Special course on inter- and transdisciplinary methods

Additional attainments for the Master's in Sustainability Transformations

Table of contents

Preface **1**

Learning outcomes 1

Reading guide 1

1 Introduction **2**

Learning outcomes 2

1.1 Sustainable development - Sustainability 2

1.2 Normativity 3

1.3 Ethics 4

2 Scientific knowledge and non-scientific knowledge **6**

Learning outcomes 6

2.1 Introduction 6

2.2 Quality criteria of scientific methods 7

2.3 Quality criteria of trandisciplinary research 8

2.4 Assessing the quality of scientific publications 9

3 Three types of knowledge **11**

Learning outcome 11

3.1 Three types of Knowledge 11

4 Transparent referencing of third-party work **13**

Learning outcome 13

4.1 Introduction 13

4.2 Referring to third party work 13

4.3 Reference system and citation styles 15

4.4 Referencing Software Programs 15

4.5 References in scientific presentatoins 16
4.6 Referencing in non-scientific publications 16
4.7 Dive deeper into the topic 16

5 Integrity and Ethics **17**
Learning outcomes 17
5.1 Introduction 17
5.2 Basic principles 18
5.3 Good research practices 19
5.3.1 In the production and dissemination of knowledge 19
5.3.2 In the collaboration with colleagues 19
5.3.3 When involving human participangs in data collection 19
5.4 Outlook and further literature 20

6 What is ID/TD? **21**
Learning outcomes 21
6.1 Explain Inter- and Transdisciplinarity 21
6.2 ID/TD case study 21
6.3 Activity 23

7 ID/TD methods and reflection on methods **25**
Learning outcomes 25
7.1 Introduction - Reflecting scientific socialization 25
7.2 ID/TD methods 26

References **28**

Preface

Version 1.0, July 2025

rationale for special courses

Learning outcomes

- can describe differences between scientific knowledge and non-scientific knowledge, and list quality criteria for scientific methods.
- can describe basic principles of good and responsible research ethics and scientific integrity, and they are aware about the implications for conducting good and ethical responsible research.
- can describe basic principles of good and responsible research ethics and scientific integrity, and they are aware about the implications for conducting good and ethical responsible research.

Assessment format: essay + quiz (pass/fail)

Reading guide

Definitions and further readings

Examples and reflections

Exercises and links to ILIAS

Chapter 1

Introduction

Learning outcomes

- Students can explain how sustainability science approaches (mode-2 science) differ from traditional science approaches (mode-1 science)
- Students can explain the role of ethics in sustainability science

1.1 Sustainable development - Sustainability

It is becoming increasingly evident that disciplinary approaches and disciplinary specializations are often insufficient to understand and address the complex challenges and **wicked problems** of the 21st century. **Sustainable development issues**, in particular, extend across various scientific and thematic fields. This necessitates collaboration between disparate disciplines and other stakeholders. Thus, **interdisciplinarity** and **transdisciplinarity** are considered to be essential research approaches in the field of **sustainability science**.

Mode-1 science	Mode-2 science
Academic	Academic and social
Mono-disciplinary	Trans- and interdisciplinary
Technocratic	Participative
Certain	Uncertain
Predictive	Exploratory

Figure 1.1: Mode 1 and Mode 2 science (Gibbons et al. 2010; Martens 2006).

Sustainability science can be understood as an arena where "contributions from the whole spectrum of the natural sciences, economics, and social sciences" (Martens 2006, 38) meet. Sustainability science distinguishes itself from "traditional" sciences, so-called **mode-1 sciences** (see Figure 1.1), since it follows the normative ideas of sustainability.

Sustainability Science

The term **sustainability science** was officially introduced in 2001 at the "Challenges of a Changing Earth" congress in Amsterdam by the International Council for Science (ICSU), the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme on Global Environmental Change (IHDP) and the World Climate Research Programme (WCRP). The following quote from Robert W. Kates captures appropriately the significance of sustainability science: "A new field of sustainability science is emerging that seeks to understand the fundamental character of interactions between nature and society. Such an understanding must encompass the interaction of global processes with the ecological and social characteristics of particular places and sectors" (Kates et al. 2001, 1).

1.2 Normativity

As sustainable development is a normative model, it is important to distinguish between descriptive (**empirical-analytical**) research and prescriptive (**normative**) research. Descriptive statements describe the current state ("is", e.g., vegetables contain a relatively high proportion of vitamins), while normative statements describe the ideal state ("ought", e.g., you should eat vegetables). In everyday life, the distinction between "is" and "ought" is often not recognized, but it is crucial for science. Moreover, it is essential to recognize that individuals hold diverse perspectives, which can lead to diverging opinions regarding what is optimal or what sustainability should entail. Consequently, the concepts of "sustainability" or "sustainable development" cannot be regarded as impartial or neutral.

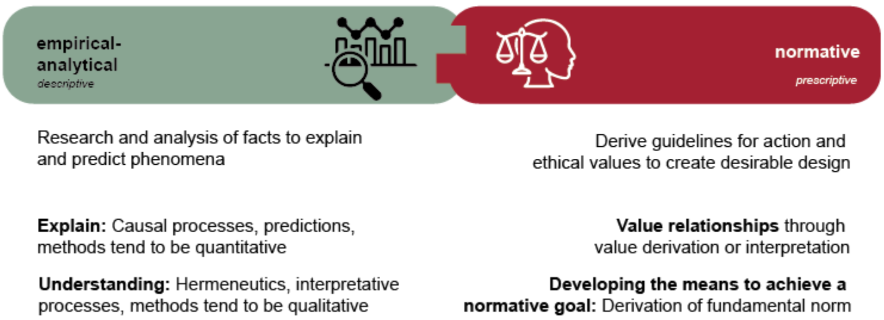

Figure 1.2: Distinction between empirical-analytical and normative (Own illustration).

Get active - Dilemmas

Reflect on an issue in your personal/social environment, where different persons have different ideas about how a problem should be solved or what sustainability should look like.

1.3 Ethics

Because sustainability/sustainable development is per se normative, this can lead to **dilemmas** (which means problems do not have an optimal solution). When looking at wicked problems such as biodiversity loss in agricultural areas there are multiple possible approaches: (1) protecting and promoting rare and extinction-threatened species and therefore reducing food production **or** (2) focusing on species with great abundance, which might be more important to economics and food security but would neglect rare species.
Depending on context, background and/or beliefs, some would prefer one approach over the other.

