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Transdisciplinary sustainability research. Procedural perspectives and professional cooperation

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ABSTRACT

This article draws on social theory to advance conceptualization and methodology in transdisciplinary research. It starts with a short introduction to the state of debate on transdisciplinarity and its challenges and proposes adopting a procedural perspective on sustainability. It argues that sustainable development, understood as a learning process, is the subject matter for which transdisciplinary research provides the means. This is followed by sociological reflections on the main challenge of transdisciplinary research: the collaboration between scholars and non-academics. Such collaboration points to an ambivalence in conceptualizations of transdisciplinarity, as transdisciplinary research involves scientific activity while at the same time claiming to essentially be an activity beyond the sciences, namely, a joint activity of scientists and non-academics. This has led to several inconsistencies in the debates. Achieving greater consistency requires acknowledging the specific 'scientific bias' inherent in the concepts in the first place: the debate on transdisciplinary research is basically scientific self-reflection about the role of scholars in collaborative activities with non-academics. As a practical answer, professionalization is recommended. The subsequent section introduces a procedural approach to learning processes in transdisciplinary sustainability research. A general model of procedures promises conceptual progress by providing a methodological foundation for sustainable learning in science–practice cooperation as well as formal criteria for evaluating such learning. Finally, transdisciplinary research is defined as a specific kind of applied science.

1. Introduction

Transdisciplinary research (TDR) has reached an interesting level of reflection and practice. After several decades of conceptual and methodical developments as well as its increased institutionalization, it seems to have become an established part of the activities in society that are concerned with — but not limited to — sustainability issues. All its progress notwithstanding, what is often missing in TDR and for underpinning its transformative aspirations is its appropriate grounding in social theory (Bührmann and Franke, 2020; Krohn et al., 2017; Lawrence et al., 2022; Meisch, 2020). This is where sociological reflection comes into play. Sociology provides one area of scientific expertise among others, yet its specific expertise pertains to its ability to elucidate the different perspectives, positions, and dynamics in society and their interrelationships (Lorenz, 2013). What sociology can contribute to this debate is thus its proficiency in analyzing transdisciplinarity as a societal phenomenon, the role of transdisciplinarity in society, and how it fits into the social order — or how it can be expected to change the social order as it becomes established. Sociological analysis can reveal new social options for sustainability that open up through transdisciplinarity or possible limits to these options and, in so doing, provide criteria for what 'good' transdisciplinarity might look like.

Starting from these considerations, this article will briefly introduce the state of TDR, outline the debates on its ambitions and challenges, particularly in the field of sustainability research, and provide a corresponding view of procedural sustainability (2). It will reflect on these observations and challenges — particularly on the challenge posed by collaboration between academics and non-academics — and suggest a shift in perspective: whereas the debate on transdisciplinarity often stresses what those who are supposed to collaborate have in common, what unifies them, the sociological focus here is on *the differences that collaborative activities build upon*; in terms of practice this requires professionalization (3). On this basis, the paper will suggest a procedural approach with the potential to provide a conception of – collaborative – transdisciplinary sustainability research that is in line with sociological insights into societal developments (4).

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2. State of the art of TDR, its challenges, and sustainable development

First of all, transdisciplinarity has been regarded as a research principle (Mittelstraß, 2011) or an overarching theoretical paradigm (Luhmann, 1990) that adopts a perspective extending beyond yet comprising individual disciplines. Following the systematics of theories of modernization proposed by van der Loo and van Reijen (van der Loo and van Reijen, 1997), such paradigmatic generalizations can be expected as typical developments in processes of rationalization: while modern societies increasingly specialize their expert knowledge, this also regularly comes with new integrations of such fields of knowledge at higher levels of abstraction. The second idea of TDR refers to the collaboration of scholars with actors from non-scientific spheres of society such as politics, the economy, the arts, religion, or civil society, who then work together on societal issues. This second meaning of transdisciplinarity is the more common one — and the more interesting one from a sociological point of view because it seems to challenge the sociological conceptions of science as a differentiated social field or system in society. Also, it may be regarded as the more general and inclusive notion because it — at least implicitly — needs to provide common ground not only for connections between scientific and non-scientific activities but for different scientific disciplines as well. This second understanding of TDR will be the focal point of this article, and it is this understanding for which the procedural perspective outlined in section 4 intends to offer an appropriate conception.

