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Exploring transdisciplinary integration within a large research program: Empirical lessons from four thematic synthesis processes

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ABSTRACT

What challenges do researchers face when leading transdisciplinary integration? We address this question by analyzing transdisciplinary integration within four thematic synthesis processes of the Swiss National Research Programme (NRP 61) on Sustainable Water Management. We adapt an existing analytical framework to compare transdisciplinary integration across the four synthesis processes regarding different types of generated knowledge (systems, target and transformation knowledge), different types of involved actors (core team, steering committee, advisory board, scientific experts and practice experts) and different levels of actor involvement (information, consultation and collaboration) at different stages of the processes. Based on a structured ex-post self-evaluation of the four synthesis processes, we present core challenges of transdisciplinary integration as perceived by core team members of the four synthesis processes and formulate empirically derived recommendations for designing and implementing future processes. We suggest that future synthesis processes should be conceptualized and initiated concurrently with all other individual research projects, involving a phasing-in stage where leaders conceptualize transdisciplinary integration, an intermediate stage of intense knowledge integration involving all relevant actor groups in a functional and dynamic way, and a final phasing out stage, where synthesis results are consolidated within the research program, validated by different actor groups and diffused to the target audiences. We argue that transdisciplinary integration requires professional competences, management skills and enough time. Finally, we suggest fostering communities of practice (CoP) to link committed leaders and enable mutual learning processes beyond the boundaries of individual synthesis projects or research programs.

1. Introduction

Research activities are increasingly organized as large programs that involve a variety of individual projects and a diversity of actor groups (Adler et al., 2009). In the field of sustainability research, these programs are often expected to contribute to solving today's key sustainability problems (Hirsch Hadorn et al., 2006). Due to the complexity, ambiguity, and uncertainty of these problems, such programs often apply a transdisciplinary research approach (Jahn et al., 2012; König et al., 2013). This approach, which transcends disciplinary boundaries and bridges between science and practice, is intended to create a more comprehensive understanding of sustainability-related problems and develop practice-oriented solutions to deal with them (de Jong et al., 2016; Jahn et al., 2012; König et al., 2013; Pohl and Hirsch Hadorn, 2008; Polk, 2014).

An increasing number of such large research programs produce a synthesis, mainly toward the end of the program. The synthesis takes stock of individual project results and generates new knowledge by integrating results to establish novel (i.e., previously unrecognized) connections between them (Jahn et al., 2012; Specht et al., 2015). To contribute to societal problem solving, program synthesis often includes targeted products tailored to the specific knowledge needs of intended audiences (Campbell et al., 2015; Defila et al., 2006; Lang et al., 2012; Pohl and Hirsch Hadorn, 2007). Although "synthesis is increasingly recognized as an essential component of the scientific endeavor" (Carpenter et al., 2009; Hampton and Parker, 2011, p. 900), very few empirical studies

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examine how synthesis processes are structured (Bechtel, 1986; Bruce et al., 2004; Defila and Di Giulio, 2015; Enengel et al., 2012; Loibl, 2006), specifically to identify the knowledge types generated, the actor groups involved at different synthesis stages as well the extent of their involvement. There are even fewer studies (Lang et al., 2012) analyzing challenges that different synthesis stages pose in terms of knowledge integration and actor involvement.

We suggest that a detailed understanding of synthesis processes would support leaders in successfully designing and implementing transdisciplinary integration within large research programs. Exploring the challenges posed by synthesis processes should reveal critical aspects to consider when leading such processes. This could, in turn, minimize time-consuming 'learning by doing' processes, "which may unfortunately lead to a 're-inventing the wheel' phenomenon, frequently experienced by researchers involved in inter- and transdisciplinary research projects" (König et al., 2013, p. 262; Tress et al., 2007).

Hence, this empirical study addressed three research questions:

1) How are synthesis processes structured, who is involved and to what extent?
2) What challenges do synthesis processes pose in terms of knowledge integration and actor involvement?
3) What recommendations can be derived for future synthesis processes?

We addressed these questions by analyzing four thematic synthesis processes, which were capstone projects within the Swiss National Research Programme (NRP 61) on Sustainable Water Management. This paper first presents the conceptual framework underlying our empirical study and then describes the materials and methods used. The four synthesis processes are compared and similarities and differences with regard to knowledge types and actor groups as well as levels of actor involvement at different stages of the process are identified. Based on a structured ex-post self-evaluation of the four synthesis processes, core challenges of transdisciplinary integration as perceived by leaders (e.g. core team members) of transdisciplinary integration at different stages of the processes are presented. Finally, empirically-derived recommendations for designing future synthesis processes are formulated.

