'Learning by Doing': Methodological Implications in Studying Interdisciplinary and Transdisciplinary Research Practices

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Abstract

This article examines how researchers who study inter- and transdisciplinary research practices conceptualise and navigate methodological choices. Drawing on science, technology and society (STS), we combined a meta-ethnography and semi-structured interviews with scholars engaged in investigating inter- and transdisciplinary research. Our analysis identifies four interrelated dynamic pairs: familiarity/exploration, systematisation/adaptability, transferability/contextualisation, and reflection/action, that shape methodological decision-making. Rather than viewing these as tensions, we argue they function as productive dualities guiding reflexive and context-sensitive research inquiry. The study underscores the importance of methodological awareness, documentation, and collaborative engagement in advancing the study of inter- and transdisciplinary research. There has, to date, been no systematised understanding of how methodological practices influence the investigation and support of inter- and transdisciplinary research and their impact. The article then contributes to STS and inter- and transdisciplinary scholarships, by offering a systematised understanding of how methodological practices influence the investigation and support of collaborative research and its impact.

Keywords: Interdisciplinary Research, Transdisciplinary Research, Knowledge Cultures, Methodological Pluralism, Meta-Research

Introduction

In recent years, the concepts of interdisciplinarity (ID) and transdisciplinarity (TD) have expanded from academic discussions to the strategic agendas of public and private organisations (Boone et al., 2020; Conroy, 2020; Kaiser and Gluckman, 2023; Stamm, 2019). Within this context, ID and

TD are frequently cited as approaches that enable transformation, particularly in discussions of risks and opportunities in transformative science and problem-solving (Alvial Palavicino et al., 2023). Growing concerns about the complexity of societal challenges, such as climate change, have heightened awareness of the need to 'transform' global systems and address complex, multidimensional, or wicked problems (Fazey et al., 2018; Klein, 2021; Regeer et al., 2024; Schneider et al., 2019). Moreover, scholars and policymakers globally are calling for more interdisciplinary and transdisciplinary research to better respond to emerging and unpredictable societal conditions (Wen et al., 2021). By integrating diverse perspectives, concepts, and methods from multiple academic disciplines and societal actors, ID and TD either deepen fundamental understanding or seek actionable solutions to multidimensional problems (Klein, 2021; Lang et al., 2012).

Inter- and transdisciplinary research constitutes a mode of knowledge production; hence, different methods are needed to capture the multiple dimensions and dynamics at play (Klein, 2021). There is not only a "pressing demand for more rigorous empirical analysis of political and institutional support for interdisciplinarity [and transdisciplinarity], and the effects that interdisciplinary collaborations have on researchers, students, organisations and knowledge" (Frickel et al., 2017: 6), but also an urgent need for an in-depth understanding of what it means to do ID and TD, with their epistemic, cultural, social, and political implications for the science–policy interface (Vienni-Baptista, 2024a). Yet ID and TD may also remain elusive because we are incapable of applying methods to grasp their heterogeneity and contextual differences.

As objects of investigation in their own right, ID and TD challenge established methodological approaches and methods and are considered ill-defined phenomena (MacLeod et al., 2019). They imply a complex body of practices, policies, institutional arrangements, cognitive structures, and social forms that vary from one case to another (Barry and Born, 2013; MacLeod and Nagatsu, 2018). The methods used to study ID and TD range from qualitative to quantitative (MacLeod et al., 2019). Authors from science, technology and society (STS) (e.g., Callard and Fitzgerald, 2015; Calvert, 2024; Felt et al., 2016; Silvast and Foulds, 2022), the philosophy of science (e.g., Andersen, 2016; MacLeod et al., 2019), inter- and transdisciplinary communities (e.g., Hoffmann et al., 2022; Klein, 2021; Lyall, 2019; Pohl et al., 2021), and sustainability sciences (e.g., Schneider et al., 2019) have investigated inter- and transdisciplinary research practices. However, to date, no scientific articles have systematised investigations of ID and TD or the implications of such investigations from a meta-research perspective (Derrick et al., 2024).

Several scholars have noted that individual case studies are often chosen for empirical examinations of ID and TD, which limits the comparability and generalisation of results across cases (Boix Mansilla, 2018; Callard and Fitzgerald, 2015; Frickel et al., 2017; Pregernig, 2006; Stokols, 2013). The current understanding of inter- and transdisciplinary research practices thus remains incomplete; there is little potential for comparison, and a disconnection exists between theory and practice (Newig et al., 2019; Wuelser et al., 2021). Other authors warn that funding policies may inadvertently encourage superficial or tokenistic collaborations – so-called 'fake collaborations' – if there is no robust foundation to support genuine, sustained interdisciplinary engagement (Conroy, 2020; Dai, 2020). Funders perceive the same problem (Graf, 2019; Schneider et al., 2019; Stamm, 2019), noting that studies about ID and TD are demanded by the policy sector. Nevertheless, recommendations in the academic and policy realms repeatedly point to a lack of joint learning, resulting from the weak links between academic and policy literatures (Vienni-Baptista et al., 2022).

This article seeks to advance the discussion on how to investigate the specific features of collaborative ID and TD (MacLeod et al., 2019) to improve their responsiveness to address societal challenges. We enquire into the methods used, how they are selected, and their implications while investigating the specific features of collaborative inter- and transdisciplinary research (as defined by Salmela et al., 2025). The goal is to initiate a research programme that examines how researchers actively construct and make sense of inter- and transdisciplinary research practices, highlighting what these situated efforts reveal

about the broader dynamics and implications of knowledge production in collaborative settings.

Investigations of ID and TD provide opportunities to redefine and reinvent the methods and conceptual frameworks used to evaluate research and innovation. Therefore, they can benefit the policy and funding sectors (Lury, 2018). Additionally, the responsiveness of ID and TD to calls to address urgent scientific and societal challenges can be improved (Fleurbaey, 2018).

In this article, we therefore address two research questions: (i) how do researchers investigating inter- and transdisciplinary settings conceive of and select methods? and (ii) what implications do these conceptions and methods have for how ID and TD are understood, experienced, and supported? We present the findings of the project titled 'Investigating Interdisciplinarity and Transdisciplinarity: Intersections of Practices, Culture(s) and Policy in Collaborative Knowledge Production' (Intersections)[1], which aims to refine the theories and methods used to investigate ID and TD as knowledge cultures (Vienni-Baptista, 2024a). This study is situated within broader considerations of how scientific and technological developments require the establishment of collaborative settings and processes that can foster more critical engagement with science and technology through inter- and transdisciplinary research (Vienni-Baptista, 2024b). In this study, we apply a cultural lens by conducting an extensive meta-ethnography and semi-structured interviews with researchers who have studied inter- and transdisciplinary practices (Charmaz and Mitchell, 2001; Noblit and Hare, 1988). The article is positioned in the anthropology of science and technology within STS (Downey, 2001; Forsythe, 2001; Hess, 1992). An anthropological study of ID and TD places these collaborative practices as temporal and spatial constructions that are "inextricably symbolically and politically construed" (Knorr Cetina, 1995: 143).

Our findings elaborate on four interrelated dynamic pairs that reveal how inter- and transdisciplinary research practices are investigated and what methods are selected: (a) familiarity and exploration, (b) systematisation and adaptability, (c) transferability and contextualisation, and (d) reflection and action. Rather than framing the navigation of methodological choices as a series of tensions – such as quantitative versus qualitative, or standardised protocols versus emergent methods – we argue that researchers investigating interdisciplinary and transdisciplinary research practices navigate coexisting and reciprocal dynamics in the form of productive dualities (Law, 2004; Mol, 2002). As balancing acts, researchers investigating inter- and transdisciplinary practices make a series of methodological decisions that are informed by these pairs, which interact and influence one another or can even contradict such decisions. Founded in STS scholarship, this paper offers the first systematised understanding of the implications of these dynamics for the advancement of ID and TD.

The article is organised as follows: First, we present our rationale positioned in the STS scholarship. We then detail our methods, elaborate on the findings of our study, and discuss the implications of the four dynamic pairs for the understanding and value of inter- and transdisciplinary research. Our conclusions offer future pathways for this research stream and indicate the double contributions of our study, namely, to STS and to inter- and transdisciplinary scholarships.

Rationale

Inter- and transdisciplinary research are increasingly invoked as vital for engaging with complex societal challenges, yet what it means to do ID and TD remains insufficiently examined (Bammer et al., 2020; Vienni-Baptista, 2024b). The rationale addresses this problem and is organised as follows: first, we discuss how a research programme on inter- and transdisciplinary meta-research engages with and problematises concepts and methods; and second, we elaborate on the conceptual grounding drawn from STS scholarship, particularly around methods, reflexivity, and the performativity of research practices.