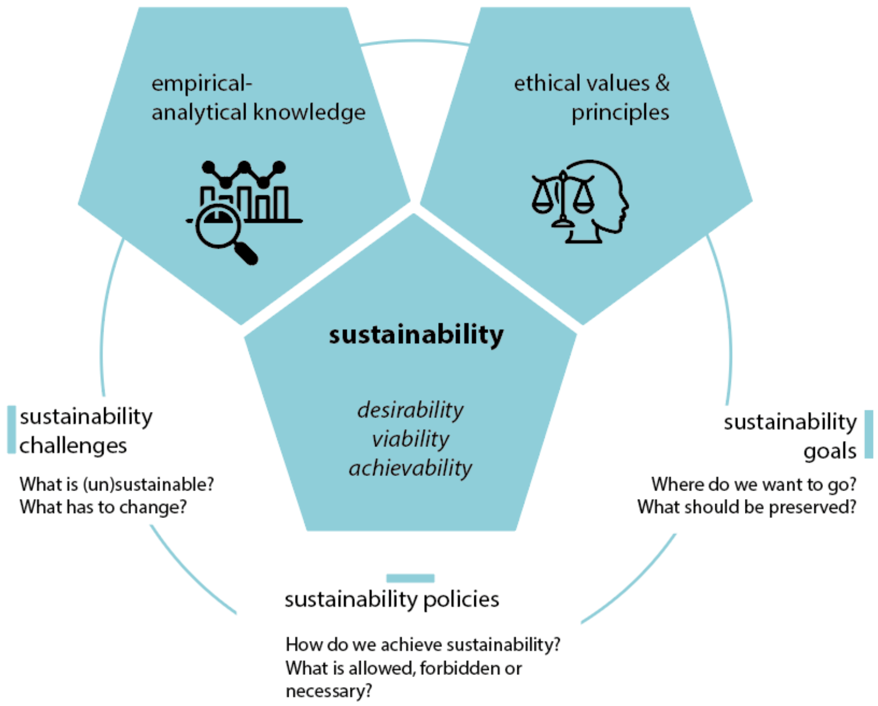

Figure 1.3: Sustainable Development as a normative concept (Own illustration).

Ethics offers orientation and decision-making structures in order to find a suitable course of action in situations such as complex dilemmas. Ethics deals with the reflection and evaluation of moral actions and behaviour and is therefore the philosophical study of morals (moral norms, value judgments and institutions). There are numerous ethical approaches, two central ones of normative ethics being “teleological” and “deontological” approaches. **Teleological ethics** evaluates actions based on their goals or purposes, which are considered “good”. An example of this is utilitarianism (established by Jeremy Bentham), which judges actions according to how much utility or happiness they produce. **Deontological ethics**, on the other hand, focuses on duties and evaluates actions based on their characteristics rather than their consequences. An example of this is Kant's duty-based ethics (Kantianism), which judges actions according to whether they comply with a moral rule or duty.

The concept of sustainability usually has a positive connotation, but it can be viewed from different perspectives. In order to function as a **guiding principle** (in an ecological, social, and economic sense), it requires clear criteria. But what grounds can we use to define these criteria?

According to Hirsch Hadorn and Brun (2007), "sustainable development" should:

- fulfil *needs*…
- … in a *just* way
- … with a view to people living today and in the future, and
- taking into account the diversity of values and the limit to which nature can be used.

The guiding principle of sustainable development is therefore not only the result of scientific research, but is first and foremost a normative, ethically based concept. It brings together "ethical and analytical ideas" and formulates "norms that express what is desirable and what should happen" (Renn et al. 2007, 39). As a result, sustainable development is a **social process of negotiation and decision-making** – of searching, learning, and gaining experience – that is guided by ethical considerations. Accordingly, sustainability research must always be aware of its involvement in social processes of perception and evaluation.

> **ℹ Hans Jonas' Ethics of Responsibility (1979)**
>
> Hans Jonas' ethics of responsibility (1979) offers an important contribution to the sustainability debate by emphasizing the ethical responsibility for future generations and nature. Jonas' approach can be described as a kind of "future ethics" that aims to address the specific new challenges of action in the context of "technological civilization". The link to sustainability ethics lies in his understanding of the concept of responsibility: Jonas understands ethical responsibility as a "non-reciprocal relationship" (Jonas 1987, 177), the asymmetry of which is derived from the power of a moral subject over one or something else that requires care: "Responsibility is the concern for another being, recognized as a duty, which becomes 'concern' when its vulnerability is threatened" (Jonas 1987, 391). Jonas' approach differs from other ethical theories in that it does not take the existence of humanity for granted and includes duties to future generations as well as to nature. Jonas argues that the first duty of future ethics is to grasp the distant effects of human action (Jonas 1987, 64). In view of the uncertainty about the future effects of human action, he advocates the decision rule "in dubio pro malo" (in doubt for the bad): "[…] when in doubt, give ear to the worse prognosis before the better, for the stakes have become too great for the game" (Jonas 1987, 67). Jonas thus develops a new categorical imperative that demands the preservation of nature and humanity and is based on the assumption of an intrinsic purposefulness of nature: "Act in such a way that the effects of your action are contractual with the permanence of genuine human life on earth", or "Act in such a way that the effects of your action are not destructive of the future possibilities of such life" (Jonas 1987, 36).

Chapter 2

Scientific knowledge and non-scientific knowledge

Learning outcomes

- Students can describe differences between scientific knowledge and non-scientific knowledge
- Students can list quality criteria for scientific methods

2.1 Introduction

How can scientific knowledge be differentiated from non-scientific knowledge, such as for example, everyday knowledge, that we acquire and apply day by day? Especially in times of "fake news", the "post-truth area" and a "knowledge crisis" (Hopf et al. 2019), this question is more crucial than ever. Because, depending on the discipline, in which they have been trained, different scientists might answer this question slightly differently. In our understanding, we follow the definitions of Bhattacherjee et al. (2019) in their introduction to social science research:

- "**Science** refers to a systematic and organised body of knowledge in any area of inquiry that acquired using 'the scientific method' ". (p.5). "The purpose of science is to create scientific knowledge." (p. 6).
- "**Scientific knowledge** refers to a generalised body of laws and theories for explaining a phenomenon or behaviour of interest that is acquired using the scientific method. Laws are observed patterns of phenomena or behaviours, while theories are systematic explanations of the underlying phenomenon or behaviour." (p.6). "The goal of scientific research is to discover laws and postulate theories that can explain natural or social phenomena, or in other words, build scientific knowledge. It is important to understand that this knowledge may be imperfect or even quite far from the truth. Sometimes, there may not be a single universal truth, but rather an equilibrium of 'multiple truths.' We must understand

that the theories upon which scientific knowledge is based are only explanations of a particular phenomenon as suggested by a scientist. As such, there may be good or poor explanations depending on the extent to which those explanations fit well with reality, and consequently, there may be good or poor theories. The progress of science is marked by our progression over time from poorer theories to better theories, through better observations using more accurate instruments and more informed logical reasoning." (p.7). "We arrive at scientific laws or theories through a process of logic and evidence. Logic (theory) and evidence (observations) are the two, and only two, pillars upon which scientific knowledge is based." (p.7)

- "**Scientific method** refers to a standardised set of techniques for building scientific knowledge, such as how to make valid observations, how to interpret results, and how to generalise those results. The scientific method allows researchers to independently and impartially test pre-existing theories and prior findings, and subject them to open debate, modifications, or enhancements." (p.9)

Thus, it can be said, that scientific knowledge is the product of a research process, in which scientific methods are applied.

Table 2.1: Distinctions between scientific and everyday knowledge.

