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Lost in a haze or playing to partners' strengths? Learning to collaborate in three transdisciplinary European Living Labs

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ABSTRACT

The ability to learn from each other plays a central role in successful transdisciplinary (TD) collaboration. This article systematically investigates how learning to collaborate allows researchers and practitioners to navigate the challenges of collaborative TD work. Drawing on social learning theory, we emphasise the processual nature of social learning in TD research as *learning to collaborate*. We examine collaborative learning processes in three Living Labs located in different socio-cultural and institutional contexts in Europe. The Living Labs explored the conditions for mutually beneficial rural-urban relations. We use data from a systematic monitoring of a 4-year Horizon 2020 research project. Our analysis illustrates how learning in and through collaboration can enhance individual and collective capacities to deal with different perspectives, priorities, and approaches, enabling the achievement of transformative objectives. We also show how particular factors and conditions lead to differing learning histories and a lack of attention to learning processes may result in challenges to collaboration. This provides a more encompassing understanding of the complex learning dynamics underpinning TD research. We argue that an intentional focus on collaborative learning processes is essential to fulfil the aspiration of TD research to contribute to creating knowledge and capacities for the co-production of sustainable futures.

1. Introduction

The need to tackle complex sustainability challenges has led to the development of approaches that engage societal actors in generating innovative solutions by supporting decision-making and implementing change, so-called transdisciplinary (TD) research

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(OECD, 2020; Takeuchi, 2014). In this article, we argue that TD research, given its experimental and learning-based approach to knowledge generation and change, shapes "pockets of future in the present".[1] These "pockets" may inform novel pathways and create transformative knowledge and capacities for the realisation of more desirable and sustainable futures (Mobjörk, 2010; Schauppenlehner-Kloyber & Penker, 2015; Wolfram, 2016).

Living Labs are a form of TD sustainability research supporting learning-oriented and experimental work at the science-society interface (Schäpke et al., 2018). Actionable recommendations and concrete intervention strategies result from meaningful involvement of societal actors (Hirsch Hadorn et al., 2006). Collaboration in Living Labs is considered to be "on an equal footing" throughout the TD process (Scholz & Steiner, 2015). However, to date, empirical work has demonstrated that collaboration in TD research, including in Living Labs, comes with numerous challenges, including the difficulty to successfully navigate different values, stakes, and knowledge in science-practice collaboration or because of institutional barriers (Brandt et al., 2013; Hakkarainen & Hyysalo, 2013).

Social learning is fundamental for successful TD research in Living Labs when addressing complex and fast changing situations and challenges (Vilsmaier et al., 2015; Westberg & Polk, 2016). Social learning in TD research refers specifically to researchers' and other actors' capacity to learn to collaborate (individually and as a group) to successfully navigate the challenges that emerge when dealing with different perspectives, priorities and approaches (Schäpke et al., 2018). This kind of learning is essential, for example, when multiple actors develop strategies together or when projects are designed to enhance the transformative capacity of individuals, institutions and entire systems (Svare et al., 2023). Thus, social learning is not only central in supporting better research, but is also essential to envision, design, and foster sustainable futures in ways that emerge from the confrontation and integration of multiple voices, interests and values (Schauppenlehner-Kloyber & Penker, 2015). Yet, social learning does not evolve from mere 'co-existence' of multiple actors with their diverse practices and often incommensurable perspectives (Akkerman, 2011; Hakkarainen & Hyysalo, 2013). Rather, it needs to be intentionally and continuously fostered (Freeth & Caniglia, 2020; van Mierlo et al., 2020).

Despite its acknowledged importance, studies of social learning in sustainability science and TD literature are often fragmented and make use of instrumental conceptualisations, where learning is usually addressed as a means to other ends, for example for knowledge integration or adaptive management (see Armitage et al., 2008; Westberg & Polk, 2016). Indeed, it is rare to find studies that carefully scrutinise what social learning entails, when and how it occurs, and its role and potential contribution to more sustainable futures (Svare et al., 2023; van Mierlo & Beers, 2020; Van Poeck et al., 2020; Westberg & Polk, 2016). Furthermore, there is a tendency to either look at individual learning, such as in education-oriented literature (Akkerman, 2011) or to focus on the social dynamics of learning (Keen et al., 2005; Leeuwis & Pyburn, 2002), which creates an obstacle to capture the interwoven individual and social learning processes that take place in collaborative settings.