Problematising interdisciplinarity and transdisciplinarity

Inter- and transdisciplinary knowledge production function as a placeholder for an ideal vision of the relationship between science and society (Nowotny, 2016). There are increasing calls for new

productions of knowledge, new roles of science in society, and a transformative science that actively tackles pressing societal challenges through inter- and transdisciplinary knowledge production (Lawrence et al., 2022; Okamura, 2019).

In this article, we address ID and TD together as a means to critically examine their shared and divergent aspects. While we recognise that these terms carry distinct meanings – ID often emphasising integration across disciplines and TD extending beyond academia to include societal actors (Pohl et al., 2021) – we argue that analysing them jointly enables a more comprehensive understanding of the challenges and opportunities they present. By considering the terms together, we seek to advance the field and respond to the calls for more nuanced analyses of the political, cultural, and economic values underpinning collaborative research (Frickel et al., 2017; Schaltegger and Vienni-Baptista, 2026; Vienni-Baptista, 2024a).

Inter- and transdisciplinary research were first considered objects of investigation in their own right in the 1970s when the Organisation for Economic Co-operation and Development (OECD) organised a seminar to specifically discuss their implications (OECD, 1972). Dimensions such as methodological implementation, definitions, and the variety of collaboration models used by researchers were highlighted (Vienni-Baptista et al., 2020). The main output of the OECD workshop showed that consistency was lacking in how both the practice and the definition of ID and TD were understood (Vienni-Baptista et al., 2022). This discussion remains: the two concepts denote a spectrum of experience (Lyall, 2019) and are defined heterogeneously, with the definition used in each case depending on the knowledge community that applies it (Guimarães et al., 2019; von Wehrden et al., 2019). This fact has oriented and influenced the discourse on knowledge production and research funding (Huutoniemi et al., 2010; Klein, 2008) in a way that has determined various streams, fragmentations, and attempts to taxonomise these phenomena (for example; Klein, 2010; Osborne, 2015).

In recent decades, researchers and funders have identified the lack of an organised body of knowledge that helps scholars to study and better understand the problems faced and urgent calls raised by inter- or transdisciplinary researchers and practitioners (Frickel et al., 2017). This body of knowledge is also scattered, as we will show later, because inter- and transdisciplinary research face several pervasive challenges (Vienni-Baptista et al., 2020). Investigation of the implications and impacts of ID and TD is urgently required if policymakers and funders are mandated to promote and support collaborative research (Graf, 2019).

To respond to these challenges, previous studies have focused on two main topics: (i) how to perform inter- and transdisciplinary research and what factors hinder or help its development; and (ii) which methods and tools are best to develop inter- and transdisciplinary research (Hoffmann et al., 2022; Stokols et al., 2013). For example, some contributions focus on how ID and TD are performed within teams and how to improve their outputs (Newig et al., 2019; Wittmayer and Schäpke, 2014). Some authors have studied how ID and TD have developed across a range of disciplines (Frickel et al., 2017; Klein, 2005; Weingart, 2000). One example is the so-called 'accompanying research' (Defila and Di Giulio, 2016a; 201b). Accompanying research takes place in parallel to a specific project, acting as a point of reference for developing research (Fiedeler et al., 2010) and promoting knowledge about the collaboration whilst collaborating (Freeth and Vilsmaier, 2020). Freeth and Vilsmaier (2020) conceptualise this kind of movement as dynamic positionality, where researchers move between learning about, with, and for interdisciplinary teams.

In order to address the fragmentation mentioned above, we propose a research programme to problematise the concepts and methods used to study collaborative research, its outputs and impacts (Vienni-Baptista, 2024a). We focus on how to investigate the implications and impacts of ID and TD as means of epistemological and methodological change and transformation. As understood here, problematisation is defined as a mode of inquiry because it constitutes a questioning and decentring approach (Foucault, 1984). The search for the underlying patterns and meanings that give coherence to people's practices is central (Vienni-Baptista and Pohl, 2024).

Drawing on STS scholarship, we examine how researchers engaged in inter- and transdisciplinary research navigate methodological complexity: how they make sense of their objects of research, justify their approaches, and reflect on their positionality. This study uses the concept of 'meta-research' heuristically to highlight reflexive practices without treating it as a separate field. Notably, Laynor and Stevens (2024) argue that research-on-researchers probably needs to be understood as a subfield of meta-research, and it is a subfield that is difficult to grasp. However, without ignoring the contributions of meta-research as a "burgeoning discipline that investigates efficiency, quality, and bias in the scientific ecosystem" (Hardwicke et al., 2020: 1), which has gained significant traction over the past decade (Ioannidis, 2018; Ioannidis et al., 2015; Munafò et al., 2017; Oancea et al., 2024), this study takes its analytical starting point at the boundaries of the anthropology of science and technology and STS.

Therefore, we operate at two intertwined levels of meta-research. On the one hand, we examine the meta-research practices developed by scholars who themselves investigate inter- and transdisciplinary collaborations, namely, how they conceptualise, design, and justify their methodological approaches. On the other hand, our own analysis constitutes a second level of *meta-meta-research*, as we critically reflect on how these researchers produce knowledge about the study of ID and TD. This dual perspective draws attention to the recursive nature of the methodological inquiry in STS and underscores the importance of reflexivity in studying research practices that are already self-analytical. In doing so, the study contributes to a critical understanding of the methods and methodological decisions made by scholars investigating inter- and transdisciplinary research practices and policies (MacLeod et al., 2019). For STS, such reflection is particularly relevant as it extends Law's (2004) and Mol's (2002) attention to method as practice and to the multiplicity of realities enacted through research. Reflecting on inter- and transdisciplinary meta-research is itself a site where methods are enacted, contested, and reimagined (Law, 2017; Lury, 2018).

Studying ontological multiplicity and methodological assemblages

To study the complexity of inter- and transdisciplinary knowledge production, we turn to STS, which provides tools to investigate the methodological practices and epistemic commitments of those who study inter- and transdisciplinary research practices (Kruse and Silvast, 2023; Laser, 2021). Rather than aiming to reconcile the different perspectives cited in the previous section, STS attends to how methods are enacted (Mol, 2002), situated (Haraway, 1988), and made to work in specific empirical settings (Law, 2004; Law and Ruppert, 2013).

The key contributions of STS are (i) its approach to methods as both research practices and objects for study (Law, 2017) and (ii) its sustained attention to method not just as a technical concern, but as a site of epistemic and ontological production (Silvast and Virtanen, 2023). Latour and Woolgar's *Laboratory Life* (1979) famously disrupted the idea that scientific facts are discovered through straightforward methodological procedures, instead revealing how they are socially constructed through contingent practices. Building on this, Mol's (2002) concept of *ontological multiplicity* shows how objects of knowledge (in this case, inter- and transdisciplinary practices) are not singular or fixed, but enacted differently depending on the practices that bring them into being. Law (2004, 2017) developed Mol's argument by showing that methods are performative, meaning they are not simply ways of representing the world, but actively participate in shaping the realities they describe. Law (2004) introduces the concept of *method assemblages*: dynamic constellations of tools, theories, practices, and assumptions that shape and stabilise certain realities. He invites researchers to cultivate a sensibility for mess and to experiment with methods that are "unusual to or unknown in social science" (Law, 2004: 2) to capture realities that are themselves "excessive and in flux" (Law, 2004: 14).

These insights have informed the development of *methodography* (Greiffenhagen et al., 2011; Lippert and Mewes, 2021): an approach that investigates how researchers construct, negotiate, and reflect on their own methodolog-

ical choices. Rather than prescribing the *correct* or *best* way to study ID and TD, methodography foregrounds how specific methods come to matter. This perspective aligns with work on the *social life of methods* (Law and Ruppert, 2013; Savage, 2013), which emphasises that methods are never isolated tools but are embedded in social, institutional, and material arrangements that shape what kinds of knowledge can be produced.

Situated reflexivity and methodological awareness

Accepting that social research methods have a 'social life' has significant implications for how we conceive of these phenomena (Silvast and Virtanen, 2019). In a related vein, investigations of inter- and transdisciplinary practices and policies entail a specific situatedness. Scholars such as Haraway (1988) have emphasised the importance of situated knowledge – the recognition that all knowing emerges from specific positions and relations and that objectivity is not about detachment, but about accountability. This relational view resists the illusion of a neutral, all-seeing science and opens space for epistemologies grounded in marginal, peripheral, or bottom-up perspectives (Tauginienė et al., 2020; Vienni-Baptista et al., 2022). When a pluralist epistemology is adopted, it is fundamental to keep an open mind and remain methodologically flexible. This flexibility may eventually change the course of events, as a sensitive and empathic attitude is required to truly build solidarity based on shared goals (Beaulieu, 2010).