	Everyday knowledge	Scientific knowledge
Formation	Through experience	Based on scientific methods, i.e., verifiability / falsifiability of studies, transparent result
Objectivity	Direct link between knowledge and person (subjectively influenced)	Separation of knowledge and person (intersubjectivity)
Dissemination / Communication	Everyday language, routines, publications in newspapers etc.	Scientific language, Publication as textbooks, articles in peer-reviewed academic journals

2.2 Quality criteria of scientific methods

The question of how scientific knowledge was generated (i.e., which methods were used) is therefore crucial to the differentiation of scientific knowledge from non-scientific knowledge. Different **quality criteria** have been established both between different disciplines and within schools of thought within disciplines, which are used to evaluate the scientific methods used. In other words, here too, different disciplines have divergent understandings of what is considered a "good" scientific method, and thus the knowledge produced is also considered valid. Here are some examples (this is not an exhaustive list):

- **Natural Sciences**: Empirical Evidence, Falsifiability (Popper, 2002), Reproducibility (Mayo, 1996), Objectivity (Chalmers, 1999).

- **Quantitative Social Sciences**: Replicablity, Precision, Falsifiability, Parsimony (Bhattacherjee, et al., 2019), Transparency and Reproduciability (Hardwicke et al., 2020).
- **Qualitative Social Sciences**: Credibility, Transferability, Dependability and Comfortability (Yadav, 2022).
- **Humanities**: Interpretative Depth (Ricoeu, 1981), Coherence (Gadamer, 2004), Historical Contextualization (Skinner, 2002), Ciritcal Engagement (Eagleton, 2008).
- **Philosophy**: Consistency, Coherence, and Correspondence (Reichling, 1996), Argumentative Rigor (Russell, 1912).
- **Law**: Legal Precedent (Dworkin, 1977), Argumentation & Reasoning (Fuller, 1969), Doctrinal Accuracy (Posner, 203), Normative Clarity (Habermas, 1996)

2.3 Quality criteria of trandisciplinary research

Sustainability sciences often follow **transdisciplinary** research designs. Belcher et al. (2016) describe transdisciplinary research as crossing disciplinary and institutional boundaries, and as being context specific, and problem oriented. Moreover, it combines and blends methodologies from different theoretical paradigms, includes a diversity of both academic and societal actors, and is conducted with a range of research goals, organizational forms, and outputs. It is widely acknowledged that complex and wicked social problems, as those who are the research topics of sustainability sciences, as well as the claim to contribute to reals world solutions, are best approaches by such comprehensive and holistic approaches such as provided by transdisciplinary research designs. However, as boundaries between disciplines are crossed, and as research engages more with stakeholders in complex systems, traditional academic definitions and criteria of research quality are no longer sufficient—there is a need for a parallel evolution of principles and criteria to define and evaluate research quality in a transdisciplinary research context. This is, why Belcher et al. (2016) propose, based on a comprehensive literature review, the following four quality criteria for transdisciplinary research (cp. Table 3 in Belcher et al. 2016):

- **Relevance**: The importance, significance, and usefulness of the research problem, objectives, processes, and findings to the problem context
- **Credibility**: The research findings are robust and the sources of knowledge are dependable. This includes clear demonstration of the adequacy of the data and the methods used to procure the data including clearly presented and logical interpretation of findings
- **Legitimacy**: The research process is perceived as fair and ethical. This encompasses the ethical and fair representation of all involved and the appropriate and genuine inclusion and consideration of diverse participants, values, interests, and perspectives
- **Effectiveness**: The research generates knowledge and stimulates actions that address the problem and contribute to solutions and innovation

The quality of transdisciplinary knowledge production therefore does not follow any rigid quality criteria of disciplinary research paradigms. Rather, various methodological approaches are combined, depending on the best fit with the desired research objectives and questions, with regard to the inclusion of all participants, and with regard to implementation and solution-orientation. The selected research approaches are implemented in such a way as to maximise credibility. Following Belcher et al. (2016), **credible high-quality research is authoritative, transparent, defensible, believable, and rigorous**. For this, traditional disciplinary criteria can be applied to transdisciplinary research. However, additional and modified criteria are needed to address the integration of epistemologies and methodologies and the development of novel methods through collaboration, the broad preparation and competencies required to carry out the research, and the need for reflection and adaptation when operating in complex systems.

For scientists who engage in or evaluate transdisciplinary research, this means that they should be open to and tolerant of different scientific methods and corresponding comprehensive set of quality criteria.

Moreover, Walter and Kremer (2023, 340) argue that within transdisciplinary learning contexts, the different **cultures of knowledge** provide the potential for a more **holistic reflection**, and therefore more comprehensive understanding. Persons who intend to collaborate in a transdisciplinary research project or educational task should reflect on and communicate their sources of knowledge, its reliability, and limitations. Conscious discussion may enhance mutual understanding for different approaches, documentation, and methodologies in scientific knowledge acquisition and therefore may prevent possible misconceptions. In addition, this reflection may help to identify common points of contact and complementary additions to the various disciplinary levels of knowledge, thereby enhancing **mutual learning**.

2.4 Assessing the quality of scientific publications

However, the methodological openness and diversity of transdisciplinary research does not mean that "everything" is possible and permitted. Rather, the transparent disclosure of sources and decisions made, the quality of the underlying data and the comprehensibility of interpretations are central to gaining confidence in the **quality of the knowledge** gained. In view of the possibilities created by intelligent systems (e.g., AI) in the production of knowledge, many researchers are also tempted to resort to questionable methods in the production of knowledge (see examples in Lüscher 2019). So, how can you recognise whether a scientific publication (especially if it does not originate from your own discipline) is of high quality?
We suggest the following questions that can be asked of a publication in order to assess its quality:

What is the quality of the content?

- The aformentioned quality criteria can be applied here

Who is/are the author(s)?

- Is/are the author(s) writing about a topic on which they are also conducting research (or are they commenting on topics that do not correspond to their primary research)?

- Does the author(s) have a reputation in this field?
- Might there be any conflicts of interest?

Who is the publisher?

- Does the publisher specialise in scientific publications in the relevant subject area?
- What is the reputation of the publisher (see list of predatory publishers)?
- Might there be any conflicts of interest?

Who is the target audience?

- Was the publication written for a scientific audience (or is it, for example, a text-book for students or a specialist article for a non-scientific audience)?

How was the publication received in the scientific community?

- Has the publication been cited by others (cp. citation indices)?
- Are there any reviews?

Please note that **there is no simple yes-no answer** regarding the quality of publications. Rather, this is determined gradually on the basis of multi-dimensional considerations.

