JIS Journal of Interdisciplinary Sciences
Volume 9, Issue 2; 14-22
November, 2025. © The Author(s)
ISSN: 2594-3405

The Tension of Claim and Implementation of Inter - Transdisciplinarity using the example of water research

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Abstract: *Inter- and Transdisciplinarity are contested terms. There is a confusing simultaneity in the discourse between the constant claim for Inter- and Transdisciplinarity and an insufficient implementation of it. This study wants to diminish this confusion, by describing a tension in the discourse, which should serve for understanding Inter- and Transdisciplinarity in general and the discussions around it in concrete research contexts, like water research, better. The research of water is an interdisciplinary task and it is crucial to carry out water research in an inter- and transdisciplinary way to be able to tackle modern problems. The scrutiny of the tension helps for better analysis of the discourse around Inter- and Transdisciplinarity and opportunities to speak about it more precisely. This study uses experiences of Water Research and philosophical scrutiny to aim at a differentiation of levels for understanding the tension between the demand and the implementation of Inter- and Transdisciplinarity. Not enough attention is given to the concrete problems of inter- and transdisciplinary water research. Future water management needs to realize the importance of the cross-cutting issues regarding e.g. social or ethical issues. Future water research could also benefit from overcoming technology fixation. Problems of water (supply) in the future cannot be solved by the same methods as in the past.*

Keywords: Interdisciplinarity; transdisciplinarity; water research; tension; discourse

Introduction

Much talked about, never achieved? Inter- and Transdisciplinarity (ITD) in water research

Water is an increasingly scarce resource. Water research therefore has many different, for example ethical and social aspects, which have not, in light of the technology-fixation of recent decades, received sufficient attention. The growing awareness regarding the consequences of the climate crisis is additionally ensuring increased attention on the water sector, also in Germany (Brasseur and Jacob, 2023; Carbon, 2024). Meanwhile, it has long been clear to researchers: the topic of water and water supply has so many different and complex dimensions

that scientific research on this topic should be fundamentally inter- and transdisciplinary (Pfriem, 1996; Ziegler and Groenfeldt, 2017; Sultana, 2018; Defila and Di Giulio, 2019). This study wants to analyse the discourse on the difficulties and opportunities that arise for inter- and transdisciplinary research regarding water to better understand why there is this confusing simultaneity between the constant claim for ITD and the insufficient implementation of it (Lund, 2015; Barthel and Seidl, 2017). Interdisciplinarity and Transdisciplinarity here is understood like e.g. Julie Thompson Klein elaborated it in the "Oxford Handbook Of Interdisciplinarity" (Frodeman, 2017). Interdisciplinary research actions are characterized by "interacting, integrating, linking, blending, …" and Transdisciplinarity is concerned with "transgressing, transforming, …". Both terms, regarding water research, hint at the practical problem, that there is a need for more connectivity between disciplines (Interdisciplinarity) as well as the need to carry out feasible solutions for society (Transdisciplinarity).

When analysing the topic of water research, one thing quickly becomes apparent, the sheer number of different dimensions in dealing with and considering the problems (Dixon and Sharp, 2007; Eibl et al., 2008; Sultana, 2018) means that one perspective alone, such as the focus on technical developments in the water supply system or a narrowing down to supply analyses, does not provide an adequate and sufficient basis to address these problems. Furthermore, social diversity and the question who of will be affected by what measures should be taken into account: Groups and actors that play a role and bear responsibility with regard to water (supply) are at least the following: water supply companies, local political actors (but also those at the state and federal level), technical development companies, "the population", sewage treatment plants, nature conservation organizations, water transport industry, and many more.

Compiling this list demonstrates that the system of water supply is highly complex and dependent on various sociocultural and biophysical factors (Hiwasaki and Arico, 2007) and that the management of this system requires a heightened degree of sensibility towards the different interests that form within it. Additionally, this ensures that no single academic subject will be capable of solving the challenges facing water research. Consequently, it is not surprising that those in positions of responsibility and those funding research projects are calling for the adoption of inter- and transdisciplinary approaches. By speaking about this, two different levels of discourse get confused. This is, on the one hand, the general level of discourse about ITD and on the other hand the concrete, project-specific, level of discourse about, which both will be outlined below. This study argues that these two levels should be differentiated and that this helps to understand the problem of knowledge integration in water research as well as the complains about missing or deficient implementation of ITD aspects.