Considering the points made above, our study converges around a theme that has gained increasing traction in STS: the notion of productive dualities, where apparent oppositions – such as method/theory, subject/object, and order/disorder – can be understood not just as tensions, but as sources of insight, negotiation, and co-construction. We define these productive dualities inspired by Law's (2004) notion of 'method assemblages'. In addition, Mol's (2002) conceptualisation of 'ontological multiplicity' similarly demonstrates multiple coexisting enactments of reality.

Additionally, this framing finds resonance in more recent work by Schikowitz et al. (2023), who elaborate on how aspects that may be perceived as tensions can be reframed and understood as constitutive features of transformative research settings. Drawing on Kuhn's (1977) 'essential tension of research', and taking into account mentions of 'enduring tensions' (Parker and Crona, 2012), 'essential tensions' (Turner et al., 2015), and 'inherent tensions' (Schikowitz, 2020) in relation to inter- and transdisciplinary research, Schikowitz et al. (2023) argue that the constitutive tensions cannot be resolved but must be processed. Accordingly, the epistemic implications of such tensions must be acknowledged, and researchers and practitioners alike need to "analyse and reflect upon such tensions systematically" (Schikowitz et al., 2023: 62).

We acknowledge the conceptual grounding of the terms *tension* and *paradox* (Palmer et al., 2025; Smith and Lewis, 2011). While 'tensions' refer to contradictions in collaborative theory (Farjoun, 2010; Palmer et al., 2025), they are concerned with "the choice between alternative forms of management practices" (Huxham and Beech, 2003: 74). Paradox denotes "contradictory yet interrelated elements that seem logical in isolation but absurd and irrational when appearing simultaneously" (Lewis, 2000: 760).

However, tensions and contradictions do not represent the dual nature of the dynamic pairs we have identified in this study. Therefore, we take a different perspective and embrace the need for methodological openness and reflexivity, which is echoed in calls for innovation in STS research design. Hyysalo et al. (2019: 3) identify the 'closure effects' that specific research designs can create and advocate for approaches that can better account for extended, heterogeneous knowledge-making processes – an imperative particularly relevant for the study of inter- and transdisciplinary knowledge production. Our analysis identifies four interrelated dynamic pairs that shape methodological decision-making during the investigation of ID and TD. Rather than viewing these as tensions, we argue they function as productive dualities guiding reflexive and context-sensitive research approaches.

Methods

We elaborate on the methods applied in two interrelated phases: First, we performed a meta-ethnography to study the bodies of academic and policy literatures on ID and TD. Second, we describe the semi-structured interviews carried out with scholars dedicated to the study of interdisciplinary and transdisciplinary settings. The two-phase design thus combined a meta-ethnography to synthesise existing knowledge with interviews that sought to capture researchers' experiential insights, ensuring both a broad conceptual foundation and an in-depth understanding of inter- and transdisciplinary meta-research processes.

Phase 1: Meta-ethnography and case setting

Data collection

Meta-ethnography implies a distinctive analytic process of translation and synthesis of translations (France et al., 2019; Hammersley, 2013). This process involves systematically comparing conceptual data from primary qualitative studies to identify and develop new overarching concepts, theories, or models (France et al., 2019). This is done following seven phases: (1) getting started, (2) deciding what is relevant to the initial interest, (3) reading the studies, (4) determining how the studies are related, (5) translating the studies into one another, (6) synthesising translations, and (7) expressing the synthesis (Noblit and Hare, 1988). Meta-ethnography aims to produce a new configuration/interpretation, model, conceptual framework, or theory (Uny et al., 2017). Following Noblit and Hare (1988), the research team included accounts that took ID or TD as an object of research. These accounts were treated as ethnographic data because researchers in inter- or transdisciplinary settings usually reflect on the collaborative process while conducting research named 'interdisciplinary' or 'transdisciplinary' (Vienni-Baptista, 2024b).

For Phases 1 and 2 of the meta-ethnography, the team conducted a literature search. Three team members defined sets of keywords and combined them to form complex search strings (Schaltegger and Vienni-Baptista, 2023). These strings were used to search studies published in Web of Science (WOS), Scopus, and JSTOR between 2000 and 2023. The resulting dataset consisted of 15,171 records (Schaltegger and Vienni-Baptista, 2023) (Figure 1). The results of the literature search were downloaded into Endnote bibliographic software and screened against

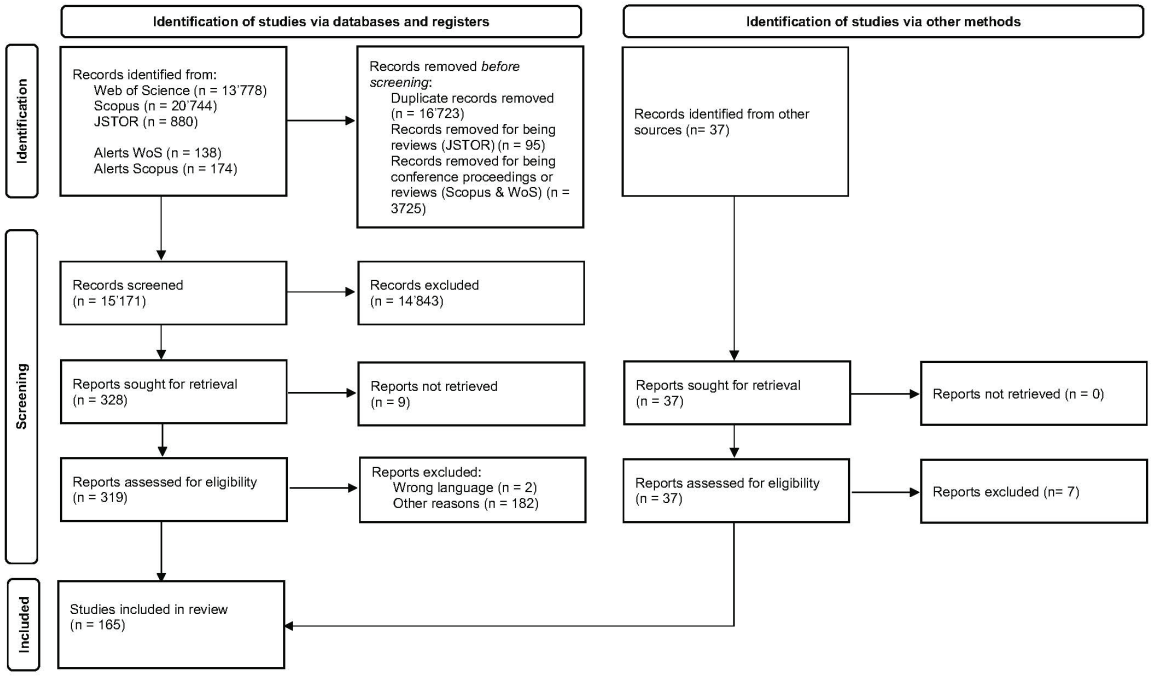

Figure 1. PRISMA 2020 flow diagram. Source: (Vienni-Baptista, 2024b)

inclusion/exclusion criteria following ENTREQ principles (Tong et al., 2012). After duplicates were removed, a sample was selected based on the titles and abstracts. Following France et al. (2019), this step involved several iterations and discussions within the research team to ensure robustness in the sample. In total, 329 records were selected (Vienni-Baptista, 2024a).

Data analysis

In Phase 3 of the meta-ethnography, the team performed a qualitative content analysis (Schreier, 2014). The categories were based on the principles of grounded theory (Strauss and Corbin, 1998) complemented by categorial thinking (Freeman, 2016). The team coded 165 articles, focusing on the questions guiding this paper.

During Phase 4 of the meta-ethnography, each team member compared the data across selected documents and determined their relationships (Noblit and Hare, 1988). In Phase 5, each team member conducted a refined comparison of concepts classified according to the categories elaborated in the previous steps (Vienni-Baptista, 2024a).

In Phases 6 and 7, the team synthesised the translations obtained through the meta-ethnography (France et al., 2019). This process allowed us to draw up a list of potential interviewees from the authors of the analysed records as well as a glossary of methods and tools employed to study inter- and transdisciplinary practices (Ly et al., 2026; Vienni-Baptista, in press). The insights gained from the meta-ethnography served as a foundational framework for the semi-structured interviews, allowing us to design questions that revisited and probed deeper into how researchers conceptualise and justify their methodological choices.

Phase 2: Semi-structured interviews

Data collection

The meta-ethnography enabled the team to identify a representative group of researchers and scholars leading current discussions of ID and TD spanning different fields of knowledge. Three researchers conducted 83 semi-structured interviews lasting 40 minutes to one hour each (Brinckmann, 2014). The aim was to characterise the problem space and draw out the complexities and nuances derived from individual interviews (Kamberelis and Dimitriadis, 2013).