Chapter 3

Three types of knowledge

Learning outcome

- Students can explain the concepts of systems knowledge, target knowledge, and transformation knowledge within the context of sustainable development

3.1 Three types of Knowledge

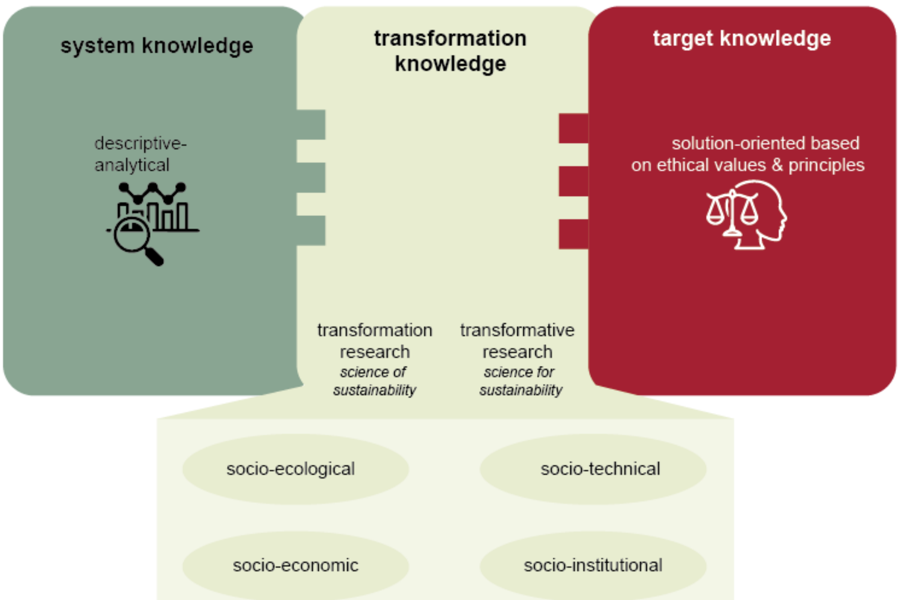

Figure 3.1: The three forms of knowledge in empirical-analytical and normative sustainability science (illustrated by Christoph Bader, based on ProClim 1997).

Systems knowledge is defined as the comprehension of the existing state of a system, encompassing the investigation of pertinent structures and processes, as well as their intricacy and dynamics within the framework of sustainable development. This is accomplished through a variety of methods, including qualitative and quantitative approaches, mixed methods, experiments, and system dynamics approaches, which frequently incorporate forecasts, retrospectives, and scenario analyses. The majority of studies on the generation of systems knowledge are classified as empirical research (Figure 3.1).

Target knowledge refers to what should be achieved and what should be avoided, and is particularly relevant through normative research. This encompasses the interpretation and concretization of the values associated with sustainable development, as well as the derivation of additional norms. Research that addresses the definition of thresholds, assessment methods, and visioning processes facilitates the formulation of clear recommendations regarding the necessary transformations (Figure 3.1).

Transformation knowledge is the process of moving from the current state to the desired state, achieved through the integration of both system and target knowledge. This entails the pursuit of demonstrably effective solutions to identified problems within the context of sustainable development. There are a number of methods that can be employed to achieve this. (translated from Ilias and enhanced with deepl) Research on transformations, i.e. the change in social organisation at different levels, can be both empirical and normative. Research focussing on past and present transformations is empirical. In contrast, research focussing on how concrete goals can be achieved is normative. This distinction is also acknowledged by the German Advisory Council on Global Change (WBGU), which employs the terms "transformation" or "transformative research." In the context of transformations, transformative education is emphasised, which aims to promote the acquisition of skills for a comprehensive and multi-layered understanding of change (Schneidewind 2013). The objective is to enhance the capacity for reflection within society, encompassing both the terms and ability of observing and actively shaping transformation processes (Figure 3.1).

> Activity: Video
>
> Watch the video below
> https://youtu.be/IeM2Ayj4F2Q?si=6eloPi0Jc02A8-U3

Chapter 4

Transparent referencing of third-party work

Learning outcome

- Students acknowledge in their work transparently knowledge from third parties by correctly and coherently using a reference systems and citation style

4.1 Introduction

New scientific findings do not emerge in an empty space. Rather, they build on ongoing scientific and social debates, they are based on existing knowledge and relate the new findings to previous scientific research and debates. This process of knowledge production usually culminates in the **communication of the new findings**. This can take various forms, for example in written student papers, scientific papers, books or scientific lectures aimed at a scientific audience. Alternatively, formats are chosen that appeal more to a non-scientific audience, for example blog posts, newspaper articles, presentations at relevant events, etc.

4.2 Referring to third party work

Regardless of which format is chosen, a scientific research procedure is characterized (and differentiated from a non-scientific approach) by the fact that it is shown in a transparent and comprehensible way, which existing knowledge of third parties is referred to. This means that it must be **clearly recognizable which statements are your own and which statements have been taken from others**, as well as where they can be found. If this is not done, one speaks of plagiarism. **Plagiarism** is the stealing of other's work without appropriately crediting or acknowledging the source and is considered misconducting scientific practice (Zabed and Qi 2022). Referring to sources not only acknowledges the knowledge of others, it also makes your own contribution more comprehensible and more substantial.

In their introductory work, Zabed and Qi (2022, 493) give numerous examples of **when a reference is required**:

- When describing or discussing a definition, theory, model, concept, or practice associated with a particular writer; e.g., “Referencing can be defined as the acknowledgement of the works or ideas of other persons, which have been published formally or are available in the public domain in another way” (Reference).
- To demonstrate the importance of the work; e.g., “It has been reported that environmental conditions significantly affect the growth of a crop during field experiment” (Reference).
- To point out a research gap in the report; e.g., “In a recent study, it has been pointed out that still there is no scientific data on how the migrant workers can contribute to the social stability of the country” (Reference).
- To show the vastness of the research work on the specific topic of the writer; e.g., “Numerous studies have been done over the last several decades to improve technical and technological aspects of energy production” (Reference-1; Reference-2; Reference-3 and so on).
- To describe the method(s) used in the study; e.g., “Starch content in the rice flour was determined by the enzymatic method” (Reference).
- To mention the source of data used in the research/report; e.g., “Data present in this report on weather conditions during the experiment were obtained from the Ministry of Science and Technology, Malaysia” (Reference).
- To identify the source of a material or equipment used during an experiment; e.g., “The constructs used in this study were drawn from recent research” (Reference)
- To show the similarity of the research outcome(s) to others’ work; e.g., “In our investigation, it was observed that organizational performance decreased significantly with the decrease in workforce diversity. Similar findings have been reported elsewhere” (Reference).
- To compare the study results with literature; e.g., “The blood pressure (BP) was recorded 140/95 in a patient under a stress condition. In an earlier study, BP was reported 145/90 in a patient under the same stress condition” (Reference).
- To explain the research outcomes logically; e.g., “It was observed that ethanol concentration reached a plateau after a certain time. This might have happened for the exhaustion of soluble sugars over time” (Reference).

Knowledge that can be assumed as **general knowledge** for the target audience (e.g., in the introduction) does not have to be referenced. For example: “climate change is a mayor threat to food systems”.
Own statements, considerations and conclusions (unless they refer to earlier, published material) do not have to contain references. They can be made explicitly recognizable as such to the reader with an active choice of words (examples: I / we propose … I / we assume, … I / we conclude …).

4.3 Reference system and citation styles

The referencing of existing sources, whether in written contributions or oral presentations, is carried out through the systematic application of a **'reference system'**. Paraphrased passages, direct quotations and other material (e.g. images) taken from third parties (or from our own earlier publications) are identified as such. In the case of protected material, appropriate permission must also be obtained for its use.

A reference system consists of a style that is consistently applied to the whole product, based on two elements (Zabed and Qi 2022):

1. Citing the source material in the text
2. Listing the full details of each source (usually at the end), so that it is easy to find. This list does not contain any entries that do not also appear within the text.