The aim of this paper is to fill these gaps and to examine how researchers and societal actors learn to collaborate individually and collectively in TD research. We empirically investigated how social learning took place in three Living Labs, by detailing researchers' and practitioners' development of a capacity (or lack thereof) to *learn to collaborate* when navigating the many perspectives, priorities and approaches of different actors in TD work. The three Living Labs were part of the EU-funded Horizon 2020 project *"Rural-Urban Outlooks: Unlocking Synergies"* (ROBUST).[2] The overarching project goal was to understand and enhance mutually beneficial rural-urban relations for the achievement of future-oriented development strategies of the European Union (Knickel et al., 2021a; Knickel et al., 2021b). The Living Labs addressed central topics for the future of rural-urban relationships, such as the role of natural capital and ecosystem services, land use practices, valorisation of a higher food quality through new relations between producers and consumers, and new models of regional cross-sectoral economic development (Knickel et al., 2021b). Identifying synergies and fostering change towards more sustainable rural and urban futures relied here on participants' capacities to learn individually and from one another, that is on social learning. We show how, depending on whether and to what extent participants were able to engage in collaborative learning processes, different Living Labs could deal effectively with differing views, priorities, and approaches over the course of four-year collaborative work.

In the rest of this paper, we first present a conceptual framework to examine social learning in Living Labs. Second, we introduce the methodological approach and explain how we investigated learning dynamics in the three Living Labs. In the results, we explore whether and how learning to collaborate occurred in the three Living Labs. In the conclusions, we synthesise the main factors conducive to developing a capacity to learn to collaborate for futures studies on TD sustainability research in Living Labs.

2. Conceptual framework

To guide the analysis of social learning processes between researchers and social actors in Living Labs, we combine two related but previously unconnected bodies of literature. The first deals with the methodological dimensions of TD sustainability research, with a focus on the relational and embedded nature of social learning (Schauppenlehner-Kloyber & Penker, 2015). The second focusses on Living Labs and collaborative spaces that rely on learning and experimentation (Voytenko et al., 2016). Through this synthesis, we conceptualise Living Labs as *collaborative epistemic living spaces* (Freeth & Caniglia, 2020) and adopt *learning to collaborate* as an analytical lens to characterise the main features of social learning in TD research (Beers et al., 2016; Jahn et al., 2012).

[1] Source:https://www.stockholmresilience.org/research/research-videos/2018-09-30-finding-transformative-potential-pockets-of-the-future-in-the-present.html (Accessed on 19 July 2022).

[2] More on the ROBUST project and Living Lab work: www.rural-urban.eu (Accessed on 17 January 2023).

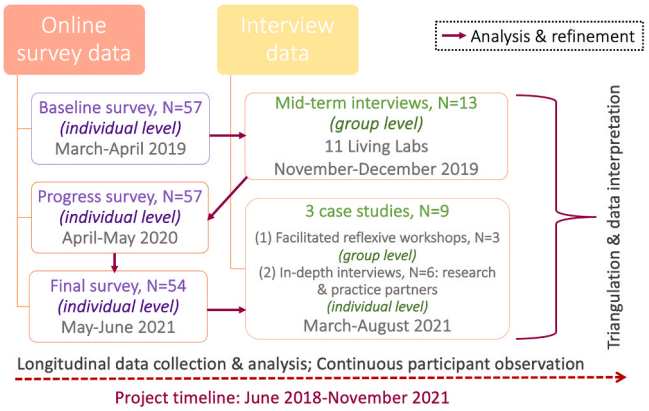

Fig. 1. Data collection for the three Living Lab cases and its intersection with wider monitoring and reflexive activities.

2.1. *Learning to collaborate in TD research as a form of social learning*

Studies on social learning in sustainability transitions and innovation studies suggest that "learning occurs continuously through experience as individuals or groups are confronted with real-life challenges, and as they learn to handle them." (Svare et al., 2023) Social learning emerges both from natural interactions taking place over time and in different configurations (e.g. meetings, email exchanges, activities within a project and outside it) as well as from facilitated exchanges introduced to foster learning, such as focus groups and workshops (Beers et al., 2016; Reed et al., 2010). In TD collaborative settings, learning is embedded in the dynamics of collaborative work. This perspective accords with experiential and relational learning (Baker et al., 2002; Klein, 1996) that focusses on how participants in collaborative processes "learn in situ and together [as a team] (learning as relational) from challenging experiences (learning as experiential)" (Freeth and Caniglia, 2020, p. 252).

The capacity to learn to collaborate while collaborating signify relational and experiential processes of learning, as actors process different approaches, perspectives and values (Freeth & Caniglia, 2020). This capacity can be conceptualised as a form of social learning. We adopt the social learning concept operationalised by Beers et al. (2016) to examine how researchers and societal actors learn to collaborate. The three components of social learning are:

- *Knowledge* as individual and shared insights and ideas, such as new problem definitions, new solutions, changed views, and new visions (Pahl-Wostl, 2006; Wals, 2007).
- *Actions* as agreements, decisions and other concrete steps that individual and groups take when making decisions and taking action (Ison et al., 2013; Sol et al., 2013)
- *Relations as* social roles, values, identities and positions of individuals and groups involved in collaboration (Leeuwis & Aarts, 2011; van Mierlo et al., 2010).