The interviewees were selected according to the concept of heterogeneity developed by Vienni-Baptista et al. (2022). The aim was to include representatives of diverse scientific communities engaged in the study of inter- and transdisciplinary practices, including STS, interdisciplinary research, transdisciplinary research, translational research, the science of team science, the philosophy of science, the sociology of science, environmental and sustainability sciences, meta-research, critical theory, history, economics, physics, and biology, and evaluation studies. Almost all the interviewees had direct experience with inter- and transdisciplinary research, having participated in collaborative projects at some point in their careers. Their inclusion in this study was based on the fact that they had published work adopting a meta-research perspective on inter- and transdisciplinary research that had already been analysed in Phase 1, during the meta-ethnography.

The focus of the study was primarily on Europe, as the research project has the same geographical scope, but other regions were included as these represent scholars with relevance to the topic under study (i.e., Australia, Austria, Finland, Germany, Netherlands, Norway, Portugal, Switzerland, the UK, Canada, the US, India, Indonesia, Japan, New Zealand, and South Africa).

The interview guideline consisted of five sections framed according to the meta-ethnography outputs and dimensions of analysis operationalised from the research questions guiding this study: (a) methods and theories applied to study how ID and TD are performed, (b) research objects and questions utilised to investigate inter- and transdisciplinary research, (c) spaces and places where inter- and transdisciplinary research practices are studied, (d) creativity (Darbellay et al., 2014) and design in conceptual tools and methods, and (e) other emerging findings from the meta-ethnography. During the interviews, further relevant literature was collected to enrich the meta-ethnography and added to the corresponding dataset (Vienni-Baptista, 2024a; Vienni-Baptista, in press).

Table 1. Extract of the thematic codebook used in the first round of analysis.

Dimensions of analysis in interviews	Dimensions from meta-ethnography
Adaptability	Impact
Collaboration	Institutional Factors
Communities	Knowledge Cultures
Reflection	Publishing
Tools	Research Practices

Data analysis

Two researchers conducted the analysis based on the principles of grounded theory (Strauss and Corbin, 1998). The coding categories mirrored the meta-ethnography outlined in Phase 1, with additional new codes emerging inductively during the coding process (Charmaz and Mitchell, 2001). In a first round of analysis, we investigated the conceptual frameworks or background methodology in which the interviewees grounded their work, methods, approaches, and tools, seeking connections between the methods and theories used to investigate inter- and transdisciplinary research practices. Coding at this stage was broad and inclusive: interview segments were placed in dimensions that captured keywords, phrases, or actions of interest. These dimensions functioned as containers for all data potentially relevant to emerging patterns and are presented in Table 1.

In the next step, we also used the auto-coding function in MaxQdA® to ensure that all the segments containing emerging topics and keywords had been captured in the first loop. Auto-coding applied lemmatised keyword searches in English, capturing passages of approximately three sentences each (Table 2).

During the second round of coding, we conducted axial coding (Charmaz and Mitchell, 2001). This involved refining and reorganising the preliminary dimensions into more nuanced categories and sub-codes. Through constant comparison, patterns and interconnections began to emerge, and 25 overarching themes were identified. These were then synthesised, with overlapping or conceptually adjacent themes consolidated into ten final themes for deeper analysis (Table 3). These final ten themes were selected based on their analytical richness, prominence throughout the interviews, and integrative potential in relation to the research question.

Following an in-depth analysis of these ten themes, which entailed synthesising all the relevant codes and related memos, we developed connections between the themes and built the four dynamic pairs that researchers navigate when investigating inter- and transdisciplinary research (Noblit and Hare, 1988): (i) familiarity/exploration, (ii) systematisation/adaptability, (iii) trans-

Table 2. Extract from codebook used in the second round of analysis. An asterisk indicates the root of the search term, which includes potential derived concepts.

Auto-Codes	
Search Term	**Explanation**
Adapt*	a recurring theme that was included in the interview questionnaire after some interviews
Collab*	a recurring theme that indicated the role of and attitude towards collaboration in different phases and contexts of the interviewees' research
Communit*	a recurring theme that indicated differences and similarities among research communities that have taken ID or TD as objects of research
Method*	this code aimed to capture all the methodologies used by the interviewees in their research processes

Table 3. Extract from codebook used in the final iteration of analysis. Plus signs (+) highlight which theme was included in the final list of themes.

Intermediate Themes	Final Themes
Adaptability / Flexibility+	Adaptability / Flexibility
Assessment of Knowledge Production	Capacity Building
Capacity Building+	Collaboration
Collaboration+	Connection to Practice
Combination of Methods	Generalizability / Transferability
Confidence in Selected Method	Guidance and Protocols
Connection to Practice+	Knowledge Production
Emerging Tools and Practices	Methodological Rigour
Epistemological Tensions	Reflection / Reflexivity
Generalisability / Transferability+	Selection of Methods

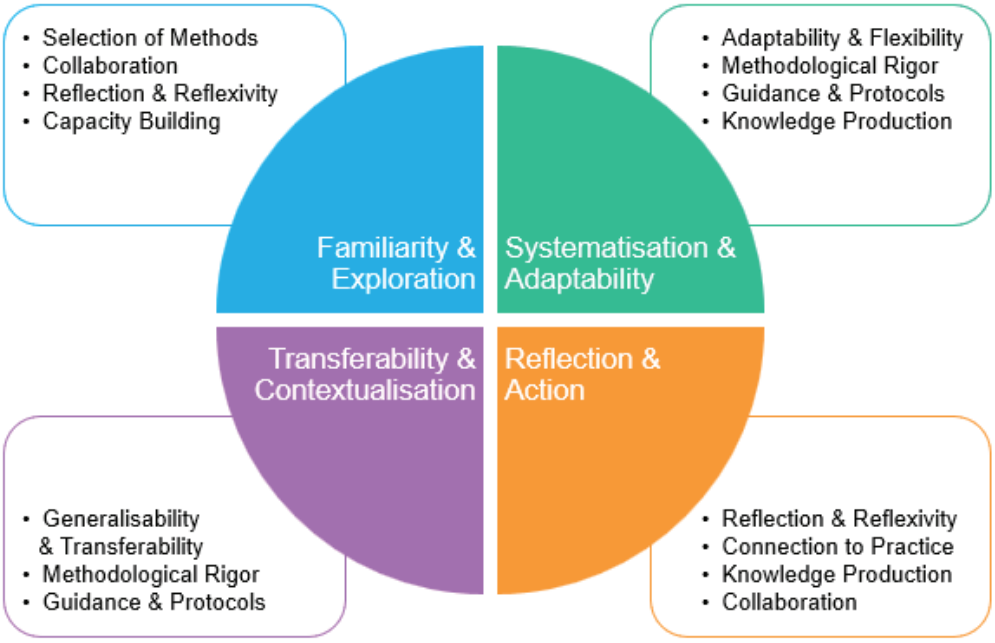

Figure 2. Relationship between dynamic pairs (in pie pieces) and main themes of analysis (in the smaller squares).

ferability/contextualisation, and (iv) reflection/action. Figure 2 shows the ten themes of analysis in relation to the topical reciprocal dynamics in the form of four pairs.

Findings

Researchers investigating inter- and transdisciplinary settings navigate complex methodological landscapes characterised by competing priorities and evolving processes. Rather than framing the navigation of all these methodological choices as tensions, our findings show that researchers also navigate coexisting, reciprocal, and productive dynamics. Below, we describe these dynamics between the four pairs, building on the concept of methodological pluralism (Law, 2004; Mol, 2002), as balancing acts researchers perform when making methodological decisions to investigate inter- and transdisciplinary settings. We indicate differences between interdisciplinary settings and

