing is essential to all researchers, but publishing in an inter- and transdisciplinary team requires additional efforts and specific journals. Communication with the public and the media is an important element for the necessary continuous exchange of experience and knowledge co-production involving scientific and non-academic partners in a TD project. Impact and outcome monitoring has become a central issue for development agencies. It is also an important topic for sustainable development research, which has to provide proof to both the donor and academic communities of its effectiveness in contributing to more sustainable development.

5.3.5 Steps and procedures

During the last 10 years, several modes of training were tested within the NCCR North-South, from ex-cathedra teaching to different types of group work. The best training results were achieved with half-day training modules.

Preparatory reading and homework may be added if necessary, but are not part of this description.

To better illustrate how a half-day module can be designed, we focus in this section on a module on inter- and transdisciplinarity. Each module includes learning objectives, input presentation(s), specific exercises, preparatory reading, and supplementary material.

Proposed procedure

Reading the documents provided as "Preparatory reading" is compulsory for all course participants prior to the course. The folder contains selected papers referring to the topic under consideration – in this case different schools of transdisciplinarity. Documents in the folder "Supplementary material" provide more in-depth information but are not compulsory.

The following time schedule has been successfully tested and evaluated positively many times. For a better overview, we allocate 45 minutes for each of the four parts of the module. But this timing can be changed anytime, depending on the needs of the participants and the aims of the instructor.

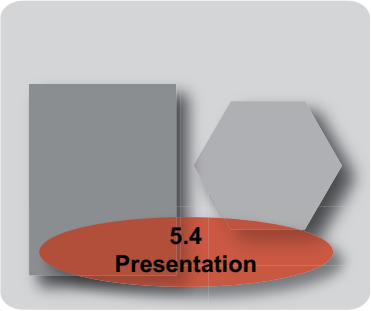
1. The input presentation (45–60 minutes) provides an overview of the topic from the instructor's point of view. At the end of the presentation, groups are formed, receive an exercise starting with a clear task disseminated in writing, and clarify open questions. Each group selects a chairperson for time management and a presenter.

2. During the group exercise (45–60 minutes), the members usually start with brainstorming, followed by structuring individual ideas. A clear task, a chairperson and a presenter, and the goal of producing an output (presentation) help to keep the group focused. This group work is often the most essential phase, because participants need clarifications, guidance, hints, and tools. This means the instructor has to be available and visit all groups for further supervision. We suggest developing a variety of exercises, depending on the learning goals, such as:
   - Comparing different schools of thought – to acknowledge different approaches, positions, interpretations of the topic under consideration;
   - Role play – to put researchers into other actors' shoes;
   - System analysis – to develop research approaches and methodologies;
   - Formulating impact hypotheses – to think about potential (positive and negative) effects and impacts of research on other stakeholders;
   - Interpreting photos – particularly recommendable for subject matter such as geographic, ethnological, or technological subjects.

3. After the exercise, each subgroup is given 10–15 minutes for presentation, depending on how many groups there are. This includes short questions from the whole group for clarification. The presentations can be used to evaluate the groups, both regarding the quality of the content they elaborated, as well as regarding the clarity, structure, visualisation, and timing of the presentation.

4. The module is completed by "matching", which means that instructors and participants complement the views of the presenters with their own views and experiences or facts. This enables the presenters to evaluate the quality and clarity of their presentation. The matching session can also be used to open a debate about different schools of thought. This completes the discussion of conceptual issues.

5.4 Presentation: an essential "soft skill"



5.4.1 Objectives and challenges

The main objective is to inform others about one's own research and results, expecting that the audience will appreciate the work and, if possible, utilise it for further research or practical implementation. This is trivial, and yet it is astonishing how many researchers still communicate in a cumbersome and incomprehensible manner, overburdening their audience with details and complicated terminology. The reason seems clear (cf. 5.1.2): researchers within the same discipline develop a common view of, and language about, the "world". This makes communication within one's scientific discipline more efficient, although writing and publishing one's own research results also requires special training. But the disciplinary language is a challenge when communicating with outsiders, be they scientists or other stakeholders. Specifically in inter- and transdisciplinary work, interaction with these outsiders is a core component of the research approach and a very time-consuming activity.

Thus, it is essential to point to some basics of communication, in order to bridge the gaps between scientific disciplines and between science and society. Effective communication will help to avoid a lot of misunderstandings and save a lot of time. In addition, a good understanding of the basics of writing scientific articles will help students to acquire the "assets" they need for their academic career – i.e. papers in peer-reviewed journals, if possible with an "impact factor". This final point is given separate mention at the end of the present section on presentation.