The two levels of the discourse

Because of this tension, it is important to distinguish between two levels of the discourse(s) around the topic of Inter- and Transdisciplinarity (ITD).

One level is the general discourse and the analysis of ITD, independent of a specific research project or subject. Questions and issues that belong to this level of discourse would include:

a) Where do demands for ITD come from? What changes in the scientific landscape have prompted these increased demands, including in water research?
b) What needs can ITD research meet and why?
c) Is ITD as a fundamental requirement for high-quality scientific work?
d) What epistemic problems generally arise in ITD work?
e) What conclusions that are relevant for water supply research can be drawn from this?

I will refer to this level as the "general level".

A second level of the discourse should be distinguished from the first. Here, questions and topics arise such as:

a) What are (concrete) methods for the demanded ITD projects?
b) How can ethical or social science aspects be integrated into technology research, for example in regard to new actuators and sensors in water distribution systems?
c) What are tools for testing and development of interdisciplinary work and social implications.
d) How should tasks and teams be set up in concrete projects? What is the organisational structure and are competencies be distributed?
e) What is the best way to set up interdisciplinary consortia for water supply research?

I will refer to this level as the "concrete" or "project-specific level". These lists provide an overview about the different aspects of the two different levels of the ITD discourse. The aspects cannot be discussed in detail here. But referring to the tension of the constant claim and the deficient implementation in the ITD discourse, it becomes clear that widespread claims for more ITD are taken on the general level, while implementations (deficient or not) are taken place on the concrete level.

Water research is an illustrative example for the discourse at both levels: At the general level it is, for example, about addressing the various possible (social) consequences of measures of further development within the water system and the desirability of the inclusion of various disciplines into the research process: ((Bio-) chemistry for water quality, engineering for technical developments, sociology for urban development, environmental engineering for long-term developments and sustainability, ethics for moral implications, etc.).

At the concrete level, concerning the ITD aspects of water research, it is for example, about how ethical considerations could be applied to the just distribution of water in a mathematical optimisation model which strives to carry out the technically feasible weighing of supply areas. This raises questions such as: How can qualitative considerations be translated into calculations within the model? According to which parameters can the relevance of a water supply area in this specific geographic region be determined? It is not difficult to see that this requires a

certain amount of translation of specific areas of knowledge, which is not a trivial task. To illustrate how difficult this discussion is, it is worth noting that these necessary translation efforts would take a different form in a different social and/or scientific context (Strübing, 2004).

It must be emphasised that the distinction between these levels is an analytical and/or archetypical differentiation which allows for better and more precise discussion. An overlap or a smooth transition between the levels in the actual research process is assumed. For the purposes of this study, the distinction between the levels serves to better understand the previously discussed tension: The abstract demand for ITD always takes place at the general level, the implementation at the concrete level. This is the reason why the topic seems, on the one hand, so outdated and worn out and on the other hand so topical and important. This also applies to ITD in water research, where its desirability appears self-evident at the general level but always produces new constellations at the concrete level, which must be dealt with in a (project-) specific way.

The tension as a whole is therefore one explanation as to why the demand for ITD remains highly relevant after so many years, even though a lot of work has already been done in this area (Gräfrath et al., 1991; Mittelstraß, 2005; Frodeman, 2017). Tellingly, the conference of the ITD society in Utrecht in 2024 was entitled “ITD beyond buzz words”. On one hand, this indicated the buzz word character of ITD while, on the other hand, making clear that the aim is to go beyond. This also shows what the current research on ITD focuses on: There is a strong focus on concrete methods and the further development of the “toolbox” in order to guarantee that the necessary requirements for successful ITD work can be met in as many contexts as possible. Carolin Seiferth reported on how the problem of water scarcity is being researched on Öland (Seiferth et al., 2024). She pointed out that problems related to water are often addressed on a single-discipline basis while inter-and transdisciplinary aspects do not receive sufficient attention. This hinders both the acceptance of research results and long-term research prospects. If the many social and ethical interconnections, taking into account technological development, are not adequately examined, this damages the utility of research as a whole and therefore potentials to e.g. increase resilience of the water sector.