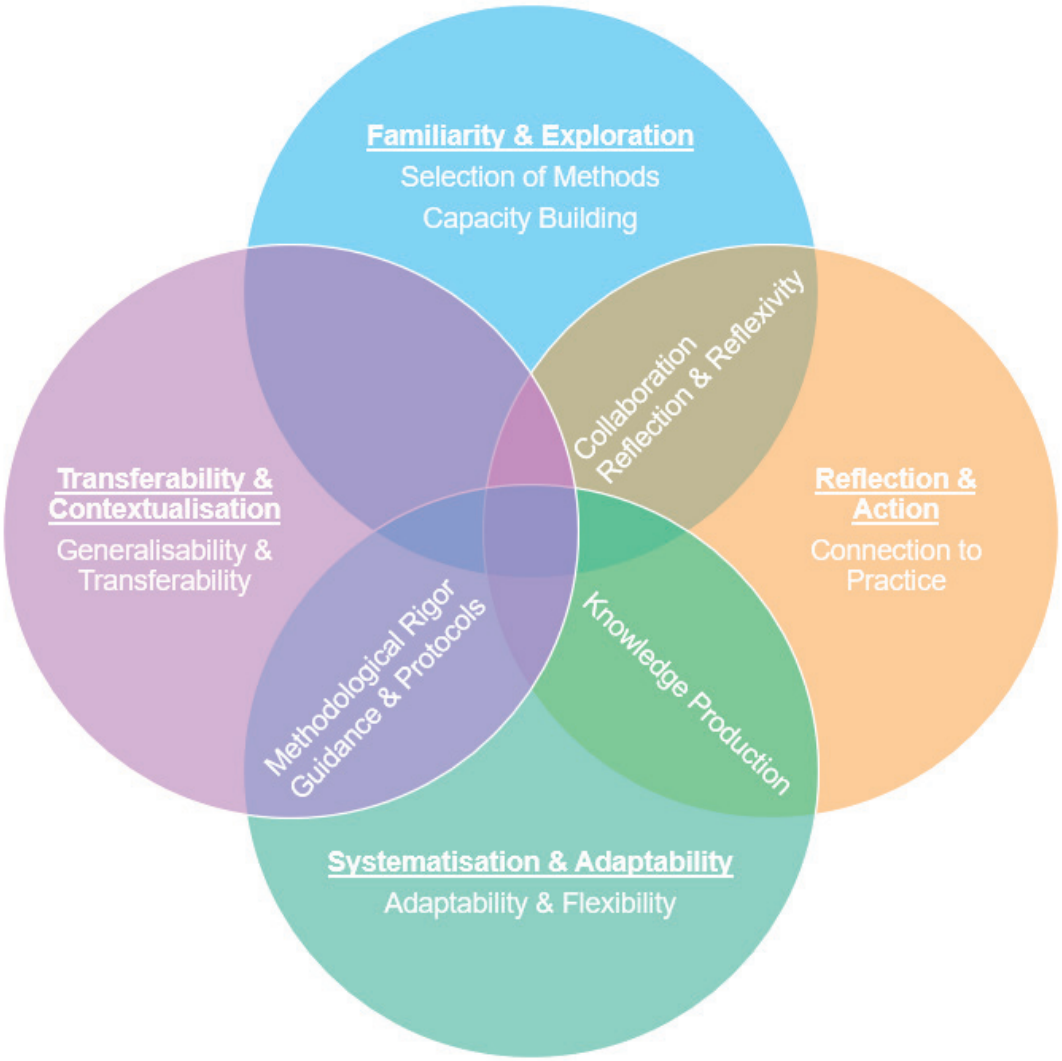

Figure 3. Venn diagram showing the overlap between the main themes of analysis among the four dynamic pairs.

transdisciplinary ones with specific quotes. Figure 3 shows the four dynamic pairs and the main themes of analysis among them.

Familiarity and exploration

The first pair – familiarity and exploration – emerges when researchers navigate whether to draw on established methodological repertoires shaped by their backgrounds or to experiment with new approaches that respond to the contingencies and uncertainties of inter- and transdisciplinary research contexts. In inter- and transdisciplinary meta-research[2], researchers are navigating a field in which few established or best practices may yet exist (Interviews 53 & 57, 2023). As a result, they find themselves balancing between methods they already know and trust and new approaches that offer opportunities for discovery and adaptation. Within this dynamic pair, we identified four dimensions:

(i) *Seeking Familiarity.* As regards selecting methods to investigate inter- and transdisciplinary research practices, several interviewees admitted that their selection was based on *familiarity*: they used a method they liked, which fit them, or which they were comfortable with due to their training or previous experience. The phrase "that [method] was some of the things I know" (Interview 32, 2023) illustrates the influence of personal experience and expertise on method selection, as also indicated by the quotes below:

> I have always done interviews; I have always done focus groups. So maybe it is also what I am used to and what I feel comfortable with. (Interview 01, 2023)

> This is one method that does it, and there are several other methods to do the same thing, but I was really first trained in that method. (Interview 30, 2023)

> The only thing I learned is this approach, and I applied it and did not have enough time to study more approaches. (Interview 46, 2023)

It becomes clear that when researchers are dealing with a topic on which little research yet exists (in this case, inter- and transdisciplinary meta-research), there is a notable urge to use at least one method that is already familiar.

(ii) *Willingness to Explore*. Few interviewees expressed a willingness to explore new methods. Those who did so were primarily driven by the perceived need to make the case for the validity and quality of their research. Meanwhile, six interviewees emphasised that they place their trust in collaboration when exploring an unfamiliar approach to investigating inter- and transdisciplinary settings:

> It was a classic method from STS, which I had never tried, I had never done, and I was in a situation in which it was easy to go into collaboration with some of the scientists working in my institute. (Interview 69, 2023)

> What I do is I try to get partnerships, people who have a very good knowledge of the tools that can help me build the instrument of analysis, which can help me treat the data. (Interview 51, 2023)

At the same time, ignorance of differences in research cultures was highlighted as "a real problem for collaboration" (Interview 06, 2023). Thus, awareness and navigation of such differences are considered crucial to reap the potential benefits of collaboration for the investigation of inter- and transdisciplinary research practices.

(iii) *Inability to Reason about Choice of Method*. The most frequently cited reason (17 interviewees) for choosing a method was that it fit the research problem, as illustrated by the quote below:

> I chose the method because it was the best method for my question. (Interview 50, 2023)

However, interviewees often struggled to define what this 'fit' meant in practice or why a given method was the best to study inter- and transdisciplinary settings. Their answers suggest that they did not approach method selection as a proactive reflection on the strengths and weaknesses of different methods, grounding their choices in context and goals, but rather as a 'gut decision' – going with an ambiguous, intangible fit between the method and research question at hand. The quote below exemplifies this:

> I am not sure that I have got evidence that I would rely on that (...) the organic approach and the particular methods that have emerged are the right methods and are delivering (...) best outcomes or anything like that. (Interview 57, 2023)

However, as one interviewee aptly stated, "if someone focuses on one method, this has consequences with regard to what knowledge he or she can produce" (Interview 38, 2023). It is therefore crucial for researchers to take a methodological approach that allows them to be sure that when familiar territory is left behind, it is left behind intentionally, with a purpose in mind, as highlighted in this quote:

> What you really need is to have a methodological approach that gives you an overview of where you want to go, what your objectives are, and how these specific methods serve the bigger purpose of understanding. (Interview 40, 2023)

Interestingly, the question of which methodological approach to take might be more important than the question of which method is used.

(iv) *Role of Capacity Building*: More than ten interviewees reported that they had never been trained in the social sciences or humanities (SSH) yet applied SSH methods in their work. While some strive for collaboration, as described above, the analysis also revealed a tendency to learn methods *on the job*:

> We were a group of four people, all doing qualitative social sciences. I was learning it on the job; I had no training in qualitative social sciences. (Interview 23, 2023)

> What I am doing now is being part of it and learning by doing it and then going out again and reflecting on it. (Interview 50, 2023)

> It was just learning by doing ourselves, initially, basically because we did not yet know how to systematically monitor and evaluate [transdisciplinary practices]. (Interview 70, 2023)

This finding is part of a fundamental problematisation of the need to develop capacities, skills, and resources to investigate inter- and transdisciplinary practices. It relates to the observation above that the selection of methods demands a substantial, intensive engagement with the method itself to grasp the dynamics of ID/TD and enable researchers to navigate familiarity and exploration in a meaningful way. The following quote is indicative:

> The methods and tools (...) are really important, but you have to go a step further. What is the capacity of the researcher to choose the appropriate method for the particular project in a particular setting, and I think that can be (…) taught in some research method course. (Interview 25, 2023)

In summary, when navigating familiarity and exploration, researchers investigating inter- and transdisciplinary research settings follow the motto summarised by one interviewee as "no method is perfect. You are always going to miss something" (Interview 19, 2023). Rather than striving for a one-size-fits-all solution, the interviews suggest that researchers should focus on understanding the strengths and limitations of different methods and selecting approaches accordingly. Hence, researchers should choose their methods and research objects by balancing their familiarity with particular methodologies and their existing knowledge of the research object. In this process, researchers often navigate a continuum between familiarity and exploration – using tried-and-tested methods they know well while also remaining open to new approaches that better suit the unique challenges of inter- and transdisciplinary contexts, which implies a learning process for the individual researcher and for the team. Awareness and justification of method selection are considered more important than achieving methodological perfection or eradicating all methodological weaknesses.

This balance between familiarity with existing approaches and exploration of new ones intersects with another pair: the balance between rigidity and adaptability. While some researchers prefer structured, systematic protocols, others emphasise the need for flexibility to respond to evolving inter- and transdisciplinary contexts.

Systematisation and adaptability

When investigating ID and TD, researchers balance systematisation and adaptability in their methodological approaches. The interviews revealed a balancing act between those who consider systematic approaches to be rigorous and desirable and those who argue that such approaches are too rigid and constraining and propose that adaptability allows researchers to flexibly respond to the emergent, dynamic nature of inter- and transdisciplinary contexts. Notably, these different attitudes reflect different perceptions of how to do research. Below, we elaborate on four dimensions, demonstrating that these two qualities are co-constitutive and mutually reinforcing rather than opposing forces.