5.4.2 Skills to be developed

The aim must be to effectively and understandably communicate with different target groups, be they scientists in one's own or other disciplines, or non-academic actors, such as policy-makers, the media, planners, farmers, merchants, etc. Just as important is the capacity to structure research results into a publishable paper; to this purpose, it is important to learn the rules of the "publishing game".

MESSAGE
Social and communication skills cannot be developed through theoretical debate: they are developed through learning by doing.

5.4.3 Investments and prerequisites

In an Integrative Training Course, we cannot accommodate an entire communication training module. Our experience has shown that it suffices to use various opportunities to exercise different forms of communication during training and research work, and provide participants with basic rules adapted to a TD approach. In addition, we have provided training on the essentials of scientific writing and publishing, since this is an area where students seem to be confronted with a lack of training that is detrimental for their scientific careers.

5.4.4 Context of application

Communication is exercised at all times during training courses, case studies, oral and poster presentations, writing, etc. If some basic rules of communication are explained and exercised explicitly, pointing out the specificities of communication within a TD project, students will be able to adapt to different audiences and communicate more effectively. Based on ample experience, we spelled out essential rules of communication in two training modules which contain various exercises for "Communication with the media and the general public" and "Scientific writing and publishing".

5.4.5 Steps and procedures

Doing research means producing knowledge, knowledge that partly loses its value if it is not shared with others. When preparing a presentation, we usually think about how to structure our deliberations in order to provide as much information as possible about our work to others. This means we start thinking about what we want to communicate from our own point of view. There is nothing wrong with this, but it could be advisable to think as well from the audience's point of view. Who is the audience? What are their interests and what do they want to hear? How can I contribute to what interests them? Only when such questions have been answered is it time to start thinking about what my *main messages* are, what it is that I have to say, and *how much time* I have for this?

If we decide to do research to increase knowledge about selected parts of the world and specific issues, it will be sufficient to consider scientific writing and presentation to share our thoughts with other members of our disciplinary community of practice. To this purpose, learning the rules of one's own discipline will suffice. However, focusing on research and training in an inter- and transdisciplinary setting implies that we have already decided to share our findings with other scientific disciplines, as well as with society, the government, a community, the media, policy-makers, etc. In what follows, we will emphasise PowerPoint and poster presentations, two techniques that are widely used in nearly every scientific conference, workshop, lecture, or training event. In addition, we briefly evoke the most basic rules of scientific writing and publishing.

PowerPoint

PowerPoint is an omnipresent form of presentation used by almost everyone, but presentations are not necessarily good, especially if they are lengthy and dominated

Cartoon 7: An inappropriate learning approach cannot be improved by modern presentation technology! (Cartoon: Karl Herweg)

by text-based slides. To put it clearly: there is no law about how to make a presentation, but considering a few recommendations can help to make a presentation really successful, i.e. interesting for the audience. Beyond that, please use your own style, creativity, and common sense – what would you yourself like to see or avoid in a presentation? And remember that PowerPoints with too many gimmicks are just as tiring as a series of slides that say exactly what the presenter says.

Before turning on the computer, it may be helpful to consider the following points first – it may actually even be refreshing to use old-fashioned hardware, i.e. paper and pencil, to outline the structure and main messages:

- Ask yourself who is in the audience and what is the context of the presentation. Will you talk to a group of peers at a conference or training course, to students during a lecture, to policy-makers at an information event, to journalists, or to farmers in a village?
- What are their interests, and what do they probably want to hear?
- What would you like to present? Collect ideas and formulate three to five key messages you want to communicate to your audience. What could be the "take home message"? Do not try to describe specifics and unnecessary details.
- Make sure you have one or two surprising and catchy stories that will allow you to make your messages memorable.
- Think of possible questions that could be raised by your listeners and make sure you are able to answer them. You can even encourage discussion after the presentation if you touch upon interesting aspects only briefly during your presentation, and have additional slides ready when questions are raised in the discussion.

- Touch on lengthy components only briefly and thus give people a chance to ask related questions later during the discussion.
- After collecting ideas and formulating key points, group and structure them.