Reflection on the relationship of scholarship and non-academic activities or knowledge has accompanied sociology from its beginnings. (e.g., Habermas, 1974; Weber, 1949) This issue has been on the agenda of current controversial debates in sociology as well, for instance, of those revolving around the possibilities of a 'public sociology' (Burawoy, 2005). Other conceptions have been debated in and outside sociology and sometimes independently of, sometimes as a part or a specific means of transformative and TD research. (e.g., Hecker et al., 2018; Luque and Foraster, 2020; van Rießen and Bleck, 2019; Schäpke et al., 2018; Vohland et al., 2021) Such a more comprehensive endeavor would by far exceed what is possible here, so that I will limit myself to taking a closer look at the debates on transdisciplinarity only.[1]

Current TDR might be characterized as being in a stage of summarizing and reflecting on the results of its development so far, looking for chances for new syntheses. Several overviews and review articles (Bernstein, 2015; Brandt et al., 2013; Bührmann and Franke, 2018; Bührmann and Franke, 2020; Grunwald et al., 2020; Jahn et al., 2012; Klein, 2014; Lang et al., 2012; Lawrence et al., 2022) as well as handbooks (Bergmann et al., 2012; Defila and Di Giulio, 2018; Defila and Di Giulio, 2019; Hirsch Hadorn et al., 2008) have documented the state of the art and show the broadly developed field characterized by a variety of different approaches, practices, and conceptions.

Sociological reflection to advance the conceptualization of TDR should start with the problems identified in the TD debates. The latest overview is provided by Lawrence et al. (Lawrence et al., 2022), who differentiate three main sets of problems and challenges that they observe to be the most important and frequently mentioned ones: the question of how researchers and non-academic actors can appropriately collaborate, the normativity of TDR goals that are not limited to scientific knowledge but include transformative sustainability goals, and the evaluation of TDR projects' societal impacts. All of these points also refer to the question of what issues TDR actually deals with or for what kind of problems we need it (Lawrence et al., 2022). And all of these challenges finally call for a more comprehensive conception of TDR to achieve – referring to Thomas Kuhn – a new scientific paradigm of TDR (Lawrence et al., 2022). The quest for a better conceptualization corresponds with the need for its better grounding in social theory, as other authors have postulated as well (Bührmann and Franke, 2020; Krohn et al., 2017; Meisch, 2020).

For the purpose of this article, two main aspects are the most relevant and inherently involve the other ones. The first aspect is appropriate collaboration between researchers and non-academics; depending on this collaboration the joint compliance with normative rules as well as the effective pursuit of common goals with relevant impact will be possible or not. The second aspect is a suitable fit between the concept of TDR underlying such collaboration and an understanding of the kind of problems to be investigated (e.g., wicked problems or sustainable development, see below). Only when such a fit is given will the concept of TDR prove functionally effective and normatively binding.

Let us begin the discussion with the second point and return to the first one in section (3). Similar to many other authors, Lawrence et al. (Lawrence et al., 2022) introduce TDR as intending to "support sustainability-oriented transformations and address wicked problems and other complex societal challenges." (Lawrence et al., 2022) They describe such 'wicked problems' (Bernstein, 2015) as being "so complex and interconnected that they cannot really be *solved*, rather only *resolved* in multiple ways, with differing costs and benefits for those involved." (Lawrence et al., 2022) Wicked problems have neither a final solution nor clear-cut criteria to determine what a solution would be. They do not even have an ultimate definition.

There can be no doubt that there is much value in discussing the meaning and conception of TDR as a means of addressing the kind of problems to be investigated. Yet my suggestion here is to choose an approach other than that of 'wicked problems,' namely, one that starts with a specific determination of sustainability or sustainable development. This does not contradict the 'wicked problems' approach but shifts the focus from the characteristics of a specific kind of problem to the way of dealing with these problems. Such a shift is enabled by applying the idea of procedural sustainability (Grunwald and Kopfmüller, 2006; Lorenz, 2014; Slater and Robinson, 2020). This perspective stresses the meaning of sustainable *development* as an ongoing process, which is similar to 'wicked problems' in that it too cannot be defined once and for all. Procedural conceptions of sustainable development understand it as an open learning process instead of applying substantial social and ecological criteria; step by step, the procedure approaches sustainability objectives, which are not completely known in the beginning but are increasingly elaborated and adjusted in the process.

This conception of sustainable development has several implications (Lorenz, 2014). First of all, sustainable development as an ongoing process is about an uncertain future. In principle, there is no way to know the future in advance, and this is why learning processes are necessary for such developments. Second, sustainable development is not only about surprises in the unknown future but also about preferred developments. A sustainable society requires avoiding unsustainable paths or options, and this raises normative questions of what is desired or what criteria to apply. Third, ever since the Brundtland report (Brundtland, 1987), sustainability conceptions have called for an integrated view of social and environmental aspects. Sustainable development means that society should flourish without destroying environmental living conditions or even allow for a good life of human and non-human beings. The fact that social and environmental concerns are typically raised by a multiplicity of actors implies the need for integrating the diversity of social perspectives and positions.

[1] The most popular 'freedom of science' debate in the German sustainability discourse — with strong references to sociological theory — was the controversy between the head of the German Research Foundation (DFG) Peter Strohschneider and the head of the Wuppertal Institute Uwe Schneidewind (Schneidewind and Singer-Brodowski, 2013; Strohschneider, 2014).

This procedural idea of sustainability entails several requirements for TDR. It needs to be able to investigate both open and intentionally directed developments. And it has to be able to integrate different perspectives and actors. The next sections will show that the procedural conception of TDR meets these requirements. Understanding sustainability and – correspondingly – TDR in such a procedural way makes this a suitable fit, i.e., TDR (organized as a learning process) can provide the means for researching and facilitating sustainable development (as a learning process).