There exist numerous different reference styles. These are sometimes specified by a particular academic field, or by a particular publication format (e.g. a specific journal). Examples of reference styles that use the **"in-text name style"** are APA, Chicago or Harvard. Examples of reference styles that use the **"in-text numerical style"** are Vancouver, ACS or IEEE.

Unless explicitly stated otherwise by the lecturers, you are free to choose which citation style you would like to use in our degree program, but you are expected to transparently refer to third party work by referencing it and to apply the chosen reference style consistently across the whole publication. For each style, there are extensive rules on how to refer to sources in the text and how to present different types of sources.

Examples for reference styles

- APA reference style
- Vancouver reference style

4.4 Referencing Software Programs

The implementation of a coherent citation style is supported by the use of appropriate software apps. There are many such programmes, e.g. Zotero, Endnote, Citavi, Mendeley Referencing Manager, etc.

Most of these programmes not only support correct and coherent referencing but also serve as helpful reference management systems. We recommend that you use an app to manage and reference your literature. Again, you are free to choose, but we recommend Zotero. On the one hand, Zotero is very user-friendly, on the other hand, you have unlimited storage space with the e-mail account of the University of Bern.

When writing with **LaTex** or **RMarkdown**, the formatting is done automatically. Here some further links:

- Zotero and LaTex
- Zotero and Jupyter Notebooks
- Zotero and RMarkdown

4.5 References in scientific presentatoins

The previous explanations can easily be realized in written texts. Please note that we also expect in **scientific presentations** (e.g. on Powerpoint slides) that knowledge taken from third parties is referenced, be it in the speech you give (e.g. "… previous findings of XY show that …") and/or on the presented slides.

The same applies to images, figures or tables used from third parties. In order to keep the slides clear, citation styles that use a short form on the slide and a full list at the end of the presentation are particularly recommended.

4.6 Referencing in non-scientific publications

Also, in texts and presentations targeting at a non-scientific audience, it is essential to acknowledge the knowledge used by third parties. However, such publications usually focus on the author's own findings and conclusions. This means that the embedding of one's own statements in the existing body of knowledge is less extensive and limited to key sources.

In addition, the choice of citation style can be used to try to disrupt the flow of reading as little as possible (e.g. with the in-text numerical style, or by underlaying text passages with hyperlinks that lead to the original source).

Last but not least, a text can become more comprehensible for a non-scientific audience if additional background information on the third party is provided when referring to statements and knowledge of third parties (e.g., "…. Maja Göpel, one of the most renowned transformation researchers in Germany, suggests in her work that …).

4.7 Dive deeper into the topic

- Tutorials on the APA style
- Quick start guide provided by Zotero
- A bit more thorough guides to Zotero: https://www.youtube.com/watch?v=tnbwKj6-pD8 or https://www.youtube.com/watch?v=JG7Uq_JFDzE
- Information on copyright and licences

Chapter 5

Integrity and Ethics

Learning outcomes

- Students can describe basic principles of good and responsible research ethics and scientific integrity
- Students are aware about the implications for conducting good and ethical responsible research

5.1 Introduction

Scientific or research **integrity** refers to the requirement that researchers to conduct research in accordance with appropriate ethical, legal, and professional frameworks, obligations, and standards. This relates to several levels of **accountability**, including those of individual researchers, their institutions, (potential) clients, the government, and the general public. Only a high level of integrity allows to maintain society's trust in research, to protect the reputation of researchers and institutions, to ensure the reproducibility of research results, and to prevent fraud and misconduct (Alavi and Schmohl 2023).

Good scientific practice and scientific integrity adheres to **legal regulations** (e.g. New Federal Act on Data Protection), as well as **principles and codes of conduct on research ethics and scientific integrity of the scientific academies** (e.g. The European Code of Conduct for Research Integrity of All European Academies, or the Code of conduct for scientific integrity of the Swiss Academies). Various **scientific communities and academic fields** also specify further codes and principles (e.g., the Guide for Transboundary Research Partnerships of the Swiss Alliance for Global Research Partnerships, the Ethical Principles of Psychologists and Code of Conduct of the American Psychology Association, or the Code of Ethics of the International Sociological Association).

For **international and interdisciplinary researchers**, this means that they must actively inform themselves about the applicable laws in the countries in which they conduct their research, as well as the applicable principles and codes of conduct of their (disciplinary) research communities.

In our view, the following principles are particularly important for students on the Master's programme on Sustainability Transformations.

5.2 Basic principles

Based on recommendations of All European Academies (ALLEA), the Swiss Academies have formulated **four basic principles** of scientific integrity (Swiss Academies of Arts and Sciences 2021, 15):

1. **Reliability** in ensuring the quality of research and teaching in order to maximise the credibility of, and trust in, science. Reliability is reflected in particular in the design, methodology, and analysis of research; it involves both transparency and traceability.
2. **Honesty** in developing, designing, undertaking, reviewing, reporting and communicating research and teaching activities. These activities should be carried out in a transparent manner with a view to achieving maximum impartiality.
3. **Respect** for colleagues, students, study and research participants, society, our cultural heritage, ecosystems and the environment. Due consideration should be given to the diversity and life experience of all persons involved.
4. **Accountability** for research – from an idea to its valorisation and transfer – and for its administration and organisation as well as for training, supervision, mentoring, and the careful use of resources.

Moreover, the EU specified in its European Charter for Researchers a set of general principles and requirements which specifies the roles, responsibilities and entitlements of researchers. They are aimed at all researchers at all stages of their careers and cover all areas of research in the public and private sectors. The Charter formulates the following requirements for researchers:

Table 5.1: General principles and requirements for researchers (based on the EU Charter for Researchers).

Research freedom	Professional attitude	Good practice in research	Relation with supervisors
Ethical principles	Contractual and legal obligations	Dissemination, exploitation of results	Supervision and managerial duties
Professional responsibility	Accountability	Public engagement	Continuing professional development

5.3 Good research practices

From these basic principles, more concrete **implications for good scientific practices** can be derived, for example (for more details cp. Swiss Academies of Arts and Sciences 2021):

5.3.1 In the production and dissemination of knowledge

- Responsible data management is required when handling the data. This ensures security and longevity of data, as well as reproducibility of research results. On the one hand, the procedures follow the requirements of data protection guidelines and data management plans, on the other hand, they are oriented on Open Science Guidelines.
- When producing knowledge, it is important to disclosure apparent, potential, and actual conflicts of interests. It is also required to respect intellectual property, and to explicitly and correctly refer to existing knowledge and literature (cp.)
- It also means to use AI in research responsibly and make their use transparent (cp.) It goes without saying that due diligence is required when collecting and analysing data and no practices that contravene scientific integrity are used (such as e.g. data fabrication, cf. also the regulations concerning scientific integrity of the University of Bern, Article 5).

5.3.2 In the collaboration with colleagues

- Good practice in this regard includes, for example, naming all persons who have made a significant contribution to the planning, realisation and quality as authors.
- Peer review procedures are an important quality assurance mechanism in science. Researchers should also make their contribution here and provide appropriate feedback with a commitment to objectivity, impartiality, and confidentiality.