The tension is inherent in almost every discussion on the topic, except that one is always at different points in the research process, which can create the impression that ITD is all about hollow buzz words, or else that one already has concrete results in hand, which, despite having incorporated and absorbed many ITD influences, may no longer be recognisable as such. Therefore, the examination of ITD is fundamentally deficient: Before the process it now often consists of overused or empty words, during the process there are concrete methods, and after the process concrete results, in which the incorporated demands may no longer be recognisable. Many get the impression that everything; or at least enough; has already been said at the theoretical, general level and it is then only a matter of implementation in the concrete research project. This differentiation is also a basis for arguing for a more empirical approach to theory of science (Jungert et al., 2013). It should be discussed whether it would be a beneficial to the presentation of research results to retrospectively make ITD aspects explicitly recognisable.

The tension in the discourse regarding Inter- and Transdisciplinarity

This section addresses basic problems of Inter- and Transdisciplinarity (ITD), to then work out how these challenges (and chances) relate to water research. There is a discrepancy between the demand for more Inter- and Transdisciplinarity and the realisation of that demand (Lund, 2015; Barthel and Seidl, 2017). In view of the complexity of the practical fields to be addressed, the fulfilment of ITD-elements either falls short or takes on a specificity that hinders transferability to different environments. This, in turn, leads to the demand of Inter- and Transdisciplinarity within another research question, as it must be examined "anew" because the specific execution does not work in different contexts. Regarding the development of the water supply, this concerns, for example, the geographical limitations of measures. Due to, alternating legal frameworks, other geographical settings or different technological requirements, solutions which worked in one region (e.g., South America or Africa) cannot be transferred one-to-one to other regions, for example in Central Europe. This is not the only but a key reason why the demand for ITD in water supply research will remain relevant and its implementation precarious (Berscheid, 2019). This tension creates a discourse between repeated demands and (not) delivered or only highly specific implementation.

This area of conflict is crucial: There are different reasons why Inter- and Transdisciplinarity were decried as buzzwords already in the 80s (Marquard, 1986) but are still demanded today. However, this dynamic is a decisive reason for addressing this problem from a metatheoretical perspective. On the one hand, many are tired of hearing the continuously repeated calls for Inter- and Transdisciplinarity within research, as one gets the impression that these are merely empty phrases, used by "grandstanders" to get their hands on research funding (Hanschitz, 2009). On the other hand, these demands would not exist if satisfactory, sustainable implementation had already been achieved.

To understand this as a model, I now suggest the following tension to approach the problem: To begin with, the demand for ITD within the scientific process is abstract – how could it not be, after all, it cannot, as a demand for a "between" (inter-) or an "over" (trans-), rely on existing expertise or claim something from the perspective of a particular discipline. If we now achieve a successful implementation within a particular research context, it is necessarily project-specific which, in turn, means that results are scarcely transferable (Strübing, 2004; Berscheid, 2019). This gets strengthened, if we take into account that transdisciplinary research produces "experiential knowledge" (Hanschitz, 2009). Therefore, in view of the world's increasing complexity and interconnectedness (an interconnectedness for which water is probably the best example) demands for aspects of ITD will not subside but rather remain a constitutive claim of the research landscape.

Potentials of understanding inter- and transdisciplinary perspectives in water research

The goal of discussing ITD in the context of the further development of water research is not to follow some guideline for inter- and transdisciplinary research or to adjust the research

process of a project in a certain way. Instead, it is to show that measures taken to develop the water supply system have such far-reaching consequences that are initially impossible to predict and assess that it becomes clear, that the perspective of any single research discipline must fall short when trying to tackle the resulting problems adequately. At the same time, specialist perspectives lose none of their relevance for the overall research process! This is important to emphasise: ITD in no way renders disciplinary expertise obsolete – one could even say that it makes it even more important (Mittelstraß, 2003). The problem is that ITD has no substance at the *general level* – ITD is not a subject of its own (yet). This results in the difficult situation that, on the one hand, someone without expertise can hardly contribute meaningfully to interdisciplinary research while, on the other hand, deep subject knowledge often leads to a lack of the kind of openness that is required for ITD work at the *concrete level*. This once again highlights the difficulty that lies in this tension, which is why the discussions around ITD will not subside.

Discussion

The aim of this study was to emphasise that water research, especially under modern, crisis-prone conditions, is so complex that inter- and transdisciplinary research perspectives are increasingly required to deliver adequate results. Therefore an outline of a tension for understanding the discourse about ITD in water research was delivered, which provided a distinction between two levels, the general level of discourse on a concrete project-specific one. These two levels often get confused in discussions, which leads to misunderstandings as well as different conceptions of the term of Inter-and Transdisciplinarity.