Social learning is both individual and collective. Although it is individuals who learn, not organisations, focussing exclusively on the individual level overlooks the social context where individual learning occurs (Fazey et al., 2005). In this study, we conceptualise social learning as learning to collaborate as an intertwined process of both individual and group learning processes (see Fig. 1).

2.2. *Living Labs as collaborative epistemic living spaces fostering partners' capacity to learn to collaborate in TD research*

The literature on Living Labs refers to them both as a space and as an approach (Hossain et al., 2019; Schäpke et al., 2018; Steen & van Bueren, 2017). For example, Voytenko et al. (2016) define Living Labs as both "an arena (i.e., geographically or institutionally bounded spaces) and … an approach for intentional collaborative experimentation of researchers, citizens, companies and local governments" (ibid. p. 2). In practice, Living Labs are often groups of actors from research, practice and policy who jointly develop innovative solutions to specific local challenges with the intention to explore new ways forward that are beneficial to all involved (Steen & van Bueren, 2017). This may entail the development and testing of new technologies, products, services, policy instruments, and planning tools as well as organisational forms and governance arrangements, or ways of living.

We adopt a concept of collaborative epistemic living space to conceptualise how learning to collaborate can help participants to navigate the challenges of collaborative work in Living Labs. The concept was originally proposed by Freeth and Caniglia (2020) to frame research collaborations both as multidimensional – epistemic, social, symbolic, spatial, and temporal dimensions – and as taking

Table 1
Key characteristics of the three Living Lab cases.

Key characteristics	'Drift'	'Dancer'	'Untapped'
Territorial level	NUTS 3	NUTS 3	Local Administrative Unit
Geographical location in Europe	South	North-West	North-East
Rural-urban characteristics	• Predominantly rural • Urban sprawl • Land abandonment in adjacent rural areas • Varied landscapes	• Predominantly rural • Urban sprawl • Close to urban centres • > 50% of land environmentally designated	• Predominantly rural • 60% of inhabitants in urban centre • Presence of remote and under-served areas
Key economic characteristics	• Agriculture • Gastronomy • Tourism with a focus on gastronomy and culture	• Agri-food • Cyber innovation • Tourism • Growing high-tech sector	• Food, metal and wood processing industries • Agriculture and forestry • Cultural and natural heritage-based tourism
Policy context	Political momentum for territorial planning and food policy	Interest in natural capital-based development in regional policy	Enlargement of municipality resulting from administrative reform
Population change (2015–2020)[a]	Slight decline	Significant increase	Significant decline
Overarching Living Lab goal	Develop a local food policy and territorial plan to reduce urban sprawl and foster synergies between city and countryside; valorise cultural heritage, landscape and territory	Assess the potential and feasibility of circular economy and natural capital growth models in the case study region; realise their potential for improved urban-rural linkages	Develop a coherent cultural strategy that realises the cultural potential for improved territorial cohesion and smart growth
No. of Living Lab members (Research + Practice)	9 (6 + 3)	6 (3 + 3)	8 (4 + 3)
Professional background of partners	Agricultural Economics, Planning, Regional Development, Environmental Sciences	Social Sciences, Planning, Environmental Sciences	Social Sciences, Planning, Regional Development

[a] The values are coded to respect the confidentiality of the Living Labs and are provided to illustrate the trend only.
Source: Own compilation based on data collected as part of the ROBUST project as well as (Eurostat, 2018, 2019, 2020; Knickel et al., 2021a; Knickel et al., 2021b).

place on a learning continuum that goes from comfort to discomfort. Certain levels of discomfort may occur in any of the dimensions in response to individual and collective experiences. Most learning occurs when teams are in what Freeth and Caniglia (2020) term a 'learning zone', where participants can learn how to cope with the challenging experiences of collaboration while working together on complex issues. In this paper, four of the five dimensions that played a significant role in the Living Lab case studies were selected, namely: epistemic, social, symbolic and temporal. The spatial dimension was not included as no link was evident in the empirical material relative to how Freeth and Caniglia (2020) defined it (i.e., as "ways in which different spaces enable or constrain collective research work"). This could be explained by the Covid-19 pandemic which led to the 'normalisation' of online communication. The four dimensions were employed to scrutinise how participants in Living Labs engaged in collaborative learning processes. Each dimension refers to specific issues:

- ***Epistemic:*** How knowledge should be generated, what defines 'good knowledge' (Felt & Fochler, 2012); levels of uncertainty, complexity, and novelty associated with the problem, and/or lack of consensus (Carew & Wickson, 2010).
- ***Social:*** Team members' relations in knowledge co-production (Felt et al., 2012), including emotional dynamics (Boix-Mansilla et al., 2012); psychological safety (Edmondson, 1999); ability to manage interpersonal tensions, conflicts, and consensus (Vilsmaier et al., 2017).
- ***Symbolic:*** Implicit and explicit power asymmetries, e.g. from those responsible for policy towards researchers, or researchers towards stakeholders (MacMynowski, 2007); differing and competing expectations, interests and values (Jahn et al., 2012); top-down approaches in governing research, expectations of research excellence or accountability (Felt et al., 2012).
- ***Temporal:*** Time-consuming nature of TD research; balancing immediate outputs (e.g. policy document) and longer-time outcomes (e.g. trust- and capacity-building) (Binder et al., 2015); tensions between delivering and reflecting (Cilliers, 2006).

3. Methodology

3.1. Empirical basis and selection of the case studies

Various factors influence learning in participatory processes, such as individual, organisational, cognitive, affective or behavioural (Ernst, 2019a; Gerlak & Heikkila, 2011). To reflect this multi-dimensionality, we combine a range of research methods to understand what factors, at what level, affect the way researchers and societal actors engage in TD collaboration. This includes also investigating what conditions are required to support collaborative work, tested empirically in three Living Labs, all part of the EU-funded ROBUST

project (2017–2021).

ROBUST was a TD research project by design, with each Living Lab co-led by a research and practice team. The former was represented by universities, research institutes and consulting firms, while the latter by municipal or regional authorities overseeing regional development planning and policy. The teams engaged with additional local and regional actors (e.g. policymakers, businesses and citizens) to experiment with new ways of organising rural-urban relations. Work Package 3 (WP3) provided guidance for the Living Lab work. A key baseline for the joint work was a Research and Innovation Agenda developed by each Living Lab. This project-level guidance allowed all Living Lab activities to be comparable while allowing for iterative revision over project's time. WP3 also included a task dedicated to a systematic monitoring of Living Lab work. As a part of this task, each team was encouraged to regularly reflect on work progress and collaborative experiences as well as adjust experimental work as it unfolded (see Knickel et al., 2019).

The three Living Labs analysed in this article were selected based on: 1) the collaboration trajectories of all eleven Living Labs (see Fig. 3 in the Annex), and 2) the aim to have a diversity in geographic, socio-cultural, economic and political context as well as in rural-urban dynamics (see Table 1). The collaboration trajectories were identified in the longitudinal analysis (see Section 3.2). Following a Responsible Research and Innovation approach (Von Schomberg, 2011), we anonymise the Living Labs and their participants. In this article, we therefore use names that reflect the learning history of each case – *'Drift', 'Dancer'* and *'Untapped'* – and refer to individual partners as Research partner / Practice partner 1, 2, 3 etc.

3.2. Data collection and analysis

The core empirical basis for this article are three case studies complemented by the insights from the longitudinal analysis of the semi-quantitative survey data, semi-structured interviews, observations during project meetings and documents (see similar approaches in Brummel et al., 2010 and Schäpke et al., 2017). These different data sources shed light both on the individual and group-level perspectives required to examine partners' capacity to learn to collaborate. Fig. 1 summarises the approach for the case analysis, including its intersection with wider monitoring and reflexive activities for all eleven Living Labs and how different phases of data collection were informing and reinforcing one another.

After the interview data had been fully transcribed, both inductive and deductive coding approaches were employed (Miles et al., 2014). Deductive coding was carried out using MAXQDA 2022. In addition, the final reports prepared by the three Living Lab teams were examined. All data and insights were validated using triangulation (Carter et al., 2014). While the inductive analysis allowed for applying a framework to scrutinise learning processes, the deductive one was essential to explore contextually relevant variables and their relationships to develop theoretical propositions emphasised (Gerlak & Heikkila, 2011).

Prior studies (see Ernst, 2019b; Muro & Jeffrey, 2008) call for reflection on research design as well as its limitations and bias when attempting to empirically investigate social learning as an individual and group process in collaborations in sustainability contexts. One of the risks, for example, is relying too much on "own experiences or empirical data extrapolated from activities meant to evaluate other processes or concepts" (Ernst, 2019b). As learning is a change process and takes place within different phases, ex ante, mid-term and ex post assessments are indispensable to capture change over time[3] using a mixed-mode research design to minimise biases, such as those emerging from self-reports (see Ernst, 2019a,b on social-desirability bias). The framework for monitoring and reflexive activities in ROBUST was designed to address these kinds of biases and to capture individual and collaborative learning processes from the start. The learning process was looked at longitudinally from different perspectives using various qualitative and quantitative methods for its assessment where the case study method was complemented by different empirical data sources (see Fig. 1).