3. Reflections on the collaboration of diverse actors

Aside from the aforementioned suitable fit between the conception of TDR and the understanding of the subject matter to be investigated, the other crucial question for TDR mentioned in section 2 revolves around the possibility of collaboration between scientific researchers and non-academics in the first place. My starting point for discussing this challenge is a specific bias or primacy implied in the discussion of transdisciplinarity, namely, the primacy of science (3.1). This will be followed by suggesting a perspective on TDR on the basis of the sociological theory of differentiation, namely, one that acknowledges the specific and partial primacy of science (3.2). Practical advicse for collaboration of diverse actors can be found in professionality (3.3).

3.1. The scientific bias in TDR

One of the main characteristics of TDR is cooperation between scientists and non-academics. However, the term 'TDR' alone obviously indicates that its point of reference is the (scientific) *disciplines* and that it is primarily about *research* or focuses on cooperation and objectives *from a scientific perspective*. This tension of TDR between symmetry and asymmetry, between being both a scientific activity and an activity beyond science, between scientists and non-academics, causes several inconsistencies in the debate.[2] I will demonstrate this finding using examples from the most developed TDR conceptions.[3]

Lang et al. (Lang et al., 2012) explicitly state that "transdisciplinary research in its strong version goes beyond the 'primacy of science' as well as the 'primacy of practice,'" but they nevertheless "apply a broad definition of transdisciplinarity that reads as follows: Transdisciplinarity is a reflexive, integrative, method-driven *scientific principle* aiming at the solution or transition of social problems and concurrently of related scientific problems by differentiating and integrating knowledge from various scientific and societal bodies of knowledge." [25; my italics, S.L.] The question here is how a 'scientific principle' could integrate scientific and non-scientific activities without acknowledging the 'primacy of science.' As a consequence, similar problems appear in other parts of their article and descriptions of TDR processes and tasks. For example, while the authors insist on "a truly mutual and joint problem-framing process," (Lang et al., 2012) they self-evidently assume that transdisciplinary processes are done by "a collaborative *research team*" and that the "design principles" they elaborate in the article should "facilitate an effective and efficient *research process for all actors* involved." [25, my italics, S.L.][4]

Whereas articles about TDR typically claim equal participation of scientists and non-academics in one way or another, they also typically introduce TDR as an essentially scientific activity. This is actually displayed in idealized TDR models by Lang et al. (Lang et al., 2012) and Jahn et al. (Jahn et al., 2012), where 'scientific practice' is juxtaposed with all other 'societal practice(s)' and thus assigned a prominent position among these. The priority of the sciences is likewise obvious in many determinations of transdisciplinarity and not at least in the fact that the conceptual discussion takes place in scientific fora and publications. Moreover, several authors confirm that TDR projects are mostly initiated by the sciences (Grunwald et al., 2020; Lang et al., 2012).[5]

In a symmetric process, transdisciplinarity would mean that collaboration takes place among different actors, who may participate or not depending on the problem at stake. However, in the reality of TDR, there is one actor who is always involved and for whom non-participation is not an option: scientists. In their comparative discussion of different types of TDR projects, for example, Grunwald et al. (Grunwald et al., 2020) explicitly exclude initiatives without research activities. TDR would not be TDR without science. Any other group, by contrast, is dispensable.

The purported participation on an equal footing not only produces inconsistencies in the debate but can also cause problems in the collaboration because it suggests common ground that is unlikely to exist, for instance, that the common purpose of the endeavor is *research* and participation in this research is *the shared focus of all participants*. Reports of non-academics voicing disappointment and complaints attest to disparity among the participants (e.g., Grunwald et al., 2020; Lang et al., 2012). At least one of the problems obviously is that TDR conceptions fail to sufficiently consider the relative independence of the collaborating partners — that is, their different motives and interests — as a basis of equality.

Improving cooperation and encouraging more realistic expectations — or guarding against disappointment — among TDR participants requires more broadly reflecting on what collaboration means with regard to heterogenous social actors. Scholz and Steiner point in this direction when they characterize collaboration between science and practice for "*sustainability learning*" (Scholz and Steiner, 2015a) as being crucial for TDR, although it is not the key point of their conceptualization.

3.2. Improving collaboration by acknowledging the scientific focus of TDR debates

Serious questions have been raised about the role of the sciences in TDR collaboration. However, shifting the perspective to the role of *difference* in such collaboration will immediately provide some clarification. The suggestion here is to explicitly accept the research focus in the TDR debate as the one to be prioritized — as the 'legitimate bias' of such debates. Conceptions of TDR are attempts to integrate science and practice, by scientists for scientists. Acknowledging that the conceptual discussion is a *scientific* one and reflecting on the role of scientists and research in collaborative activities with non-scientists can lead to a more appropriate understanding of the nature of this cooperation so as to

[2] Moreover, such inconsistencies are both concealed and fostered by the less specific connotations of 'research' in TDR. 'Science' typically pertains to 'pure' science—that is, that which takes place in the system of science—whereas 'research' is often understood as another term for 'applied science.' 'Research' has a broader meaning because it refers to objectives beyond 'pure' science and is also a common term used in everyday life with an even broader meaning. This results in argumentative confusion as the following discussions in this article show. Use of the term 'research' points to both the explicitly scientific aspirations of TDR—that is, to academic inter/disciplinary standards—and its applied objectives of successful problem-solving.