Designing a presentation

- Keep it simple!
- Create a template for your presentation. Do not use too many different fonts.
- Slide numbers and a table of contents on every slide are not mandatory, but may help the reader to keep track of where you are.
- Use a meaningful title for every slide (not "Introduction").
- Do not list your speaker's notes or write whole paragraphs. The slide show should support your speech, not substitute for it. If you use text on your slides, make sure everyone can read it. A good rule of thumb is no more than 7 lines per slide, each with a maximum of 7 words.
- However, you can use selected text slides. In this case, these can be printed and disseminated before the presentation or as hand-outs afterwards, so that the audience does not try to write down everything and instead listens to what you are saying, which then should be a brief summary of the slide.
- Use pictures and simple diagrams to underline your explanations. It is important that labels are readable. If you have to show a more complex graph, take your time to explain the axes or the legend. Keep in mind that your audience will need some time to look at and understand graphs and pictures. Make sure you refer to the picture during your speech, otherwise do not project it.

Structure of the presentation

- Write your name, institution and the title of your speech on the first slide, so the audience already knows who is talking to them. Make sure you introduce yourself.
- Tell your audience what they are in for. Provide a "roadmap" of your presentation.
- Take your key messages and build your presentation around these points.
- Give a short summary at the end of the presentation, where you repeat the "take home messages" again.

Timing

- Do not overload your presentation. A slide with a photograph may take one minute of presentation time, a slide with text or a complex graph may take three minutes. An average of two minutes per slide is a good rule of thumb to avoid having to rush through a PowerPoint, especially through the last slides.
- Practise your presentation: if it takes you too long to present it, be courageous and shorten it without hesitation (you can save nice slides somewhere else).

Speaking in front of an audience

- Define one position in the room to give your presentation. Do not walk around too much, but change your position if it is required (e.g. to explain the projected picture).

- Keep eye contact with your audience during your presentation. If you look at one person, keep the contact for a sentence. Do not hide behind your laptop or talk to the screen. Your audience will be grateful if you talk to and look at them.

Posters

Usually, presenting a poster puts you in a large room with many colleagues and your poster is only one among many others: how can you make everyone care most about yours? Again, there are certain recommendations regarding how to make a poster, but such a product should also reflect your personal note and your own style and creativity. A number of guiding questions should be sufficient to help you create an attractive poster.

- Have you been given a specific timeframe (e.g. 3–5 minutes) to present your poster as one of many, or are you supposed to wait for interested persons, trying to attract visitors passing through a larger poster exhibition?
- What is your audience: scientists, practitioners, policy- and decision-makers, the public?
- What contents might be attractive for this audience?
- What elements would entice the audience to come closer and start reading your poster? Use …
  - a short, meaningful title, readable from a few metres' distance;
  - a mix of photos, graphs, (limited) text;
  - a clear, visible structure (title, subtitle/chapters);
  - boxes for explanatory text, so that people can also read more if they want; however, you should be careful with the amount of text and choose a font size readable from 1–2 metres' distance. In an exhibition with many posters, the audience will probably not be easily attracted by large amounts of text and small fonts.
- If you get the chance to briefly present your poster:
  - How can you make it interesting to listen to you within the first 20 seconds?
  - What are your three main messages?
  - How can you trigger a discussion? Which details should you only hint at, so that people become curious and ask for further information?
- Do not forget to include your contact details (name, address, email, etc.) as well as the logo of your institution and funding agencies!

Publish or perish? Some basics of scientific writing

Writing articles for peer-reviewed journals is a must, as this is the prime means of communicating exciting new results to the scientific community; moreover, an academic career is often evaluated on the basis of the number of peer-reviewed articles one has been able to publish in journals (if possible journals with high "impact factors"). Therefore, it is worth learning the rules of writing such articles at an early stage. Indeed, the task is not insurmountable at all: knowing the rules makes it much easier to write manuscripts that can be submitted, i.e. that will be read with interest by reviewers and eventually published by the journal of your choice.

Writing is NOT something one should do in an ivory tower: sharing a manuscript with colleagues to "try out the audience" is crucial, as these test readers' reactions will help you to understand whether you are expressing a clear, interesting, and scientifically convincing message for an audience of peers. Choose your readers among peers who "know the rules" of scientific writing, as they will be able to point out from experience where and how to make revisions.