5.3.3 When involving human participangs in data collection[1]

- When data is collected from human participants (mostly in humanities and social sciences, as well as in transdisciplinary research, e.g. through observations or surveys, but also on social media), it is essential to comply with the applicable data protection laws. Both the European Data Protection Act and the new Federal Act on Data Protection stipulate corresponding requirements.
- The different (disciplinary) research communities often go one step further in their research ethics guidelines (e.g. the Ethics in Social Science and Humanities for the European Commission). These place the dignity and well-being of the participants at the center, particularly, if vulnerable groups are involved. Most of these research ethical guidelines are based on the Belmont Report of the National Commission for the protection of Human Subjects of biomedical and behavioural

[1] Other rules and ethical guidelines arise when animals are involved; these would have to be consulted in a corresponding case. We do not comment on this in the present document, as to our knowledge this is rarely the case in transdisciplinary sustainability research.

Research of the United States. The Belmont Report defines three basic ethical principles:

1. **Respect for Persons** expresses the ethical convictions that the autonomy of individuals should be respected and that persons with diminished autonomy are entitled to equal protection.
   □ This results, for example, in the requirements of **voluntariness, confidentiality/anonymity, and informed consent**.
2. **Beneficence** describes an obligation to protect subjects from harm by maximizing possible benefits and minimizing possible harms. □ Participants **must not suffer any impairments or disadvantages as a result of their participation** (e.g. no negative emotions). If this is the case, such burdens must be justified by the benefits of the research. An ethics committee should decide whether this is the case.
3. **Justice** promotes equitable representation in research in terms of fairly distributing the risks and benefits of research. □ The groups of people involved must not suffer any disadvantages as a result of their participation (e.g. refusal of treatment if they are assigned to the control group).

5.4 Outlook and further literature

- You will gain in-depth knowledge about fairness, ethics in fieldwork, conflict sensitivity, etc. in the seminar «Be fair, contextually aware, and conflict-sensitive in inter-cultural and inter-contextual collaborations: key competences for sustainability transformations» (Autum Term). The seminar will expand and complement the basic principles presented .
- If you are planning to involve human beings in data collection in student projects, a future learning expedition will provide you with details on the correct procedure. Please consult this expedition and / or Ahsan Ullah (2022) before you start collecting data.

i Dive deeper into the topic

- Watch this introductory learning video on Research Ethics.
- Consult the Recommendations of the University of Bern on Research Compliance and Good Research Practice.
- Learn more about what the New Federal Act on Data Protection means for Open Access practices in this Webinar.
- Learn more about the background and content of the Belmont Principles in this webinar.
- Explore the Toolbox for Research Integrity of the SOPs4RI project.
- Explore the platform for research integrity and ethics of the EnTIRE and VRT2UE projects.
- Complete the online course on «Research Integrity» of the University of Bern.

Chapter 6

What is ID/TD?

Learning outcomes

- Students can explain the concepts of multidisciplinary, interdisciplinary (ID), and transdisciplinary (TD) approaches, and describe the differences between these terms

6.1 Explain Inter- and Transdisciplinarity

According to Stock and Burton (2011, 1091) **“sustainability is […] inherently transdisciplinary”**.
But what is transdisciplinary? And what are all the other terms?

To gain a better understanding of this, watch the following video.

https://youtu.be/KnVWoymu4kI?si=PRAxKZzLcMB4KYlI

6.2 ID/TD case study

Insight into an inter- and transdisciplinary CDE research project: **How does a region become climate neutral?**

In 2019, the Oberland-Ost Regional Conference set itself the strategic development goal of moving the region towards climate neutrality. In order to put this goal into practice, a participatory strategy process was initiated with numerous stakeholders from the region. Representatives from the public sector, local clubs and associations, the tourism and mobility sector, energy producers and suppliers, the private sector and the agricultural and forestry sectors have developed a joint “vision” and “transition paths” (these describe the steps required to realize the vision). In addition, initial “transition experiments” were outlined (i.e. pilot projects that reduce regional GHG emissions, such as support for biogas production by local farmers). All of this was published in a “Transition Agenda”.

This process was initiated, accompanied and researched by an inter- and transdisciplinary team of CDE researchers from the disciplines of psychology, geography and communication sciences together with representatives of regional authorities. CDE researchers were responsible for identifying and involving key regional stakeholders, as well as facilitating a series of workshops to develop the transition agenda. In addition, a survey was conducted among the local population to find out whether they supported the vision developed by the regional representatives. The results of the survey were then incorporated into the strategy process.

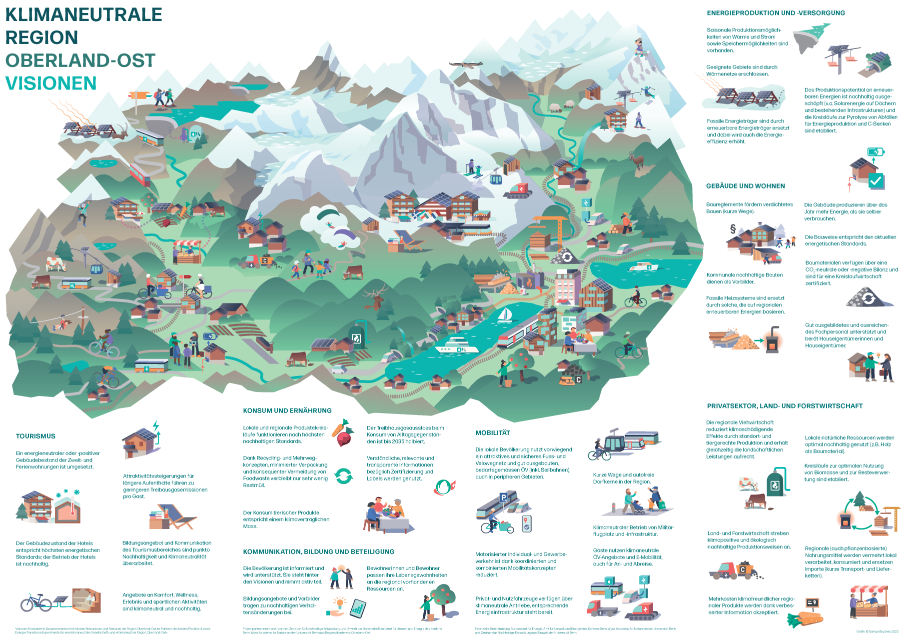

Figure 6.1: Visions of a climate neutral region Oberland-Ost (illustration by Samuel Bucheli).

The project was funded by the Swiss Federal Office of Energy SFOE (Energy Research and Cleantech Section) and co-financed by the Wyss Academy for Nature at the University of Bern and the Economic, Energy and Environmental Directorate of the Canton of Bern.

More Information on the project on the CDE-project website.