[3] I mainly refer to the conceptions by Lang et al. (Lang et al., 2012) and Jahn et al. (Jahn et al., 2012) which integrate several conceptual developments provided by other authors.

[4] A similar model with shared origins is presented in Jahn et al. (Jahn et al., 2012). They define transdisciplinarity analogously as a "*research* approach" which nevertheless should "enable mutual learning processes between science and society," while "integration" is mainly understood as a "*cognitive* challenge of the *research* process." [23; my italics, S.L.] And the second phase of this model denotes such an integration between science and society as "interdisciplinary integration" and a "science-driven process of generating the new knowledge" (Jahn et al., 2012).

[5] A detailed discussion of the relationships between scientists or scientific institutions and research funding programs could provide a more differentiated answer to the question of who the main initiators of TDR are.

advance our conceptions of TDR.

Two corresponding sociological ideas can support this effort. One is the benefits of diversity for collaboration (a) and the other the functional differentiation of society (b).

a) The first idea can be promoted from two perspectives. Maasen (Maasen, 2019) criticizes the "strong unifying ambitions" that she diagnoses in transdisciplinary debates. Instead, she argues, collaboration is interesting and useful precisely *because of* the *differences* between participants' positions, perspectives, or values – "transdisciplinarity is all about working with differences and boundaries between disciplines, stakeholders, organizations, and values. The ultimate trick for collaboration to happen is to engineer socio-intellectual spaces that allow for trading differences, and dissent even, in a productive way." As a consequence, she relies on science and technology studies (STS) in particular when recommending several applicable concepts for an improved collaborative practice. These concepts are '"boundary objects,' 'trading zones', 'interactional expertise,' and 'community of practice.'"

The second perspective draws on pragmatist thinking and is at the center of the sociological work by Richard Sennett. It is elaborated in his book on cooperation in particular (Sennett, 2012) but already present in his early work on public life (Sennett, 1974) and guides his current thinking about urban planning and dwelling (Sennett, 2018). According to Sennett, good workshop collaboration as well as democratic life and the urban public rely on a culture of diversity and on the differences among the participants instead of on collective values or identities, shared feelings or abstract principles. The social ties are bound by collaboration that lets the participants maintain their social distance instead of trying to make them 'the same.' "Accepting the otherness of the other is seen as a prerequisite for mutual learning," as Scholz and Steiner (Scholz and Steiner, 2015a) put it. This idea of keeping one's distance as an important basis of good collaboration is even more true in professional constellations and will be revisited in the next section (3.3).

b) What about societal differentiation? The TDR debate tends to argue against strong social differentiation and stresses joint activities, common ambitions, and shared normative sustainability objectives (Maasen, 2019). In sociology, the idea of socially differentiated societies has been spelled out in detail in functionalist systems theory (Luhmann, 1995; Luhmann, 2012; Luhmann, 2013) yet goes back to early sociologists like Emile Durkheim and Max Weber and is one of the fundamental assumptions underpinning sociology's understanding of societal development. What we should bear in mind here is that functional differentiation of society is not only about institutionalized structures but also involves values. Historically, people have fought for several freedoms, not only for the freedom of science but for the freedom of speech and public opinion, for democratic participation, for free religious practice, the freedom of entrepreneurship, and an independent legal system as well as the independence of the arts. All of these freedoms have become highly valued, although none of them can claim to be absolute; all of them need to be put in context or balanced in relation to the others at one point or another. As a consequence, scientific research and knowledge is of primary interest in the sciences but cannot be expected to be of similar significance in other contexts. Assuming "a collaborative research team" or a "research process for all actors involved" in TDR (Lang et al., 2012) is a plausible interpretation of the transdisciplinary process only from a scientific point of view. It implicates the idea that non-academic partners would be most respected as equals when they are addressed as being the same as 'we' — the scientists — are. However, good collaborative TD practice should not assume scientists' interests to also be of primary relevance to all other participants. The non-academic collaborators are not most acknowledged when they are addressed as (quasi-) researchers but when their specific expertise is appreciated. A politician might be a curious person who is interested, or even talented, in research, but as a professional politician that person is first and foremost an expert in collective decision-making. Artists might be individually interested in scientific findings, but in the role of an artist they will engage with such knowledge to 'translate' it into an artistic expression — and should be appreciated for their ability to do so. In other words, conceptions of TDR should work with such differentiations and accept that the scientific profession is one among others and abstain from expecting that non-academics share the same interests. Seen from this angle, the clarification of TDR conceptions is particularly of scientific interest and serves the self-reflection of participating scientists.