Further biases in the investigation of learning processes emerge due to different epistemological and ontological beliefs of individual researchers as well as from their positionalities and roles (Caniglia et al., 2023). In ROBUST, researchers performed multiple roles, such as methods expert, change agent, knowledge broker and facilitator, which are typical of sustainability research (Bulten et al., 2021). As authors, we contributed to the overall project management (authors 3, 5, 8), methodology development and monitoring and evaluation activities, including reflexive sessions for Living Lab members (authors 1, 3, 5, 7). Thus, research partners had to make sure project requirements were met while also creating safe spaces for reflection and learning (Kok et al., 2023: 3). The diversity of roles that researchers had to 'juggle' was regularly reflected upon as part of monitoring and evaluation activities.

4. Results: how researchers and practitioners learn to collaborate in the collaborative epistemic living space

In the analysis of the three cases, we present a 'learning history' of how each Living Lab – Case 'Drift', 'Dancer' and 'Untapped' – dealt with the difficulties of learning to collaborate within the collaborative epistemic living space provided by the Living Labs. In each case we:

(1) Examine whether, to what extent and how researchers and practitioners developed a capacity to learn to collaborate through new knowledge, actions, and relationships.

[3] A study of Yuen et al. (2013) demonstrates the importance of timing: in their study, the researchers only discovered evidence of single-loop learning, because assessments of double- and triple-loop learning require relatively long-term longitudinal studies, which were not possible to undertake in this case. In contrast, Lumosi et al. (2019) apply the concept of "learning spaces" to study emergent social learning processes over a long-term period, which better reflects the lengthy and iterative character of social learning.

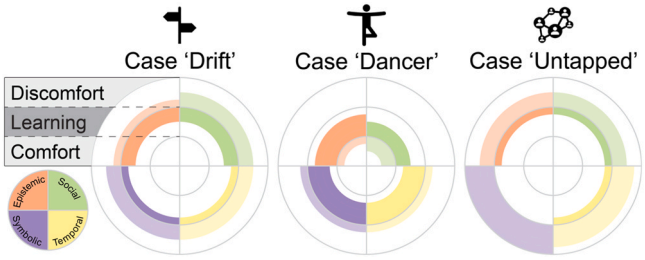

Fig. 2. Visualisation of the position[41] that each Living Lab tended to occupy in the collaborative epistemic living space. Learning zone is illustrated with higher opacity to highlight the more beneficial position for the team.

(2) Scrutinise how the four dimensions of the collaborative epistemic living space shaped participants' engagement in the collaborative processes. In each case, we also examine to what extent the team may be located in the 'learning zone' depending on how partners were able to work effectively together on complex issues (see Fig. 2).

In the learning history of each case, key aspects related to how researchers and practitioners perceived learning and collaboration experiences were inductively derived from the data analysis. Quotes from both are included to illustrate individual experiences. The quotes were assigned to specific dimensions of the conceptual framework and ranked in the iterative process of the data analysis (see Tables 2–4 below). As learning and collaboration processes tended to be complex and intertwined, it was not always possible to attribute a single learning and collaborative epistemic living space dimension to each quote. In these cases, other dimensions are listed in order of importance.

In the inductive analysis, the following eight cross-cutting aspects were identified as to whether, how and to what extent partners learn to collaborate in the collaborative epistemic living space:

(1) Dealing with the experimental component of Living Labs in practice
(2) Coping with diversity: recognising own and each other's positions and roles
(3) Finding common ground
(4) Clarifying roles, priorities and expectations in the project
(5) Aligning activities with local dynamics
(6) Experimenting the way forward: flexibility & adaptation
(7) Decision-making and trust
(8) Politics inherent to collaborative work

In the first case ('Drift'), aspects such as reaching agreement as part of finding common ground and leadership issues were also central. In the latter two cases ('Dancer', 'Untapped'), striving for agreement and clarifying leadership roles were less prominent but institutional buy-in and transformative potential of joint work were more pronounced. By comparing the three cases, we highlight the implications of whether and to what extent the partners developed a capacity to learn to collaborate. The case-by-case synthesis in this section leads to a cross-case discussion (Section 5) and conclusions (Section 6).

4.1. Case 'drift': a Living Lab drifting apart

The collaboration trajectory for this case started relatively low and continued with a downward trend (see Fig. 3 in the Annex). More significant partners' learning on how to collaborate was recorded mainly in the final project phase (see Table 2). Learning was sometimes triggered by crisis situations, especially towards the end of the project, when it became more apparent that the goals would not be fully achieved. Learning was greater when crises coincided with reflexive activities at the project level (e.g. surveys, interviews). In the final months of the project – within the final survey, reflexive session and individual interviews – lab members acknowledged missed opportunities. Both research and practice partners realised that they could have invested more in their collaboration from the start.