(i) *Need for Adaptability*: The interviewees generally agreed that adaptability is a crucial component of inter- and transdisciplinary meta-research. One interviewee explained that "what works (...) is always tailor-made", since "everything is quite contextual" (Interview 70, 2023). This quote indicates that adaptability is inherent to study ID/TD, as this kind of research is characterised by a certain unpredictability. Many aspects only emerge during the research project, to which the researcher must be able to react. These considerations led several interviewees to contrast the necessary adaptability with a systematic approach:

> To me, it seems an anachronism to be purer than pure in terms of framework when you are working in a transdisciplinary project because emergence and uncertainty and flexibility are so critical to any successful project. (...) I need something that is more eclectic. (Interview 39, 2023)

> (…) Probably [my selection of methods] gravitates towards methods that are flexible and adaptable

> because it is a method of working that is quite organic. I guess I do not use a lot of rigid methods that require a very systematic procedure. (Interview 57, 2023).

At the same time, various interviewees were able to demonstrate the contributions of a systematic approach, as shown in the next section. Notably, as highlighted by one interviewee, adaptability and combination go hand in hand:

> You have to adapt, and I believe, personally, you also have to combine. (Interview 45, 2023)

Combining several methods allows researchers to capture the complexity of inter- and transdisciplinary research endeavours, making room to "catalyse divergent thinking, but at the same time (…) to develop convergent thinking" (Interview 27, 2023). Mixed methods were highlighted as a meaningful approach to inter- and transdisciplinary meta-research by 11 interviewees.

(ii) *Contributions of Systematisation*: Several interviewees pointed out that a completely organic, non-systematic approach prevents the transferability of findings. Others highlighted the role of a rigorous approach in enabling systematic evaluation, which they understand as crucial to make the case for the value of meta-research:

> Your approach must also be adaptive when you have a meta-perspective because you have to grasp all these specificities and then always ask, yes, there are differences, but where are the similarities behind this? (Interview 52, 2023)

> We still do not have sufficient funding for these meta-studies (…). It is getting better because most research funding agencies are becoming aware of (…) how important it is to follow a more rigorous approach, which usually calls for evaluation and meta-studies. (Interview 52, 2023)

> If we are not being systematic about evaluating [inter- and transdisciplinary] research projects (…), it is going to continue to be difficult to have that conversation about why I should allocate extra funding to [investigating these practices in their own right]. (Interview 57, 2023)

As one interviewee observes, it is necessary to demonstrate the benefits of research projects "in terms that are going to make sense to stakeholders" when making the case for the value of ITD meta-research (Interview 57, 2023). Hence, despite all the enthusiasm for completely adaptive and emerging approaches, researchers need to demonstrate a certain rigour in their approach when investigating inter- and transdisciplinary research practices – at least in the current funding system.

(iii) *Documentation as a Sensible Step*: Documentation could represent a minimum consensus on the balance between systematisation and adaptability. Two interviewees reported how little established documentation is available for conducting meta-research. This lack can easily be linked to the highly individualised, emerging methods that were mentioned above:

> Many of these methods that we developed (…) in doing research about inter- and transdisciplinarity are not documented. (Interview 38, 2023)

> There are plenty of examples of that stuff that were embedded in the ethnographic work that I did, which I have not really written about as a method. (Interview 72, 2023)

Therefore, documentation represents a sensible step to navigate systematisation and adaptability. It may not be necessary to render the entire approach rigid and highly structured, but documentation is a necessary measure enabling adaptability to be detached from hard-to-follow arbitrariness.

(iv) *Role of a Formalised Theoretical Basis*: One interviewee highlighted that the systematisation of their approach was constrained by the lack of a formalised theoretical basis:

> We did not really have a strong or a very formalised theoretical basis. So, we drew upon some ideas in the literature, and then we developed the whole conceptual framework. It was not very rigid. (Interview 28, 2023)

This comment is intriguingly linked to an observation shared by three other interviewees: that

there is a lack of consolidated understanding of what certain methods, concepts, and approaches encompass when investigating inter- and transdisciplinary practices:

> People are talking about specific pieces and specific questions (…) without understanding what the final purpose of things is. The discussions are terrible because people are discussing completely different details, even if the name of the method is the same. (Interview 40, 2023)

> The problem is that the theoretical backgrounds of these concepts are not compatible. (…) You cannot bring them together because of the methodological differences. (Interview 42, 2023)

This consolidated understanding "can only be discussed within a community" (Interview 38, 2023); however, this very community (i.e., of those interested in investigating ID/TD, their methods, and their conceptual underpinning) is lacking:

> A lot of methods were introduced in a toolbox. (...) But I would say it is not a super-systematic approach, and it cannot be because the community is not yet very consolidated. (Interview 21, 2023)

Balancing rigidity and adaptability raise questions about what insights can be generalised across projects and what must remain context specific. ID and TD often operate in highly specific contexts, yet researchers strive to produce knowledge that can inform broader scientific and societal debates (Wuelser et al., 2021).

Transferability and contextualisation

The third dynamic pair – transferability and contextualisation – concerns researchers when it comes to making insights tangible. In investigations of inter- and transdisciplinary research practices, researchers must balance the unique, context-specific nature of each project with the desire to produce transferable insights that can inform broader scientific and societal debates. While contextualisation ensures that findings remain rooted in local realities, transferability allows researchers to compare and share knowledge across cases. This point relates to both the approaches they use and the insights that have emerged from the project, as we show in the following four dimensions.

(i) *Context-specific Nature of Inter- and transdisciplinary Projects*: The interviewees emphasised the difficulty of comparing inter- and transdisciplinary projects due to their unique and context-embedded nature. Context-specific factors, for example, limit the transferability of findings:

> If you have multiple cases and you want to compare them, that makes it more difficult because every transdisciplinary project is so unique and embedded into the context that it is hard to compare one project against the other. (Interview 54, 2023)

> There is a lot of learning for the people involved, but to step back from it and then say, "Alright, what can we take from that process to apply somewhere else?" We can do it because we were involved in it, but for someone else looking at it, they would say, "That was so deeply context dependent that I cannot see what I can use from that in my own situation". (Interview 57, 2023)

> It's very difficult to generalise about inter- and transdisciplinary projects. We tried, it's very difficult. (…) The context specificity matters, and each project and each context and each culture is unique and has its unique issues. (Interview 69, 2023)

One interviewee also highlighted that inter- and transdisciplinary research "is not replicable" (Interview 15, 2023), contrasting this aspect with the uniqueness and complexity of contexts in which ID or TD take place.

(ii) *Interest in Transferability:* Thirteen interviewees acknowledged their interest in being able to transfer insights and learnings between projects, indicating their challenges when it comes to transferability:

> We are far from knowing exactly why things work. Sometimes they do work, and we will be trying to generalise and abstract from this next time, just the same thing did not work. We see why it worked last time, but it did not work this time. (Interview 29, 2023)

The interviewees predominantly highlighted their individual approaches to different projects, which fits with the inherent adaptability discussed above, leaving several interviewees wondering how transferability could be achieved:

> We don't have many processes (…) [and] each of them is unique. So, how can you compare or not compare? (Interview 29, 2023)

> What exactly do we have to document, and what exactly is transferable to other [inter- and transdisciplinary] contexts, and what is context-specific, and what is over-documenting? You can over-document anything, and you can destroy data by documenting the data. (Interview 38, 2023)

Evidently, it is not easy to generate transferable insights in meta-research on inter- and transdisciplinary practices, in part because the number of projects researched is often relatively small and thus "a big statistical data analysis" (Interview 29, 2023), for example, is not possible.

(iii) *Comparability rather than Generalisability:* Several interviewees suggested making the insights and approaches from one case at least comparable with *some* other cases and not striving to develop generally valid findings. The following quote highlights the balancing act researchers face:

> I think the limitation is that we are losing the specificity of the individual case. That's always the case in these difficult conversations between quantitative and qualitative approaches. But I feel we need to find a hybrid there. We need to be detailed enough and qualitatively oriented enough to understand the inner mechanics of these projects and, at the same time, not make them too specific, so that they are not comparable to others anymore. (Interview 53, 2023)

Another interviewee highlighted the potential of analogies to achieve transferability with a focus on comparability rather than assuming sameness between different projects:

> The transferability is based on analogy, not on causal structure. Analogy basically says there were similar things happening, but they are not the same. (Interview 29, 2023)

Thinking about analogies in a somewhat more abstract way and defining a few cornerstones or markers along the lines of the strategies described above can ease the apparent tension between context-specific approaches and the demand for generalisable findings, especially from research funding bodies.