All of the participants in a transdisciplinary collaboration process are interested in *problem solving*, but the definition of the problem to be solved depends on their perspective, which derives from their social position and affiliation. Even if there is an abstract shared interest or objective — let's say to initiate a process of sustainable urban development — all of the participants will 'translate' this objective into specific ones. Better collaboration would not mean to build a *research* team consisting of all participants but to build a *collaborative* team consisting of scientists, politicians, artists, and so on. All the non-academics are typically interested in collaboration and in the scientific knowledge provided therein *to the extent that it is of use to them for solving their problems or their particular part of the shared problem*, whereas the scientists are primarily interested in developing their scientific agenda and discovering new scientific knowledge. Seen from this perspective, the process of transdisciplinary collaboration between scientists and non-academics can be characterized by ongoing mutual inspiration and 'translations.' The work by Maasen or Sennett can provide appropriate means for that (see above, 3.2.a).

Lang et al. (Lang et al., 2012) even model the task of (re-)integrating the results into the sciences as well as societal practices; this acknowledges that there are social fields, interests, and objectives other than scientific ones that merit being considered in their own right. However, this acknowledgment remains part of the inconsistencies in the TDR debates referred to in section 3.1. Improving the conceptions of TDR will depend on explicitly clarifying the *specific* role and perspective of science in TDR, including its particular interest in developing such conceptions. Such an awareness of one's own role is a precondition for conceptualizing it more accurately and playing it appropriately. This sheds a different light on complaints by scientists about partners who are not sufficiently dedicated to scientific activities. (e.g., Grunwald et al., 2020; Lang et al., 2012) Of course, pursuing one's own agenda at the expense of one's partners is always a risk in cooperation. Yet being dedicated to non-academic agendas is also quite 'normal,' can be expected, and is even worthy of being acknowledged because it is the strength of cooperation that the *different* actors contribute according to what *they* do well. Scientists may well be good researchers but are most likely not the better politicians, business people, or activists and vice versa.

Moreover, scientists are just as prone to questioning their non-academic partners when their scientific interests are at stake. This is not only a conceptual issue or one of reflection but also a matter of practical interests, particularly about the funding of projects, institutions, and scientists. That said, good cooperation thrives on knowing one's limits and being able to restrict one's own activities accordingly. Scientific reflection on one's "own role and responsibility in societal innovation processes" is explicitly part of what Jahn (Jahn, 2016) calls critical transdisciplinarity, which can also be "critical of its own results."

3.3. *Professionalization as a practical way of good collaboration*

Scientific research is a distinct social activity that, even in cooperative settings or projects, follows its own rules and aspirations. As a consequence, an appropriate understanding of collaboration should not only stress the need for the participants to engage in joint activity but also acknowledge that they need to maintain a distance in the process. Such an understanding is implicated when Grunwald et al. (Grunwald et al., 2020) compare TDR with other social practices, particularly with technological (engineers), medical (physicians/therapists), and legal

(lawyers) practices. According to the authors, these practices have in common with TDR that they rely on scientific training and 'apply' it to everyday life or real-world issues. And this 'application' is not just deduction from expert knowledge; rather this expertise has to be creatively adapted to the individual case by collaborating with the respective clients. No patient is like any other, and each legal case has its particularities. However, what the authors relegate to a footnote should be moved to the center of the debate and called by its name: professionalization.

Professionality as practiced in therapy or legal advocacy, for example, is in line with a conception of collaboration based on differentiated social positions. In such constellations, professionals and clients deal with practical problems on a cooperative basis by applying expert knowledge and skills to the individual case and assuming different and distant roles — the therapist should not fall in love with the client, for instance.

Obviously, the setting in TDR is not exactly the same because one cannot always differentiate a professional–client constellation here. First and foremost, it is more precisely described as collaboration among different professionals. The comparison is nevertheless helpful for learning more about how professionality works and how it is ensured in the collaborative practice of scientists.[6] Second, TDR cannot be conceptualized as professional support for better problem solving on the clients' end alone. Rather, all the collaborators are intent on addressing societal sustainability issues, even though they define that 'same' issue in terms of their particular field. Third, scientists as professionals are generally more involved in the issue at stake; they also want to achieve a sustainable future. However, when it comes to addressing specific problems, professional distance still works if the professional rules and standards are respected.

4. A procedural approach to transdisciplinary sustainability research

The suggestion here is that reformulating the challenges of TDR outlined in sections 2 and 3 and modeling TDR in terms of procedural social theory can provide conceptual progress that corresponds with differentiation theory on the one hand and the idea of procedural sustainability on the other. Procedural conceptions of sustainable development understand it as a learning process — and learning processes are what procedures serve to organize. A *general model of procedures* can shed new light on negotiation processes between heterogeneous, yet collaborating, actors as well as on necessary steps, requirements, and evaluation criteria of procedures. This may help to understand problems associated with transdisciplinarity better and to deal with them appropriately. The next sections will outline basic aspects of procedural thinking (4.1) and apply this to the conception of TDR (4.2).