6.3 Activity

Review terms and definitions

For each definition select the **correct term**.
A specific branch of knowledge or field of study that follows a distinct set of theories, methods, and principles.
– Choose an answer – Discipline Interdisciplinary (ID) Intra/monodisciplinary Transdisciplinary (TD) Multidisciplinary Crossdisciplinary

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Uses methods and concepts from one field of study to address questions or problems in another. It seeks to draw parallels and find applications across different areas of knowledge.
– Choose an answer – Discipline Interdisciplinary (ID) Intra/monodisciplinary Transdisciplinary (TD) Multidisciplinary Crossdisciplinary

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The integration and collaboration of multiple fields of study to address a common research question or problem. It aims to create new insights and understandings that transcend the boundaries of individual areas of expertise.
– Choose an answer – Discipline Interdisciplinary (ID) Intra/monodisciplinary Transdisciplinary (TD) Multidisciplinary Crossdisciplinary

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Involves a collaborative process that integrates academic and non-academic knowledge to address complex, real-world problems. It goes beyond traditional fields of study, incorporating perspectives from stakeholders, practitioners, and community members.
– Choose an answer – Discipline Interdisciplinary (ID) Intra/monodisciplinary Transdisciplinary (TD) Multidisciplinary Crossdisciplinary

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Research or inquiry conducted within a single field of study, focusing on deepening knowledge and understanding of a specific subject area. It relies solely on the concepts, theories, and methods specific to that field.
– Choose an answer – Discipline Interdisciplinary (ID) Intra/monodisciplinary Transdisciplinary (TD) Multidisciplinary Crossdisciplinary

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Involves several fields of study working alongside each other on a common topic, but without necessarily integrating their perspectives or methods. Each area maintains its own methodologies and standards while contributing to a broader understanding of the issue.
– Choose an answer – Discipline Interdisciplinary (ID) Intra/monodisciplinary Transdisciplinary (TD) Multidisciplinary Crossdisciplinary

Chapter 7

ID/TD methods and reflection on methods

Learning outcomes

- Students can describe typical methodological approaches of their previous scientific socialisation (e.g. the BSc degree programme)
- Students can discuss them critically with regard to their field of application, strengths and limitations

7.1 Introduction - Reflecting scientific socialization

As students progress through their academic studies, particularly during their Bachelor of Science (BSc) degree programs of a certain discipline, they are exposed to a **scientific socialization** towards a disciplinary culture (Boden, Borrego, and Newswander 2011) whereby each discipline has a distinctive approach to defining and legitimizing their research methods (Austin 2002). It is therefore of great importance for students to gain an understanding of their socialization and the methods they have employed during their studies. This enables them to engage in critical evaluation and application of different research methods in their respective fields. Moreover, it is essential to understand the relative merits and limitations of each approach and its potential applicability in inter- and transdisciplinary contexts.

> Mandatory Reflection Exercise
>
> The following exercise is designed to facilitate an understanding of, discussion about, and reflection on, the methodological approaches and skills that you have acquired during your previous studies.
> Write a short reflective essay (approx. 500 words) that addresses the following points:

- **Description of methodological approaches**: identify and describe at least 3 key methodological approaches you encountered during your BSc program. Those approaches might be analytic, qualitative, quantitative, or mixed. Provide a brief explanation of each method, including principles and procedures involved. Potential methods might include:
  - Qualitative methods: interviews, focus groups, oral history, ethnography, qualitative content analysis etc.
  - Quantitative methods: survey and questionnaire, experiments, statistical analysis, remote sensing or GIS, etc.
  - Mixed Methods
  - Others: Your methodological background might not apply to the above-mentioned categories, such as in maths, philosophy, literature studies or arts (Pilcher and Cortazzi 2024).
- **Field of application**: discuss the typical context or types of research where each of the described methods is applied. If possible, provide concrete examples from your previous studies.
- **Reflecting on strengths and weaknesses/limitations**: After describing your methods, reflect on the strengths and weaknesses/imitations of said methods. To do this, you can consult Haq (2014, 3–11), Choy (2014, chaps. 2.1–2.4), and/or Queirós, Faria, and Almeida (2017). The papers may assist in acquiring a more profound comprehension of potential elements pertaining to your methodology. It is possible that the findings will differ from those proposed by the authors.
  - Strengths: Discuss/reflect on the main advantages of each method.
  - Limit/Weaknesses: Critically evaluate the potential drawbacks / challenges / limitations associated with each method.
- **Interdisciplinarity**: Think about how these methods might work in an interdisciplinary or even transdisciplinary field. What might be the advantages and disadvantages?

Please hand in your reflection as soon as you register for the oral exam.

7.2 ID/TD methods

At present, there is a considerable array of distinct **ID/TD methodologies**, derived from both research and practice. The objective of this section is not to present a comprehensive account of applied methods; rather, it aims to offer insights into a select number of methods. However, before we start to explore ID/TD methods, it is essential to acknowledge that a vast variety of scientific methods are used. Various scientific methods offer specific approaches to analysing the objects of investigation and are considered complementary, as they provide different approaches to description and explanation. The choice of method therefore depends heavily on the research question and the object of investigation (cf. Schirmer 2009, 129ff). The range of scientific methods is huge, making it difficult to categorise them. Pilcher and Cortazzi (2024) used semi-structured interviews with scientists to ask about their understanding of the frequently used categorisation into quantitative and qualitative research. It is important to note here that the categorisation into quantitative and qualitative methods is made particularly in the social sciences - as Pilcher and Cortazzi (2024) show. In some disciplines, researchers only conduct a certain type of research and never need anything other than clear 'quantitative' definitions (e.g. mathematical sciences); others only conduct research that involves texts but not numbers (e.g. literary studies). Further, some researchers considered how certain aspects lie outside the 'qualitative' or 'quantitative' (e.g. the 'theoretical' in German studies), or they conducted research that they considered to contain no 'knowledge' (sculpture in the visual arts), while others conducted basic 'conceptual' research that they considered to be at a stage prior to any quantity or quality judgement (philosophy). Finally, some researchers considered the terms to be of little relevance to their specialisms.

In many cases, the problems and issues in sustainability science require integrative, interdisciplinary and transdisciplinary approaches in addition to human and natural science methods. By definition, **interdisciplinary science**, as sustainability science is, positions itself across the disciplines. For them, translations between disciplines are important. And when **transdisciplinary approaches** enter the respective social field and thus dissolve the disciplinary institutional distance, this must also have methodological consequences: It is about more inductive approaches in which the multiplicity of positions and approaches is recognised (Berger 2010). Collaboration in heterogeneous groups with experts and stakeholders (from science and/or practice) creates a mutual learning and research process, as all those involved can contribute their specific experience, knowledge and disciplinary methods to the project. In this way, existing methods are sometimes recombined and reimplemented.

Interdisciplinary and transdisciplinary methods are characterised by the fact that they support the integration of different knowledge and enable co-creative processes for the development of sustainability contributions.

i Exploring methods

Due to the wide variety of applied ID/TD methods, we won't be able to demonstrate everything in our study programme. Therefore, you can also explore some ID/TD methods yourself:

1. **Explore the td-net Toolbox** and read through the presented methods. We recommend reading the tools "actor constellation", "three types of knowledge tool", and "Theory of Change". Feel free to read through further methods/tools.
2. We recommend to **read the chapters** "Citizen Science" and "Indigenous Knowledge" from the "Handbook Transdisciplinary Learning" (Philipp and Schmohl 2023). You can download the full book-pdf.

i Further Reading

Creswell (2013)
Kagan (2009)

References

Ahsan Ullah, A. K. M. 2022. "Ethics and Empirics: Essence of Ethics in Social Research." In *Principles of Social Research Methodology*, edited by M. Rezaul Islam, Niaz Ahmed Khan, and Rajendra Baikady, 471–82. Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-19-5441-2_34.