Firstly, this has served to once again address fundamental problems of ITD research while secondly keeping the research disciplines (engineering, chemistry, business administration, sociology, law, ethics …) involved in water research alert to the emerging issues. This is a balancing act; it requires the research discipline-specific perspectives to address the arising questions in the best possible way and according to the latest state of research. However, there is also a need for approaches that transcend the boundaries of disciplines and consider social consequences as well as cross-cutting issues of the disciplines involved. A higher level of *knowledge integration* is needed. Therefore, future research should examine how different academic disciplines are referring differently to water research and what challenges does this entail. To enrichen the ITD discourse on the general level we need to better understand in which different "worlds" scientist live, due to their discipline. Methods that stem from the Theory of Science or Sociology of Knowledge could be promising here to grasp the "action grammar" and implicit values, which are inherent in the disciplines.

This is also becoming increasingly important as a perspective because specialised researchers need more and more time to keep up with the developments in their own field. Additionally, the susceptibility of the modern water supply system to crises has led to increased attention being paid to disaster events. Coping with these disasters (in the context of water these are mainly droughts and floods) requires in particular a higher degree of interdisciplinary and political connectedness, as they do not stop at the boundaries of competencies or disciplines.

The requirements for the further development of the water sector therefore give rise to social challenges which in turn send requirements back to water research. These interactions have not yet been sufficiently understood, which creates a vacuum to be filled by scientific and social research and design. The following questions can be used to exemplify this more concretely: What technical restrictions of an amount of water are possible and what ethical problems do they entail? How can responsibilities in disaster situations be allocated even across jurisdictional boundaries in order to allow for an adequate response? What legal restrictions apply to water supply companies and how is this assessed from a business perspective? Is it even possible to fairly distribute a reduced amount of water? All of these questions highlight the social, ethical, and legal dimensions of water research. Those can be tackled more efficiently, if we better understand the interdisciplinary pitfalls of the research disciplines involved.

Conclusion

A lot of work remains to be done in the context of researching water and its inter- and transdisciplinary aspects (with considering knowledge integration). As described at the beginning, a technology-fixated perspective will, in the future, no longer be able to adequately deal with the complexity of the relevant factors in the continued development of water supply. More institutional arrangements are needed to deal with the cross-cutting issues, the social consequences, and the ethical implications of measures in the water sector. This calls for different kinds of expertise, the cooperation of which requires increased coordination. The work of heterogenous research collectives, whose results are meant to be empirically reflected, is discussed under the terms of Inter- and Transdisciplinarity. It was demonstrated that the discourse on ITD can be divided into two levels: a general level, at which the necessity of ITD work is expressed due to the developments in the scientific system, and a concrete level, which addresses the work emerging in the context of specific topics. Both levels exist simultaneously and are often blended together, which leads to misunderstandings and confusion. On the general level, the demand for ITD is constantly repeated, which causes many to see it as nothing more than empty phrases. To experience concrete results and effects of ITD research, one must examine specific results. It has been argued that this tension of demand and specific implementation must be distinguished to adequately grasp the problem of the discourse around ITD. This realisation should provide new impulses for the discussion around the topics of ITD, because it allows to speak more precisely about temporal structure of ITD-projects and the discourse around it. At the general level, it is becoming increasingly clear that the research of water should be inter- and transdisciplinary because, on the one hand this type of research produces greater awareness of social and ethical consequences (calls for Interdisciplinarity) and on the other hand there is the hope that by including societal stakeholders practical benefits can be derived from the research (calls for Transdisciplinarity). Both calls are abstract before there is concrete research. That research is then carried out on the concrete level, if a research project develops and establishes corresponding techniques or concepts.

Insights from this article on the topic of the water sector lie in the better deliberation of these facts and problems, which could foster more comprehensive, efficient, and sustainable

research. One last remark on water and resource use: Due to climate change, even in water-rich countries, it will no longer be so much about distributing a hypothetically unlimited amount of water with increasingly efficient and complex technologies but rather about distributing (or having to distribute) water during times of drought or limiting/preventing damage from too much water during floods. Therefore, the topics discussed here could also be linked to security and resilience discourses.

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Paper Received February 25, 2025; Accepted August 23 2025; Published November 2, 2025