4.1. Procedural thinking for learning processes

The following explanations start with an excursus about main theoretical references (a) for the procedural model which is presented in the next step (b).

a) The conceptual developments draw on the procedural theories by Luhmann (Heck et al., 2020; Luhmann, 1997), Habermas (Habermas, 1992; Habermas, 1996) and Latour (Latour, 2004; Latour, 2007). What these authors have in common is that they understand procedures as learning processes, although they have very different ideas of what learning means in such procedures.[7] In Luhmann's functionalist perspective, learning means adapting individual expectations to the reproduction of systemic structures. Habermas stresses the possibility of procedural rationality: the rationality of results depends on the rationality and appropriate use of procedures. Latour's conception allows for negotiations of new network connections, what he calls the assembling of collectives.

One of the main characteristics of procedures is that they must come to an end even though it is impossible to take all aspects into account completely. For example, the political debate needs to be closed with a decision in legislation, the judge must pass a judgement at a certain point, or results of studies need to be published. This being the case, Luhmann stresses that legitimacy should not be mistaken for 'true justice.' Habermas agrees that there is no final truth, legitimacy, or justification in the post-metaphysical society, but according to him learning means the possibility of achieving better decisions, that is, results that can claim a greater or lesser degree of rationality. Although he mainly discusses procedural rationality in the fields of morality, positive law, and democratic politics (Habermas, 1996), he includes the sciences as well (Habermas, 1992). In science, the procedures are the scientific methods, and the rationality of scientific results always depends on the methodical procedures applied. They can claim no truth beyond these procedures. Latour's conception of a 'parliament of things' (Latour, 2004) allows a further widening of procedural thinking. What he procedurally grounds in the basic terms of 'ontopolitics' or 'cosmopolitics' — assembling the 'collective of human and non-human entities' that negotiate their 'common world' — is actually realized in the specific fields and activities of scientists and engineers, economists, politicians, moralists (i.e., civil society activists and mobilizers), lawyers, and artists. Similar to Habermas, Latour sees the moral and democratic quality of these activities bound to the procedures, that is, to the experimental learning processes that they induce.[8] I suggest combining the main aspects of these ideas of procedures to develop a more general conception of procedures as learning processes.[9]

Latour's 'parliament of things' allows for a procedural perspective on all parts of society; his 'common world' is made up of procedures that all follow the same rules in principle ('ontopolitics'), although they do so in specific ways in the different practical fields such as the sciences, law, the arts, and so on. Furthermore, he stresses procedural learning processes as change, as establishing new networks. While Latour claims democratic ambitions, Callon developed an earlier conception in the field of actor–network theory in terms of a sociology of power (Callon, 2022). In Callon's four-phase model, the main concern is how one of the actors in a network can achieve the most influential position and impose that actor's own purposes. Powerful interventions are always to be expected in negotiations and collaboration, and they may often

[6] Academic qualification is the very basis of the professions (Großmaß, 2017). In the case of scientists, academic training can be assumed to be given, yet specific training for TDR (as suggested by Scholz and Steiner (Scholz and Steiner, 2015b)) would still be beneficial. This could also involve training in practical fields to better understand the role that science plays in relation to other roles in collaborative projects. Drawing on established practices from other professions could also be helpful to ensure professionality in TDR — for instance, introducing something similar to supervision. The latter could involve offering the TD researcher opportunities to talk with scientists who are not involved in the collaborative practice with non-academics. Currently, accompanying research or project boards may have a similar function.

[7] This procedural perspective was developed in more detail in further articles including broader theoretical discussions (Lorenz, 2010; Lorenz, 2013; Lorenz, 2018). The focus here is limited on basic conceptual aspects of procedures and learning in these theories.

[8] This 'experimental approach' is similar to the procedural perspective and the conception of the "real-world experiment" by Groß and Hoffmann-Riehm (Gross and Hoffmann-Riem, 2005; Lorenz et al., 2010). Latour also draws on pragmatist ideas, particularly on the pragmatist focus on newly raised issues as the starting point and center of the analysis, as this is where the renegotiation and realignment of networks can be observed. The main reference is Dewey, specifically his political theory (Dewey, 1991) and his theory of scientific inquiry (Dewey, 1938).