Steps towards a sound scientific article, in a nutshell

1) **Read** systematically in your field of research in order to find out, on the one hand, what might be considered "new" for the readers of your target journals, and on the other hand, how authors present their material in these journals.
2) **Your message:** decide what results you want to "sell" under what message (one message per article is enough: it will be summarised in the title – remember that you cannot say everything you found out in 3 years of research in only 10 pages!). Then ask yourself: is this really a new message? And why is it new? The answer to these two questions is based on your extensive reading of the literature.
3) **Structuring and writing:** the simplest (and most common) way of structuring an article is called "IMRAD"; even for papers in the social sciences and humanities, it will be useful to think along these lines: Introduction, Methods, Results, And Discussion. What each part is meant for:
   - **Introduction:** for establishing a research territory (by referring to the relevant literature), then establishing the niche (or research gap) in this territory, then saying how you will fill this niche.
   - **Methods:** for saying what you did, i.e. how you got to the results you have chosen to present in the article. For each result you need a method, for each method you should have a result.
   - **Results:** for presenting what happened and what was found when the method(s) was (were) applied. Ask yourself: can I believe it as a scientist? Only report on relevant results! Use text, tables, graphs, photos, maps, etc.
   - **Discussion:** for interpreting your results and comparing them with what other researchers have found before you; try to cite a few articles from the journal of your choice, since this shows you want to contribute to the debate in this journal. The structure of the discussion should help you to make your main message clear. The discussion can be followed by a conclusion (which can contain recommendations – something that may be important in the context of an inter- or transdisciplinary study).
4) **Revising:** do not hesitate to rewrite your paper several times, to make sure you provide the reader with what you promise in the title. Ask several people to read your drafts and comment on them critically. At the end, ask a native speaker to correct your paper.
5) **Formatting:** strictly follow the formatting rules of the journal you want to submit your article to! Write the abstract and keywords accordingly, and format the references carefully.
6) **Revising after peer review:** respond in a respectful way to every comment you receive from reviewers and editors, even if you do not agree. Do not be discouraged if your paper is rejected the first time; rewrite the article completely or choose another, more appropriate journal for it.

And finally …

We could have added much more material regarding the presentation of research results. As in the previous chapters, we wanted to restrict ourselves in this toolbox to summarising our own experience. We hope to encourage readers to critically reflect on our recommendations first, and then find their own style and solutions, be it for designing training courses, case studies, modules, presentations, or other useful tools to train young researchers and have them ready to conduct research that will eventually be relevant and useful to society.

References

Braungart Margaret M, Braungart Richard G. 2011. Educational and learning theories. *In:* Butts Janie B, Rich Karen L, editors. *Philosophies and Theories for Advanced Nursing Practice.* Sudbury, UK: Jones & Bartlett Learning, pp 203–246.

Chambers R. 1994. The origins and practice of participatory rural appraisal. *World Development* 22(7): 953–969.

Conway GR. 1985. Agroecosystem analysis. *Agricultural Administration* 20(1): 31–55.

Cooper PA. 1993. Paradigm shifts in designed instruction: From behaviorism to cognitivism to constructivism. *Educational Technology* 33(5): 12–19.

Dembo MH. 1994. *Applying Educational Psychology.* 5th edition. White Plains, NY: Longman.

Dubs R. 2009. *Lehrerverhalten. Ein Beitrag zur Interaktion von Lehrenden und Lernenden im Unterricht.* 2nd edition. Stuttgart, Germany: Franz Steiner Verlag, 608 pp.

Freire Paulo. *Pedagogy of the Oppressed.* New York, NY: Herder and Herder, 1970.

Good TL, Brophy JE. 1990. *Educational Psychology: A Realistic Approach.* 4th edition. White Plains, NY: Longman.

Herweg K, Künzel M, Rist S, Hurni H. 2008. Gemeinsames Lernen in Forschungspartnerschaften mit dem Süden. Praxisnah, interkulturell und transdisziplinär. *In:* Darbellay F, Paulsen T, editors. *Herausforderung Inter- und Transdisziplinarität. Konzepte, Methoden und innovative Umsetzung in Lehre und Forschung.* Lausanne, Switzerland: Presses polytechniques et universitaires romandes, pp 83–91.

Herweg K, Rist S, Liniger HP, Prasuhn V, Schneider F, Ledermann F, Fry P, Zimmermann A, Hurni H, Wiesmann U. 2010. Transdisciplinarity: An option for applied landscape ecology in complex and uncertain contexts. Special Issue: Landscape Ecology and Beyond. *Die Erde* 2010 141(4): 1–16.

Hmelo-Silver Cindy. 2004. Problem-based learning: What and how do students learn? *Educational Psychology Review* 16(3): 235-266.

Hmelo-Silver Cindy E, Ducan Ravit Golan, Chinn Clark A. 2007. Scaffolding and achievement in problem-based and inquiry learning: A response to Kirschner, Sweller, and Clark (2006). *Educational Psychologist* 42(2): 99–107.