The findings show that research and practice partners of this team learned to collaborate especially in the relations dimension. Both started recognising their own and each other's positions and roles – until this happened, it was challenging to find common ground and reach agreement to progress with joint work. In the knowledge dimension, learning to collaborate was mainly manifested through dealing with the experimental component of Living Labs in practice, aligning joint work with the local dynamics and new insights on leadership patterns and the role of politics. In the actions dimension, learning to collaborate concerned finding ways to cope with diverse partner roles and priorities and developing alternative solutions to move on with the work agenda in the absence of agreement (see Table 2).

In terms of collaborative epistemic living space, members unanimously referred to their collaboration as hard to navigate. Over time, both researchers and practitioners realised how different their perspectives on central issues were and how these should have been approached. On this basis and given the complexity of regional issues this Living Lab aimed to address, it was very challenging for

Table 2
Summary overview of the learning history of Case 'Drift'.

Aspect *Selected illustrative quotes*	Learning Dimensions	Collaborative epistemic living space dimensions
Dealing with the experimental component of Living Labs in practice *"Living Labs are new instruments* [and] *an experiment. … Interdisciplinarity … is a challenge, … transdisciplinarity is another challenge. … We just need to identify key learning points."* (Research partner 1)	Knowledge	Epistemic
Coping with diversity: recognising own and each other's positions and roles *"For researchers theory matters … because the work one does at universities is analysing, writing papers, indicators… We do analyses in a public institution too, but they're always focussed on the things you must find a solution for."* (Practice partner 1)	Relations	Epistemic Symbolic
"Different competencies and personalities from both research and practice in the project … are also a serious obstacle because everyone sees problems from his/her own point of view. … Due to this complexity, we needed much more time to focus on the objectives which would satisfy everyone in the group." (Practice partner 1)	Actions Relations	Epistemic Temporal
Finding common ground and reaching agreement *"*[The research team] *had already conducted studies on the topic* [of food] *in other projects. … They were interested in exploring certain aspects deeper. For us it was a completely new experience. Our interest was land use but in a broader sense. … Focussing just on food was a bit limiting for us."* (Practice partner 1)	Knowledge Relations	Epistemic Symbolic
"The Living Lab work plan was developed late in the project. We ended up asking what the objectives were when the project was halfway through. … I remember having very harsh discussions with the [practice partner] *because the agreement was not there."* (Research partner 1)	Actions Relations	Epistemic Temporal
Clarifying roles, priorities and expectations in the project *"I said we need a process* [for organising our work in the Living Lab]. *… It was also a question of assigning precise roles to everyone according to skills. … I was giving examples to be clear.* [The research team] … [agreed] *this is the way to go. However, at the next meeting the dynamics was the same"* (Practice partner 1)	Actions Relations	Symbolic Social
Aligning activities with local dynamics *"We realised that it is better … to work within available 'political' spaces such as the intermunicipal food policy and territorial planning. This was an opportunity to be more connected to the dynamics of the policy environment in the region. At the same time, it was a limitation because the timing of our activities really depended on that."* (Research partner 4)	Knowledge	Epistemic Temporal
Experimenting the way forward: flexibility & adaptation *"We had two different perspectives and priorities: food and territorial planning. We had to arrange our work in a way that allows both of us to achieve our* [research and practice] *priorities* [in the project] *without interrupting the established connection with local stakeholders."* (Practice partner 1)	Actions Relations	Epistemic Symbolic
Decision-making and trust *"The practice partner at some point hired a small company* [for facilitation] *without really discussing with us. We found them totally unfit for the purpose."* (Research partner 1)	Actions Relations	Symbolic Social
Leadership *"Before ROBUST it was us who engaged a university to achieve a concrete goal. … In ROBUST, we were asked to work together as partners for a common objective on the same level. … This* [equal position] *makes a difference."* (Practice partners 1 and 2)	Knowledge Relations	Symbolic Social
Politics inherent to collaborative work *"Everything that* [the practice partner] *wants to do needs to be appropriately communicated. I learned a lot from this. … A sentence in the report reflecting on* [what did not work out in the workshop] *… could compromise their standing." (Research partner 1)*	Knowledge Relations	Symbolic
"We put our face both institutionally and politically because it is [the institution] *inviting local stakeholders as part of the Living Lab activities." (Practice partner 1)*	Relations	Symbolic

the members to develop a joint vision and agree on the work plan. This implies that Living Lab members were in the discomfort zone most of the time, but the members started moving towards the learning zone closer to the end of the project. One of the biggest learnings for both partner teams was that common goals can sometimes only be agreed upon to a limited extent and that specific goals should be pursued individually, if they are in some respect complementary.