[9] I cannot show in detail how the model is derived from these theories. For details, see Lorenz (Lorenz, 2010).

manipulate learning processes for sustainable development in the empirical world. To address this, Latour's 'parliament of things' expands the actor-network conception by adding further tasks to make *democratic* procedures possible. This conception provides criteria for democratic processes but it is obviously different from a description of empirical reality. Similarly, the procedural model that I want to develop here is of an ideal-typical nature, just as the models by Jahn et al. (Jahn et al., 2012) or Lang et al. (Lang et al., 2012) discussed above.

b) The general model of procedures illustrated below displays the basic tasks and steps of each procedure. Procedures organize learning processes — with regard to different subject matters for scientists, politicians, business people, engineers and so on. This comes with several requirements. Procedures need to be open toward indeterminacy yet have to be able to achieve results and do so neither by chance nor by determining them from the beginning. While procedures should provide guidance on how to reach outcomes, they must not define the specific outcomes to be reached. For instance, a judge must pass sentence at the end of a trial without knowing what that sentence will be beforehand; an election results in choosing a political candidate for office without determining which one that will be in advance. Procedures are both structured and have a structuring effect on what they process; they provide formal steps to achieve outcomes. As there is no ultimate reference that the procedural learning could be deduced from, the results themselves cannot claim to represent irrevocable truths. One of the advantages of procedures is the chance to reopen them again and again — court decisions are appealed, political candidates re-elected or voted out of office, new studies launched. Thus, procedures not only yield results but also offer the opportunity to decide anew.

This description suggests four basic tasks that procedures must achieve. First, a procedure needs to be initiated to address an unexpected and uncertain issue. Second, this issue needs to be negotiated and tested in several ways, which involves acts of selection — this "is the actual *doing* of research," to use Lang et al.'s words (Lang et al., 2012). The third task is the act of decision-making and determination. The fourth task is to offer a systematic opportunity for reopening the procedure (Fig. 1).

Processing these tasks step by step makes reflective learning possible, provided that every single procedural iteration is well documented. Otherwise, the same procedure would just start again instead of giving "rise to a new transdisciplinary research process that starts with a modified understanding or framing of the initial problem." (Jahn et al., 2012) Documentation can be regarded as a necessary part of reflective learning or can be viewed as a fifth task in its own right. Procedures by definition can be restarted again and again. This implies that procedures are not only connected to other procedures in temporal terms but also on different levels; they exhibit what we might call a fractal characteristic: The general steps that characterize a procedure — opening, selecting, closing, and reflective learning — are applied at any level in the same way. A court decision can be appealed to a higher court; a detailed data analysis follows the procedural steps in the same way that they are applied in pursuing the project as a whole. How is this model helpful in conceptualizing TDR?

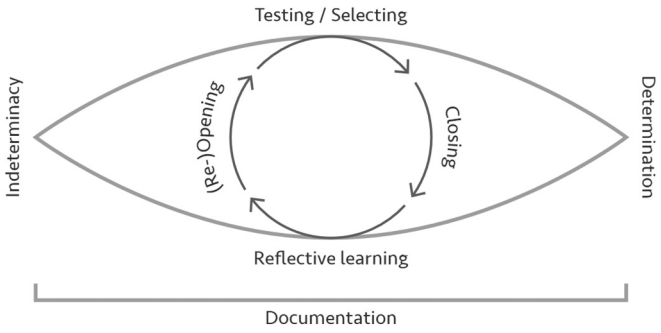

Fig. 1. The 'procedural eye' – a general model of procedures and procedural learning.
This model is a modified version from Lorenz (Lorenz, 2010). The main progress is that the model emphasizes the need for an active initiation ('open the eye') and the significance of documentation.

4.2. A procedural perspective on TDR

Thinking about TDR in terms of this proposed procedural model can advance the conceptual debate on TDR in two respects: (a) by conceptualizing opportunities for cooperation as learning processes and (b) by theoretically underpinning the development of conceptual models.

a) Given the considerations on collaboration between scientific researchers and non-academics from several fields of societal practice (see section 3), the procedural conception allows us to reformulate the challenges of such cooperation: Do all the participants pursue their own objectives and procedures, or does TDR imply that all of them must come together and act in concert in an integrated fashion in a new, 'third' procedure that is different from the specific procedures that constitute their standard operations? The answer is that both is true, in combination. On the one hand, all of the participants are part of their specific fields and have to follow its respective rules and practices. For instance, scientists *as scientists* need to use scientifically sound methods, apply theoretical reflection and justified conceptions; they articulate scientific questions and produce scientific output (articles, books, etc.). This holds true for politicians, artists, and all other participants in their particular fields, respectively. On the other hand, collaboration, by definition, cannot be limited to one field but needs to integrate the work of the participants from different fields. Focusing on the issue in question, all of them work together in a new procedure. Each of them must nevertheless do it their way. For instance, scientists *as collaborators* are still scientists and engage in the joint procedure by treading a scientific path; for instance, they define scientific objectives or redefine the shared objectives from a scientific point of view for their work; they produce scientific output or incorporate their scientific results into the common output; they need to 'translate' their specific terms to enable communication with their non-scientific collaborators while they remain aware of the scientific meaning of these terms and can immediately translate them back for their own discussion. Obviously, we still need to invent many of these tools and capacities for translation and joint communication and action that must be able to mutually adapt to but not contradict the respective 'logics' or 'programs' of the collaborating participants.