Hurni H, Wiesmann U, Schertenleib R, editors. 2004. *Research for Mitigating Syndromes of Global Change: A Transdisciplinary Appraisal of Selected Regions of the World to Prepare Development-Oriented Research Partnerships.* Perspectives of the Swiss National Centre of Competence in Research (NCCR) North-South, University of Bern, Vol. 1. Bern, Switzerland: Geographica Bernensia. Available at: http://www.north-south.unibe.ch/content.php/publication/id/1711

Keating Sarah B. 2011. *Curriculum Development and Evaluation in Nursing.* 2nd edition. New York, NY: Springer.

Kirschner PA, Sweller J, Clark RE. 2006. Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist* 41(2): 75–68.

Lélé S, Norgaard RB. 2005. Practicing interdisciplinarity. *BioScience* 55(11): 967–975.

MEA [Millennium Ecosystem Assessment]. 2005. *Ecosystems and Human Well-Being: Synthesis.* Washington, DC: Island Press.

Nicolescu B. 2002. *Manifesto of Transdisciplinarity.* Albany, NY: State University of New York Press.

Pawson E, Fournier E, Haigh M, Muniz O, Trafford J, Vajoczki S. 2006. Problem-based learning in geography: Towards a critical assessment of its purposes, benefits and risks. *Journal of Geography in Higher Education* 30(1): 103–116.

Pohl C, Hirsch Hadorn G. 2007. *Principles for Designing Transdisciplinary Research.* Munich, Germany: Oekom Verlag.

Sanjaya M. 2002. A design framework for online learning environments. *British Journal of Educational Technology* 33(4): 493–496.

Savery John R. 2006. Overview of problem-based learning: Definitions and distinctions. *The Interdisciplinary Journal of Problem-based Learning* 1(1): 9–20.

Seastedt Timothy R, Hobbs Richard J, Suding Katharine N. 2008. Management of novel ecosystems: Are novel approaches required? *Frontiers in Ecology and the Environment* 6(10): 547–553.

Singer P. 1993. *Practical Ethics.* 2nd edition. Cambridge, UK: Cambridge University Press.

Wiesmann U, Hurni H, editors; with an international group of co-editors. 2011. *Research for Sustainable Development: Foundations, Experiences, and Perspectives.* Perspectives of the Swiss National Centre of Competence in Research (NCCR) North-South, University of Bern, Vol. 6. Bern, Switzerland: Geographica Bernensia. Available at: http://www.north-south.unibe.ch/content.php/publication/id/2663

Web pages

International Center for Transdisciplinary Research. 2009. *A New Vision of the World Transdisciplinarity.* [Accessed on 25.10.2011] http://basarab.nicolescu.perso.sfr.fr/ciret/english/visionen.htm

Kiley Margaret, Mullins Gerry, Peterson Ray, Rogers Tim. 2000. *University of Adelaide.* [Accessed on 25.10.2011] http://www.adelaide.edu.au/clpd/resources/leap/leapinto/ProblemBasedLearning.pdf

Maletic Jonathan. *Giving Good Presentations.* Department of Computer Science, Kent State University. [Accessed on 25.10.2011] http://www.cs.kent.edu/~jmaletic/CSseminar/talks/Presentations.pdf

Research on global change and sustainable development issues requires a transdisciplinary approach, which implies close cooperation both between different scientific disciplines (interdisciplinarity), and between scientists and other societal actors. This, in turn, calls for a training approach that supports this type of research. We refer to this training as "integrative training", i.e. training that integrates students from different scientific disciplines, brings together researchers and practitioners, and takes into account different cultures in academic training. The training is based on "case-study-based learning", implemented in 8- to 10-day courses in environments that offer options for 2- to 3-day fieldwork activities on complex global change issues.

The present guidelines for integrative training were developed for and tested during 14 continental and cross-continental integrative training courses conducted between 2002 and 2011 as part of a large-scale Swiss-funded international research programme. They offer practical assistance for trainers who wish to design, plan, and conduct training events in complex research settings. The guidelines target training units at universities and research institutes; instructors working in interdisciplinary, transdisciplinary, and applied research settings; research programme managers; and senior scientists involved in coaching students in research projects on global change and sustainable development.

ISBN 978-3-905835-32-8

NCCR north south

UNIVERSITÄT BERN

CDE
CENTRE FOR DEVELOPMENT AND ENVIRONMENT

international graduate school north-south