The symbolic dimension was particularly pronounced in terms of explicit and implicit power dynamics. Key issues were the practitioners' propensity for commissioning research, and their emphasis on research excellence and accountability, as well as differing expectations and often competing priorities with those of the researchers. An example is the practitioners' expectation that "the research team [provides] a theory and step-by-step methodology on how to set up and run the Living Lab" and facilitates collaboration in the Living Lab as well as lab-related interactions with local stakeholders. In this situation, some of the researchers were overwhelmed with "everything that the project asks for [being] on [their] shoulders" and implied that "this is not how [they] see collaboration." Although the frictions between the partners were in the air for a long time, they had never openly discussed it, which leads to the social dimension of this case. This collaborative experience implies that the lab members were largely in the discomfort zone related to the symbolic dimension.

[4] Note: These positions are not static. In the four years of joint work, these three Living Labs traversed different zones (e.g. from discomfort to learning) within each of the four dimensions.

Table 3
Summary overview of the learning history of Case 'Dancer'.

Aspect *Selected illustrative quotes*	Learning Dimensions	Collaborative epistemic living space dimensions
Dealing with the experimental component of Living Labs in practice	Knowledge Actions	Epistemic Symbolic
"The Living Lab narrative is about experimentation, innovation, and change. It's an implication of risk-taking. … There are some real technical, commercial and legal liabilities that [the practice partner] *has to consider when being experimental."* (Research partner 1)		
Coping with diversity: recognising own and each other's positions and roles	Knowledge Relations	Epistemic Social
"Our different backgrounds and different approaches to things is actually the biggest strength of what we were doing because you're playing to the strengths of both partners." (Practice partner 3)		
"I could see people's perception of us as academics – who we are and what we do – change, kind of shattered, when they realised that we were both quite practical. We were talking about making real change shortly. We were not doing that as an abstract exercise." (Research partner 3)	Knowledge Relations	Social
Finding common ground	Knowledge Relations	Epistemic Social
"It's been critical to make sure that we communicate well. Circular economy and natural capital were quite big ideas and typically academic. We had to spend time trying to make it tangible." (Research partner 2)		
Clarifying roles, priorities, and expectations in the project	Knowledge Relations	Epistemic Social
"People persisted in thinking that they were being consulted. … We were introducing to people a new method, a new way of working." (Research partner 3)		
Aligning activities with local dynamics	Actions	Epistemic
"We are trying to do very practical things: to develop a strategy, a logistics platform, a forum. Our work is very focussed on doing something specific and practical." (Research partner 1)		
Experimenting the way forward: flexibility & adaptation	Knowledge Actions	Epistemic Social
"From a research point of view lots is known about how procurement could, should and might work. But we are still doing procurement. And it looks like it is going to be one of the strongest things we achieve. So yes, things have changed, but we've been pragmatic." (Research partner 1)		
"The academic team needs to be congratulated for being quite receptive to our demands because you could have put your fingers in your ears and gone off into a different direction." (Practice partner 1)	Relations	Social
Decision-making and trust	Relations	Social
"I never felt manoeuvred or pushed into a particular agenda. I think we had open and honest discussions" (Practice partner 4)		
Institutional buy-in	Relations Actions	Social
"There's been a breadth of engagement: we've got a huge range of different specialists who helped all along. … And they've all said, this is a great opportunity." (Research partner 1)		
Politics inherent to collaborative work	Knowledge	Epistemic Symbolic
"Finding that sweet spot between something that is sufficiently high priority politically, but not such a political hot potato that it blows up in our face. It was quite challenging to work out how all these different criteria can be met to enable this to be a fruitful partnership." (Practice partner 4)		
Transformative potential of joint work	Knowledge	Temporal
"Our work in five years' time could be incredibly transformative but it takes a while to get all mechanisms aligned." (Research partner 2)		
"Placing what we were looking at in an academic context gave it a bit of gravitas. It wasn't an approach from an officer like myself, it was from an academic institution. It helped to open some doors" (Practice partner 3) *"Having that academic input allowed to draw on national and international expertise. That much broader perspective to what we're doing locally is one of the things that* [the research partners] *have brought to the table."* (Practice partner 4)	Knowledge Relations	Epistemic

As for the social dimension, some research and practice partners referred to the emotional dynamics of in person meetings and overall communication in their Living Lab as tense, dominated by one voice, and lacking a constructive debate and opportunity to express opinions for the sake of not compromising their already challenging interaction. Several partners shared they did not feel their expertise was recognised and appreciated. Most members expressed that clarifying their roles and expectations early in the project would have had a tremendous positive impact on their collaboration. These findings indicate that the Living Lab members could not easily cope with the taxing nature of TD collaboration and stayed in the discomfort zone for most of the time. Yet again for this dimension, the members started moving closer to the learning zone only in the final months of the project when a lot of reflexive activities were organised.