2. Conceptual framework

Previous research has mainly focused on transdisciplinary integration within research projects (Bechtel, 1986; Bruce et al., 2004; Enengel et al., 2012; Klein, 2012; Loibl, 2006) or on methods and procedures to support transdisciplinary integration (Bammer, 2008; Bergmann et al., 2012; Defila and Di Giulio, 2015; Karl et al., 2007; McDonald et al., 2009; Repko et al., 2012; Vogel et al., 2013). Less attention has been directed, however, toward transdisciplinary integration within large research programs that aim at generating synthesis products tailored to the specific needs of particular target audiences. In this section, we argue that a detailed understanding of synthesis processes and the particular challenges they pose is crucial to support leaders in successfully managing this scientific endeavor. An analytical framework for describing and analyzing transdisciplinary research projects (Enengel et al., 2012) was therefore adapted for two purposes: to compare four thematic synthesis processes across different synthesis stages and to structure the ex-post self-evaluation (Bergmann et al., 2005; Defila and Di Giulio, 1999) of the four processes in order to identify challenges arising at different stages.

2.1. Transdisciplinary research

Many authors (cf. de Jong et al. (2016); Jahn (2008); Klein (2004); Pohl (2008)) trace the origin of the notion of transdisciplinarity back to Erich Jantsch who envisioned "the coordination of activities at *all* levels" of the science, education and innovation systems to "exert a dominant influence on the development of society and its environment" (Jantsch, 1972, pp. 406, 421, emphasis in original). Twenty years later, Mittelstraß (1992) reintroduced the notion in the context of environmental research (Pohl, 2008). In line with Brewer (1999, p. 328), who stated that "the world has problems, but universities have departments", Mittelstraß (1992) called on the scientific community to transcend disciplinary boundaries and re-connect research with real-world problems. According to Mittelstraß (1992, p. 250) "transdisciplinarity refers to knowledge or research that frees itself of its specialized or disciplinary boundaries, that defines and solves its problems independently of disciplines, relating these problems to extra-scientific developments". Transdisciplinarity in this context does not intend to discount specialized and disciplinary knowledge, but to ensure that problems are not perceived one-dimensionally, i.e. from a specialized or disciplinary perspective alone (Mittelstraß, 1992). Two years later, Gibbons (1994) "sparked a lively controversy" (Jahn, 2008) by contrasting a "new mode of knowledge production" (mode 2) with the older, traditional academic mode (mode 1). According to Gibbons (1994, pp. 167–168, emphasis in original), transdisciplinarity refers to "knowledge that emerges from a particular *context of application*" in which the interests of societal actors from different fields and sectors are constitutive for the research process. In this context, transdisciplinary research is a collaborative process that involves different scientific disciplines and societal actors in order to ensure that "scientific knowledge is 'socially robust' and that its production is seen by society to be both transparent and participative" (Gibbons, 1999, p. C81). Based on a literature review of 40 years of transdisciplinarity discourse, Jahn et al. (2012, p. 8) define transdisciplinarity as "a critical and self-reflexive research approach that relates societal with scientific problems; it produces new knowledge by integrating different scientific and extra-scientific insights; its aim is to contribute to both societal and scientific progress; integration is the cognitive operation of establishing a novel, hitherto non-existent connection between the distinct epistemic, social–organizational, and communicative entities that make up the given problem context". The definition emphasizes the importance of integration at epistemic, social-organizational, and communicative levels in order to reach both societal and scientific progress (cf. Klein (2012); Truffer (2007)).

Thus, we apply the term transdisciplinarity to refer to research that (i) addresses societally relevant problems as drivers for posing scientific research questions, (ii) grasps the complexity of the problem by involving a variety of scientific and societal actors and accounting for the diversity of perspectives on the problem, and (iii) generates knowledge that is solution-oriented, socially robust, and transferable to both scientific and societal practice (Lang et al., 2012; Pohl and Hirsch Hadorn, 2007). Based on this understanding, transdisciplinary research can be regarded as a comprehensive, multi-perspective, problem- and solution-oriented approach that transgresses the boundaries both between scientific disciplines and between science and practice (Pohl, 2011). Through transdisciplinary research, "the people who pose the problems, those who are implicated in the problems and those who help deal with them" have the opportunity to engage in a process of mutual learning (Beck, 1986; Pohl and Hirsch Hadorn, 2008, p. 117).

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