(iv) *Role of Systematisation*. Some interviewees argued that systematic approaches can help researchers identify similarities across cases, moving beyond context-specific insights:

> [My colleague] is looking at how you can try and essentially systematise that kind of scenario development process that you could compare across different organisations, geographic locations, and even sectors, potentially. (Interview 57, 2023)

Another interviewee suggested that overarching frameworks or protocols could provide structured ways to document and compare inter- and transdisciplinary projects:

> A lot of people are working on a lot of different overarching frameworks that could help make different projects or experiments more comparable. (Interview 33, 2023)

Agreement among researchers about using a certain framework to evaluate and study inter- and transdisciplinary processes would provide two things: "a scheme that is transparent" (Interview 53, 2023) and the possibility of doing research "in a similar way" (Interview 53, 2023), which makes cross-case comparisons easier. However, the community would need to agree on which framework to use, and, as outlined above, it is not yet sufficiently consolidated to produce a consensus.

As researchers navigate transferability and contextualisation, reflection plays a crucial role in identifying what insights can be shared across contexts and what remains unique to a specific project. This point leads to the final symmetry: balancing reflection and action.

Reflection and action

The last pair – reflection and action – represents a common challenge researchers face in a variety of fields: the need to balance critical reflection on processes with practical engagement in real-world challenges (Interviews 53, 57, and 59, 2023). Reflection allows researchers to learn from experience, evaluate methods, and improve future projects. Action not only provides new material for reflection but can also underline the value of research on inter- and transdisciplinary practices by highlighting its relevance to practice through the four dimensions on which we elaborate below.

(i) *Crucial Need for Reflection*: Eight interviewees agreed that reflection is essential to inter- and transdisciplinary meta-research, arguing that taking time to critically assess processes and methods leads to better outcomes and more meaningful insights:

> We said in this workshop that we had people who do not reflect on inter- and transdisciplinarity, and they should start justifying why not. (Interview 04, 2023)

> I do think also that this meta-level research is very valuable and […] was based a lot on self-reflection of those involved in the processes. (Interview 65, 2023)

The interviewees described how reflection helped them to document decisions, identify blind spots, and understand why certain methods worked or failed. Furthermore, methodological awareness is directly linked to a certain level of reflection, as the following quote illustrates:

> We have not stepped back to the point of evaluating whether there is a better way to do this, necessarily. (…) There is some sort of tacit evaluation going on, but the risk of that kind of organic approach is that there was a better way to do things, and you will not know because you never compared what it would have been like without the intervention that you were involved in. (Interview 57, 2023)

Reflection is, therefore, an important component when it comes to research on ID/TD. The need for reflection is also due to the fact that meta-research is not yet an established field and that many insights are still emerging from the practice itself.

(ii) *Prioritising the Relevance to Practice*: Several of the research objectives, advantages of methods, and best practices explored in the interviews come down to prioritising the relevance of inter- and transdisciplinary research to practice:

> We also try to learn from cases that have not been successful from their own perspective to discuss what could have been better. (...) [Teams] also have a benefit from reflecting and discussing with us. (Interview 52, 2023)

> We are working very closely with practice to generate knowledge, but that knowledge has its main reference point of whether it can be reused in practice. Otherwise, we are writing all these papers nobody reads, nobody uses. (Interview 53, 2023)

The focus on relevance to practice is also contextualised by the various interviewees who described having to advocate for the value of and funding for their research. If one considers "who sits in the position of grading or evaluating research proposals" (Interview 56, 2023), often scholars that come from a specific disciplinary background, it becomes clear that relevance to practice is a highly valued characteristic of research – at least in established research funding contexts, to which, accordingly, research on inter- and transdisciplinary research must conform.

(iii) *Understanding Reflection and Action as an Iterative Process*: Many interviewees emphasised the interdependence of reflection and action, describing it as an ongoing, iterative process. One interviewee, for example, explained:

> I have both, the doing and reflecting, and I have the impression they nurture each other (...) So, having the time to reflect and then sitting down and writing down the lessons I have learned (…) and then also bringing it back to the scientific community and bringing the scientific knowledge (…) into the different projects I am involved in. (Interview 04, 2023)

While practical engagement is crucial, several interviewees emphasised that structured reflection is necessary to ensure that investigations on inter- and transdisciplinary research generate meaningful insights. The challenge of balancing reflection and action is deeply embedded in methodological choices and in the roles the researchers play in the meta-research process. Methods shape whether inter- and transdisciplinary researchers prioritise structured reflection and documentation or focus more on immediate, practice-driven engagement. Some interviewees warned that inter- and transdisciplinary research might miss opportunities for learning:

> I think the gap or the lack in quality of transdisciplinarity is also a result of a lack of reflection. What I always say is, what is the specific added value of transdisciplinarity? What we can see in transdisciplinary projects is that we have either, one, a focus on the scientific outputs, or we have another imbalance in those projects that are only for the practice. So, scientists are more like a service unit that supports the practice. […] I think about what we can learn from those projects, what the scientific added value is; this is something you have to go back to and reflect on. (Interview 50, 2023)

At the same time, one interviewee described the pressure to *just do things* without taking time to step back and reflect, which can limit opportunities to learn from inter- and transdisciplinary processes:

> I hear, "Stop reflecting, stop theorising, just join us and let's do things." On that, I am not so optimistic, and probably […] we need to find a language and maybe also better arguments, and this preparedness to contribute something "practical", not just pointing the finger but also engaging and showing how it works and also openly speaking about it. (Interview 59, 2023)

It is therefore important to have both space and opportunities for reflection and the willingness to generate insights that are not only relevant for academia but applicable in practice.

(iv) *Role of Being an Inter- or Transdisciplinary Researcher/Practitioner*: One way to navigate reflection and action might be that investigations of inter- and transdisciplinary research practices must be interdisciplinary or transdisciplinary in themselves:

> I think that is an interesting question to ask (…): how far should it be a transdisciplinary thing in itself, or if not, what are the reasons? (Interview 23, 2023)

> To study inter- and transdisciplinary [research], we must be the example, we must practice what we preach. (Interview 27, 2023)

As previously highlighted, a large proportion of those who engage with a meta-perspective on inter- and transdisciplinary research have practical experience with such research themselves. The balance between reflection and action requires inter- and transdisciplinary researchers to avoid becoming stuck in abstract reflection while also ensuring that practical outputs remain grounded in critical insights.

Discussion

This study calls attention to a critical understanding of the methods and methodological decisions made by scholars when investigating inter- and transdisciplinary research practices and policies (MacLeod et al., 2019). Below, we discuss our findings in light of the two research questions guiding this article: (i) how do researchers investigating inter- and transdisciplinary settings conceive of and select methods? and (ii) what implications do these conceptions and methods have for how ID and TD are understood, experienced, and supported? The implications for each question are discussed in a dedicated section.

How researchers conceive of and select methods when investigating inter- and transdisciplinarity

Our study shows that researchers investigating inter- and transdisciplinary research practices conceive of methods not as fixed tools, but as dynamic constructs shaped by how they navigate four interrelated dynamic pairs: (a) familiarity and exploration, (b) systematisation and adaptability, (c) transferability and contextualisation, and (d) reflection and action. Each pair represents

a balancing act with which researchers must actively engage, seeking methodological pluralism (Mol, 2002). Our findings highlight that the four dynamic pairs are interdependent. Synergies often span multiple dimensions as shown in our findings. For example, some researchers found that systematic approaches facilitate the transferability of findings, while others associated systematisation with discomfort and methodological unfamiliarity, exemplifying how different dimensions across pairs might go together.

The conceptualisation of methods presented in the findings together with the four pairs open new ways to problematise how ID and TD are practised and understood (Vienni-Baptista and Pohl, 2024). Following Foucault (1984), problematisation as a mode of inquiry repositions methodological assumptions on how methods – which are far from neutral tools – perform and transform the very practices of knowledge-making (Law, 2004; Mol, 2002). This aspect was unfolded in our study. First, the balancing act between familiarity and exploration highlights the need for both methodological grounding and openness. Familiarity provides confidence and tacit expertise, which are particularly important in complex inter- and transdisciplinary environments. However, studying inter- and transdisciplinary research practices often demands methodological innovation and toolkitting – venturing into unfamiliar territory to account for the unique, emergent, and often messy realities of inter- and transdisciplinary practices (Bammer et al., 2020; Laursen et al., 2024). As a result, the process of "learning by doing" has a fundamental impact on how researchers design their investigations of inter- or transdisciplinary research, as our interviews showed.

Second, the balance between systematisation and adaptability illustrates contrasting views on methodological rigour (Devezer et al., 2021; Harley and Cornelissen, 2022). Some authors have advocated for systematic approaches as a means of ensuring consistency and credibility, enabling the transferability of approaches and insights in inter- and transdisciplinary research (Wuelser et al., 2021). Other authors, in line with what our study showed, caution that rigid frameworks may hinder the flexibility needed to respond to the emerging, iterative nature of inter- and transdisciplinary contexts (Lury, 2018). In a similar vein, for many interviewees, adaptability is not a sign of methodological weakness but a core strength, allowing responsiveness to evolving conditions in the field.

