Transdisciplinarity and Holism – How are Different Disciplines Connected in Environmental Research?

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Introduction

Transdisciplinarity in the environmental sciences is seen as a paradigm for a future science that overcomes the fragmentation in current science including the divide between the sciences and the humanities. Transdisciplinarity is propagated by many scientific institutions, and several concepts of transdisciplinarity have been put forward (Mittelstraß 1992, Gibbons et al. 1994, Balsiger and Kötter 1997, Jaeger and Scheringer 1998). However, the exact meaning of transdisciplinarity as well as the methodological approaches to and the status of transdisciplinary research compared with disciplinary research are a matter of controversy. Therefore, we present a more specific interpretation of transdisciplinarity that makes use of the concept of holism.

The concept of holism and its application to environmental systems

In the philosophy of science, holism is a claim about the structure of scientific theories. Starting from Duhem (1908), holism has been developed by Quine (1951). The claim is that isolated statements cannot be tested by experience. Instead, it is always a whole theory and in the last resort our whole system of knowledge that is confirmed or disconfirmed by experience. Quine then makes a further step: what applies to confirmation also applies to meaning. Single statements considered in isolation do not have a meaning either. The meaning of a statement is its position in a whole system of statements, which includes in the last resort all our knowledge.

The epistemological claims of confirmation holism and meaning holism are an offer which science can take up. However, on their own, they are usually not capable of influencing the everyday business of science because, in the everyday business of science, these claims are typically received in a disciplinary manner. This means the domains that are relevant for confirmation and meaning are theories that fall into well-defined disciplines and their fields of application. Only in a situation of crisis do the broader connections that finally encompass the whole of our knowledge come into focus. Our thesis is that in the environmental sciences the situation is such that the objects of science manifest interconnections which are that strong that the epistemological claims of meaning holism and confirmation holism can no longer be ignored. This means that, in the environmental sciences, the object of science itself manifests some sort of holism. In distinction from the holism that is discussed in the philosophy of science, this is an ontological holism, i.e. a holism that concerns the structure of environmental systems themselves.

A system is holistic if and only if its components have some properties which are char-

acteristic of the components only if there is the whole. A first example of holistic systems is found in quantum mechanics where there are intrinsically connected components of a whole. Other systems that are likely to show a holistic structure are social systems and environmental systems such as landscapes, see below. In the study presented, this kind of holism is compared with and distinguished from systems theory. Systems theory primarily examines a network of causal or functional interrelations between the components of a system. The point as regards holism, by contrast, are not causal relations, however complex or circular they may be, but mutual ontological dependence of the components with respect to some of their characteristic properties. That is to say: the properties themselves are not intrinsic, but relational. Something can have these properties only in relation to other things with which it is arranged in such a way that there is a holistic system of the kind in question (Esfeld 1998).

Applied to the environmental sciences, the concept of holism implies: A research object such as a landscape can, on the one hand, be investigated from many disciplinary points of view, which leads to a broad, multi-disciplinary picture of the physical, chemical, biological etc. processes in the landscape. On the other hand, the components of the landscape (e.g. forests, rivers, agricultural areas, residential areas, traffic lines) and their history contribute to the integral character of the landscape comprising various ecological, aesthetic and functional aspects of experiencing and using the landscape. Such integral aspects of the entire landscape then provide the specific focus of transdisciplinary research. An example of such a focus is the question of how the dissection due to traffic lines can be described, quantified and evaluated, in particular with respect to unforeseen effects and to the conflicting aims between recreational, ecological or other functions of the landscape (Jaeger 1999).

Consequences for transdisciplinary research

In the environmental sciences, experience from several studies has shown that disciplinary research is not sufficient to reach solutions of complex environmental problems such as environmental pollution or overbuilding of landscapes. Looking for an explanation of this situation, we examine the following hypotheses: (i) environmental systems show a significant holism on the object level and therefore require transdisciplinary research; (ii) by applying the conceptual tools of the holism in the philosophy of science to the holism on the object level, we gain methodological implications for transdisciplinary research. In this discussion we will use a methodological framework for transdisciplinary research that has been described elsewhere (Jaeger and Scheringer 1998).

A first result for the methodology of transdisciplinary research is the following: In a somewhat simplified perspective, disciplines are characterized by typical bodies of empirical and theoretical knowledge, by sets of subjects of investigation and by specific methods. This is the material that is teached to the students of a discipline. In comparison to the entire field of scientific research, each disciplinary domain may be characterized as a more or less "closed" area that, of course, evolves along the particular lines of its scientific advance. This kind of limitation is a necessary condition for the successful development of disciplinary knowledge. Complex environmental problems, on the other hand, comprise several sub-problems falling into the domains of different disciplines. Compared with the well structured fields of disciplinary knowledge, the research field related to an environmental problem is open and "ill-defined".

Therefore, the interrelations between very different sub-problems of complex environmental problems require many different combinations of various scientific methods that have to be adapted to each particular case. This means that there will not be a single and coherent discipline of "environmental sciences" like physics or chemistry. In other words,

the consequence from the holism of environmental systems is not that the existing disciplines lie at the "wrong" places and the boundaries between them have to be shifted in such a way that environmental sciences become a discipline. Instead, disciplinary research and development of methods is necessary but it has to be complemented by transdisciplinary research that is to be established in the scientific institutions as well. Transdisciplinary research is not to be understood as a "new" science replacing disciplinary research but, at the same time, cannot be seen as a sideline or a by-product of disciplinary research either. It has to be pursued according to its own methodology and quality standards and has to be based on sufficient resources like those provided for disciplinary research. Only on this basis can we reach a fruitful cooperation between disciplinary and transdisciplinary research – which is required for coping with the variety of environmental and social problems modern societies are confronted with.

References

Balsiger, P.W., Kötter, R., Fazitprotokoll des 1. Workshops im SPPU-Diskussionsforum "Transdisziplinärer Forschungsprozess", Haus der Universität Bern, März 1997 (unpublished); summary published in *GAIA* **6** (2), 155 (1997).

Duhem, P., *La théorie physique. Son object – sa structure*, Paris (1914).

Esfeld, M., Holism and Analytic Philosophy, *Mind* **107**, 365–380 (1998).

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., Trow, M., *The New Production of Knowledge*, Sage, London (1994).

Jaeger, J., Scheringer, M., Transdisziplinarität – Problemorientierung ohne Methodenzwang, *GAIA* **7** (1), 10–25 (1998).

Jaeger, J., Gefährdungsanalyse der anthropogenen Landschaftszerschneidung, Diss ETH Nr. 13503, Zürich 1999.

Mittelstraß, J., Auf dem Wege zur Transdisziplinarität, *GAIA* **1** (5), 250 (1992).

Quine, W. V. O., Two Dogmas of Empiricism, *Philosophical Review* **60**, 20–43 (1951).

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