The metaphor of a construction site, as introduced by Latour (Latour, 2004),[10] might make the nature of such collaboration more plausible. Various trades contribute to constructing a building (the joint procedure), but they do so by providing their particular skills (following their own procedures). An example Latour gives for his procedural conception is the BSE epidemic in Europe in the 1990s. This critical issue mobilized several actors: politicians and bureaucrats on various levels (EU, national, local), veterinaries, civil society activists, cattle and sheep raisers, meat consumers, and many more. They all had to find solutions for their specific problems, and in so doing, they together transformed the entire European 'network' of keeping cattle for human food.

The general procedural model applies to all participants in transdisciplinary cooperation but needs to be specified for the different actors. Its integrative capacity draws on a common methodological foundation adopted from social theory: in such collaboration, each type of actor follows the same procedural rules *in principle*, yet each in the specific way or according to the 'program' common in that actor's

[10] It is interesting that Latour, in his *Politics of Nature* (Latour, *2004*), tacitly shifts his conception of a 'parliament of things' to a 'construction site of things' (implicating a shift from [political] negotiation to the collaboration of trades). This discrepancy is obviously a consequence of his unclarified normativity.

practical field; these fields can be science, politics, civil society (Latour's 'moralists'), the arts, and so on or subdivisions of these fields, for instance, different scientific disciplines including the social and natural sciences.

Finally, these ideas are relevant to the graphic representation of the model introduced above. The clear distinction between science and societal practice drawn by the model versions discussed in section 3.1 has also been criticized by Lawrence et al. (Lawrence et al., 2022) They suggest looking for an improved depiction that shows science as being an equal among the many other societal actors involved. The 'procedural eye' model does not intend to display all possible actors as this would quickly become very confusing. It rather proposes a model that is similarly valid for all actors in principle—be they scientific or non-academic.

b) It is not difficult to relate the procedural model to the phase models used in TDR. In doing so, my intention is not to replace the existing conceptions, which have been developed on the basis of rich empirical work and are saturated with the many years of research experience. The idea is rather to use the procedural model as a conceptual foundation derived from social theory to achieve more consistency in conceptual development. The three phases in the ideal-typical models by Lang et al. (Lang et al., 2012) and Jahn et al. (Jahn et al., 2012) can be described and methodologically justified in terms of the first three steps of the procedural model. The iterations that these phases require (which have been proposed by several authors) as well as the aspect of procedural knowledge and reflexivity added by Lawrence et al. (Lawrence et al., 2022) or similarly by Jahn (Jahn, 2016) correspond with the fourth task of the procedural model: that of 'reflective learning.' Sustainable development as a learning process can also be appropriately conceptualized in the procedural model; similar to the idea of 'wicked problems,' the procedural approach to sustainability does not promise final solutions but conceptually stresses the possibility of producing — factually and normatively — justifiable results while being open for renegotiating them.

The procedural model can provide formal guidance in terms of how to organize learning processes and problem solving around emerging issues — sustainability issues, for instance. The general steps can serve to derive *formal criteria* as to what a procedure has to accomplish and how its progress can be evaluated. The basic criterion is that each step of the procedure has to address the tasks required to complete that step. Moreover, each of the identified steps leads us to ask specific questions that provide further criteria. In regard to the first task, the question that needs to be asked is: Is this an open procedure, or how can the agenda be opened up to search for new perspectives, inputs, and options for action? The second set of questions should be: Are all relevant people, perspectives, positions, and aspects involved appropriately? By what means? Do they have a voice in negotiating the issue at stake? Third: Does the procedure come to an end, and how is it closed? Fourth: Do the determinations encourage reflexive leaning? What options exist for restarting the procedure on the basis of the previous results? Is the progress achieved by the procedure well documented?

5. Conclusion

This discussion of TDR started with the observation of inconsistencies in the TDR debate as a result of such research being a scientific activity yet also claiming to be a joint activity involving scholars and non-academics. If we recall the statement by Lang et al. (Lang et al., 2012) that TDR "goes beyond the 'primacy of science' as well as the 'primacy of practice'" to establish a "third epistemic way," the procedural conception inspires another notion: TDR is not about a third option but about (good) cooperation among different actors — with no 'primacy' regarding the subject matter but with a scientific bias because it is debated from a scientific perspective. The conceptual debate is an act of scientific self-reflection about the role of scientists in collaborative activities with non-academics; it is the integration of science and practice by scientists for scientists.

Greater conceptual consistency would require acknowledging that TDR has this inherent 'scientific bias.' TDR is neither a scientific knowledge transfer to society nor is it scientific counseling, or contract research for non-scientific actors. It is a specific kind of applied science: scientists collaborating with non-academics; that is, they work together on a societal sustainability issue. It nevertheless remains science. And scientific expertise is exactly what TDR contributes to the collaboration with non-academics – even if this collaboration requires additional qualification to gain "a collaborative expertise in its own right that might be applied to various constellations and problems." (Maasen, 2019) For that purpose, professionalization is suggested.

In light of the established state of TDR, the debate and practice should promote its further professionalization and research – informed by social theory – should focus on chances of collaboration between diverse actors.

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