Alavi, Marie, and Tobias Schmohl. 2023. "Research Integrity." In *Handbook Transdisciplinary Learning*, edited by Thorsten Philipp and Tobias Schmohl, 1st ed., 6:297–306. Bielefeld, Germany: transcript Verlag. https://doi.org/10.14361/9783839463475-031.

Austin, Ann E. 2002. "Preparing the Next Generation of Faculty: Graduate School as Socialization to the Academic Career." *The Journal of Higher Education* 73 (1): 94–122. https://doi.org/10.1080/00221546.2002.11777132.

Belcher, Brian M., Katherine E. Rasmussen, Matthew R. Kemshaw, and Deborah A. Zornes. 2016. "Defining and Assessing Research Quality in a Transdisciplinary Context." *Research Evaluation* 25 (1): 1–17. https://doi.org/10.1093/reseval/rvv025.

Berger, Wilhelm. 2010. "Methoden Der Interdisziplinarität." In *Interdisziplinarität. Wissenschaft Im Wandel. Beiträge Zur Entwicklung Der Fakultät Für Umwelt-, Regional- Und Bildungswissenschaft.*, edited by Werner Lenz, 51–67. Wien: Löcker.

Bhattacherjee, Anol, Mark Toleman, Samara Rowling, Anita Frederiks, and Nikki Andersen. 2019. "Social Science Research: Principles, Methods and Practices." Edited by Samara Rowling. https://doi.org/10.26192/Q7W89.

Boden, Daniel, Maura Borrego, and Lynita K. Newswander. 2011. "Student Socialization in Interdisciplinary Doctoral Education." *Higher Education* 62 (6): 741–55. https://doi.org/10.1007/s10734-011-9415-1.

Choy, Looi Theam. 2014. "The Strengths and Weaknesses of Research Methodology: Comparison and Complimentary Between Qualitative and Quantitative Approaches." *IOSR Journal of Humanities and Social Science* 19 (4): 99–104. https://doi.org/10.9790/0837-194399104.

Creswell, J. W. 2013. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. 4th ed. London: Sage Publications.

Gibbons, Michael, Camille Limoges, Helga Nowotny, and Simon Schwartzman. 2010. *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*. London. https://doi.org/10.4135/9781446221853.

Haq, Muhibul. 2014. "A Comparative Analysis of Qualitative and Quantitative Research Methods and a Justification for Adopting Mixed Methods in Social Research." Annual PhD Conference, University of Bradford Business School of Management. https://doi.org/10.13140/RG.2.1.1945.8640.

Hirsch Hadorn, G., and G. Brun. 2007. "Ethische Probleme Nachhaltiger Entwicklung." *SAGW: Nachhaltigkeitsforschung – Perspektiven Der Sozial- Und Geisteswissenschaften*, 235–54.

Hopf, Henning, Alain Krief, Goverdhan Mehta, and Stephen A. Matlin. 2019. "Fake Science and the Knowledge Crisis: Ignorance Can Be Fatal." *Royal Society Open Science* 6 (5): 190161. https://doi.org/10.1098/rsos.190161.

Jonas, Hans. 1987. *Das Prinzip Verantwortung. Versuch Einer Ethik Für Die Technologische Zivilisation*. Frankfurt am Main: Suhrkamp.

Kagan, Jerome. 2009. *The Three Cultures: Natural Sciences, Social Sciences, and the Humanities in the 21st Century*. 1st ed. Cambridge University Press. https://doi.org/10.1017/CBO9780511576638.

Kates, Robert W., William C. Clark, Robert Corell, J. Michael Hall, Carlo C. Jaeger, Ian Lowe, James J. McCarthy, et al. 2001. "Sustainability Science." *Science* 292 (5517): 641–42. https://doi.org/10.1126/science.1059386.

Lüscher, Thomas F. 2019. "Honesty and Truth in Academic Research and Writing." In *A Guide to the Scientific Career*, 139–54. John Wiley & Sons, Ltd. https://doi.org/10.1002/9781118907283.ch17.

Martens, Pim. 2006. "Sustainability: Science or Fiction?" *Sustainability: Science, Practice and Policy* 2 (1): 36–41. https://doi.org/10.1080/15487733.2006.11907976.

Philipp, Thorsten, and Tobias Schmohl, eds. 2023. *Handbook Transdisciplinary Learning*. 1st ed. Vol. 6. Bielefeld, Germany: transcript Verlag. https://doi.org/10.14361/9783839463475.

Pilcher, Nick, and Martin Cortazzi. 2024. "'Qualitative' and 'Quantitative' Methods and Approaches Across Subject Fields: Implications for Research Values, Assumptions, and Practices." *Quality & Quantity* 58 (3): 2357–87. https://doi.org/10.1007/s11135-023-01734-4.

ProClim. 1997. "Research on Sustainability and Global Change – Visions in Science Policy by Swiss Researchers." Bern: ProClim-Forum for Climate; Global Change. proclim.ch/id/Yzz6d.

Queirós, André, Daniel Faria, and Fernando Almeida. 2017. "Strengths and Limitations of Qualitative and Quantitative Research Methods." *European Journal of Education Studies* 3 (9). https://doi.org/10.5281/zenodo.887089.

Renn, Ortwin, Jürgen Deuschle, Alexander Jäger, and Wolfgang Weimer-Jehle. 2007. *Leitbild Nachhaltigkeit*. Wiesbaden: VS Verlag für Sozialwissenschaften. https://doi.org/10.1007/978-3-531-90495-5.

Schirmer, Dominique. 2009. *Empirische Methoden Der Sozialforschung: Grundlagen Und Techniken*. 1st ed. Stuttgart, Deutschland: utb GmbH. https://doi.org/10.36198/9783838531755.

Schneidewind, Uwe. 2013. "Transformative Literacy. Gesellschaftliche Veränderungsprozesse Verstehen Und Gestalten." *GAIA - Ecological Perspectives for Science and Society* 22 (2): 82–86. https://doi.org/10.14512/gaia.22.2.5.

Stock, Paul, and Rob J. F. Burton. 2011. "Defining Terms for Integrated (Multi-Inter-Trans-Disciplinary) Sustainability Research." *Sustainability* 3 (8): 1090–1113. https://doi.org/10.3390/su3081090.

Swiss Academies of Arts and Sciences. 2021. "Code of Conduct for Scientific Integrity." Swiss Academies of Arts; Sciences. https://doi.org/10.5281/zenodo.4707560.

Walter, Hildrun, and Kerstin Kremer. 2023. "Scientific Knowledge." In *Handbook Transdisciplinary Learning*, edited by Thorsten Philipp and Tobias Schmohl, 1st ed., 6:339–48. Bielefeld, Germany: transcript Verlag. https://doi.org/10.14361/9783839463475-035.

Zabed, Hossain M., and Xianghui Qi. 2022. "Plagiarism and Referencing Techniques Used in Social Research Report." In *Principles of Social Research Methodology*, edited by M. Rezaul Islam, Niaz Ahmed Khan, and Rajendra Baikady, 485–505. Singapore: Springer Nature. https://doi.org/10.1007/978-981-19-5441-2_35.