Third, the dynamic between transferability and contextualisation reflects the dual aspiration to produce insights that are both locally grounded and broadly relevant. While contextualisation anchors research findings in specific settings, enhancing their situated meaning and practical resonance, transferability enables the movement and adaptation of insights across cases and contexts (Flyvbjerg, 2006). Researchers are thus tasked with balancing the richness and specificity of local knowledge with the need to contribute to wider theoretical or methodological conversations within and beyond their disciplines. This negotiation is particularly salient in the study of ID and TD, where methods must simultaneously attend to context and abstraction. As we showed, this meta-research perspective also implies shifting roles in the conceptualisation of methods: the same researchers act both as practitioners within collaborative projects and as meta-researchers reflecting on how such projects are studied and represented (Felt, 2017).

Fourth, the interplay between reflection and action underscores the iterative and co-productive character of research processes in inter- and transdisciplinary enquiries. Reflection enables learning, methodological refinement, and critical engagement with the assumptions underpinning research practices (Nicolini, 2009). Action, understood as engagement with real-world contexts and collaborators, not only provides the empirical ground for reflection but also performs the practical and societal relevance of research (Nowotny, 2016). In our study, this dynamic pair highlights that methods are not static but evolving practices shaped through cycles of doing and thinking – a process central to how inter- and transdisciplinary researchers conceptualise, test, and transform their methodological repertoires (Laursen et al., 2024). In this sense, reflection and action together enact a virtuous cycle of methodological learning, where inquiry itself becomes

a site of experimentation and knowledge co-production (Law, 2004; Mol, 2002).

Importantly, our interviews suggest that there is no one 'best' method for meta-research on ID and TD. Rather, effective research hinges on the strengths, limitations, and epistemic assumptions of different methods. Method selection is therefore not merely technical, but inherently political and epistemological, shaping what kinds of knowledge are considered valid and valuable (Law, 2017).

In our study, methodological awareness and justification were considered more important than achieving methodological perfection. Actions such as combining and tweaking certain methods were accompanied by choices that align with the goals and purpose of the project at hand. Reflexivity, which is a primary topic in the STS scholarship (Bourdieu, 2004; Latour, 1987), involves turning inquiry onto oneself, examining the investigative process as part of the investigation. It transforms the 'subject' into the 'object' of study, and it aligns with the critical perspective that inter- and transdisciplinary research also seeks to achieve (Vienni-Baptista et al., 2022). Within STS, reflexivity serves as a critical tool (Law, 2004), highlighting the multiplicity of ontologies and the situated nature of knowledge production.

The growing number of toolkits that provide methods, frameworks, and other resources for designing and implementing inter- and transdisciplinary research (Laursen et al., 2024) signals an increasing interest in structured support. To date, however, no such toolkit exists for methods to study ID and TD. Developing such a resource could support researchers in navigating complex methodological decisions.

Implications for inter- and transdisciplinary meta-research

Our analysis of how researchers navigate four dynamic pairs when investigating inter- or transdisciplinary research practices yields several implications for inter- and transdisciplinary meta-research and how these are understood, experienced, and methodologically supported, contributing to the second question guiding this article.

The first methodological implication relates to the foundations of meta-research: our findings suggest that research on inter- and transdisciplinary research should strive to embody the very principles of ID and TD. In other words, the study of inter- and transdisciplinary research benefits from being inter- and transdisciplinary itself. This recursive insight is grounded in our observation that many of the core concepts, principles, and practices from inter- and transdisciplinary research – such as integration (Hoffmann et al. 2022; O'Rourke et al., 2016), reflexivity (Klein, 2021; von Wehrden et al., 2019), and bridging epistemological differences (Khoo et al., 2018) – are not only subjects of study but also useful for conducting the research itself.

Second, collaboration emerges as a critical enabler of high-quality research on ID and TD, as stated and discussed in both STS (Bourdieu, 2004) and inter- and transdisciplinary scholarship (Klein, 2021). Collaborative arrangements were indicated in the findings as allowing researchers to integrate unfamiliar methods, leverage diverse expertise, and navigate the complexity inherent in inter- and transdisciplinary settings. Moreover, collaboration with practice partners can enhance the societal relevance and impact of the meta-research, bridging the often-cited gap between theory and application (see, for example, Schneider et al., 2019).

Third, our findings emphasise the potential of employing mixed methods approaches. The interviewees suggest that the complexity of studying inter- and transdisciplinary research cannot be adequately captured through single-method designs. A mixed-methods framework provides the flexibility to address both the contextual nuances and the systemic patterns inherent in inter- and transdisciplinary processes, allowing for more comprehensive and layered understandings.

Last, we identify the need for improved documentation of methodological decisions and research processes. The interviewees frequently cited insufficient documentation as a key obstacle in conducting and evaluating research on inter- and transdisciplinary research practices. MacLeod et al. (2019) have advocated for documenting empirical investigations that provide systematic ways of tracking various aspects of the inter- and

transdisciplinary processes. Addressing this gap can not only improve the replicability and credibility of meta-research on ID and TD but also serve as a valuable resource for training and guiding new researchers entering the field. It would also provide insights on how and why these collaborations may fail and how to leverage their effects in science and policymaking (Fam and O'Rourke 2021; MacLeod, 2018).

Despite its contributions, this study has two main limitations. Its geographical focus is predominantly on scholars and literatures from the Global North, which may narrow the perspectives represented and overlook alternative conceptualisations and inter- and transdisciplinary practices emerging in other contexts. Additionally, while the semi-structured interviews facilitated focused insights, their format may have constrained the participants' narratives and limited the interactive exchange possible in formats such as focus groups or workshops.

Conclusions

While much existing work has focused on how to perform ID and TD or which tools best support collaboration, less attention has been paid to how these research modes are conceptualised, enacted, and methodologically investigated. Grounded in STS, this article operates at two intertwined levels: analysing how scholars conduct meta-research on ID and TD and reflexively examining how such studies enact particular realities of collaboration. Rather than framing apparent oppositions as tensions to be resolved, it advances the notion of productive dualities in four interrelated and dynamic pairs. In doing so, the article strengthens the conceptual and methodological foundations of research on inter- and transdisciplinary research.

This article makes three primary contributions. First, it helps consolidate a fragmented and scattered body of scholarship by articulating inter- and transdisciplinary meta-research as a distinct field of inquiry, thereby creating a clearer conceptual space for future studies. Second, it introduces an ontological multiplicity lens to the study of how ID and TD are themselves investigated, shifting attention from evaluating outcomes to examining how different methodological realities are enacted in meta-research practices. Third, it demonstrates how researchers navigate methodological complexity specifically within inter- and transdisciplinary meta-research, making visible the tensions, trade-offs, and strategies that shape the study of collaborative knowledge production. The emphasis on "learning by doing" foregrounds the four dynamic pairs, while posing two main challenges in the consolidation of a research agenda on investigations of inter- and transdisciplinary research. First, in our study, those who engage with a meta-perspective on ID and TD typically also have practical experience in these collaborative settings. A focus on 'doing, doing, doing' without systematically documenting decisions, reflecting on failures, or critically examining what is happening limits the potential for meaningful inter- and transdisciplinary research. Second, inter- and transdisciplinary meta-research must avoid becoming stuck in reflective elaborations that remain disconnected from practitioners' needs and real-world contexts.

From an STS perspective, our study on inter- and transdisciplinary meta-research is not simply an exercise in methodological assessment, but a necessary space for reflexive inquiry into how collaborative knowledge practices are organised, legitimised, and transformed. By examining how researchers themselves construct and negotiate the boundaries of collaboration, evidence, and relevance, meta-research reveals the epistemic, institutional, and political conditions that shape what counts as good or valuable research (Felt, 2017; Law, 2004). Such reflexivity is essential if ID and TD are to move beyond policy rhetoric and become genuinely transformative modes of inquiry (Vienni-Baptista, 2024a). Attending to the performativity of methods – how they enact specific worlds, relationships, and futures – allows STS scholars to not only critique but also reimagine how interdisciplinary collaborations can contribute to more just, situated, and responsible forms of knowledge-making (Mol, 2002; Frickel et al., 2017; Vienni-Baptista et al., 2022).

Further studies into how meta-research is conducted in inter- and transdisciplinary research and policy settings will help consolidate a coherent methodological and theoretical corpus

with potential impacts on how these practices are designed, assessed, and funded. Additionally, efforts to consolidate a scientific community focused on studying inter- and transdisciplinary research practices will contribute to recognising the expertise and competencies researchers need to engage meaningfully in this type of work (Bammer et al., 2020).

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Notes

1 For more details, see: https://csts.ethz.ch/research/intersections.html

2 In this section, we use the term 'inter- and transdisciplinary meta-research' following the term coined by the interviewees.