In terms of the temporal dimension, while being "on the run", both partners regretted that they had not had enough time to reflect on the direction of joint work, their experiences as a team or their relations. Moreover, with the many political and societal developments in the region unfolding in parallel with the project, expectations to make the work relevant were high, putting additional pressure on the team. Achieving a balance between tangible and more immediate outputs and more long-term but potentially impactful outcomes (e.g. trust, new partnerships) was also voiced as one of the partners' concerns. In retrospect, the research partners expressed that a proper definition of the scope and boundaries of the joint work and familiarity with the history of interactions between researchers and local authorities are needed. These findings point to the connection between insufficient reflection at the individual and group level and limited learning on how to handle various 'temporal' issues. This implies that the members were in the discomfort zone in their collaborative experiences where pressure was high and learning on how to address the challenges was minimal.

Table 2 presents the learning history of Case 'Drift'. The table consists of 3 columns: illustrative quotes and corresponding dimensions of learning and collaborative epistemic living space.

4.2. Case 'dancer': a Living Lab learning to meet halfway

The collaboration trajectory of this case started with an average position, moving further upward over the project's time (see Fig. 3 in the Annex). Reflexive activities at the project level were generally perceived as very helpful. The team referred to a few instances as "positively disruptive" where more substantial learning occurred. Despite prior experiences in multi-actor projects and similar partnerships in their region and beyond, team members emphasised that there was still a lot to learn about TD collaboration. At the same time some practice partners learned already midway through the project how impactful Living Lab work can be. Practice partner 1 expressed it: "I've been really pleased with how relevant the work is. We have got at least 2–3 strong outcomes emerging, which could be quite significant for us."

As in the Case 'Drift', the knowledge and relations dimensions were the ones where the partners learned most on how to collaborate. In the knowledge dimension, both partner teams learned to recognise their own and each other's positions and roles and to cope with this diversity, experienced how politics can interfere (impede or foster) in the experimental work and how transformative Living Lab work can be given the right conditions. They also experienced how important the process of clarifying roles and expectations of both partners is as well as remaining flexible in the emergent collaborative work and receptive to each other' needs. In the relations dimension, the lab members particularly learned to find common ground to develop a truly co-owned agenda while nurturing trust and good relationships, drawing on each other's expertise as core strengths and building institutional buy-in. In the actions dimension, the partners learned how to go about the experimental nature of Living Labs and collaborate more effectively as well as align activities with local dynamics while remaining pragmatic about the impact (see Table 3 for a detailed overview).

As for the collaborative epistemic living space, this team learned more quickly how to navigate their work compared to Case 'Drift'. The social dimension was underpinning for the other three dimensions. Personal motivations, such as shared enthusiasm about the topic, open communication culture and ethos of constructive cooperation (also emblematic for the wider region) played a major role in the team's positive collaborative experience. Social factors played a role also in the engagement of a larger number of colleagues from the practice partner institution, and even beyond. Appreciating each other's diverse expertise and perceiving it as an asset, collegial trust-based relationships and listening to each other contributed to strengthening the team spirit and moving towards joint goals.

From an *epistemic* perspective, the partners were systematically exploring different views on the issues to be addressed and the competences required. More practically, it entailed scoping out objectives and experiments, identification of relevant partners, and selecting the most suitable methods for different stages of the joint work. Many rounds of discussion on what is relevant and realistic led to a truly 'co-owned' work plan. The assessment of how feasible planned work is, was deemed fundamental. Some of the Living Lab members argued that their "innovations have been quite technical [as they] did not really cover money or politics", which could have reduced the complexity of the problems this team was dealing with.

A strong positive manifestation of the social dimension alleviated the effects of the symbolic dimension, such as power asymmetries, competing expectations and priorities, and tendency towards governing research in a top-down way. The members of this Living Lab perceived their collaboration more as a "whole new world" to discover in terms of each other's realities, roles, priorities, and approaches. Researchers, for instance, learned why experimentation – a core principle of the Living Lab approach – associated with risk-taking is not always compatible with the practitioners' reality. Over the course of the project, they have also learned more about the mandates of different institutions and external factors that need to be seen as given. At the same time the practice partners were grateful for the broader international and academic perspective, which enriched their local work and "helped to open some doors." However, there were several occasions when the research team had less constructive discussions with the practice partner team when trying to find "that sweet spot between something that is sufficiently high priority politically, but not such a political hot potato that it blows up in [the] face". Coming back to the learning zone took time and effort on both sides.

As for the temporal dimension, one of key learnings voiced by the researchers was that experimentation can take a long time but could be incredibly transformative in the long-term. That the project urged the team to focus on specific outputs and left limited room for reflecting on the experiences was seen as disadvantageous. Looking back, increasing visibility of the joint work at regional and national levels and building new partnerships was deemed particularly important. Both partners also emphasised the importance of investing in the continuity and legacy of the collaboration.

Overall, one of the most remarkable characteristics of this case was readiness of both partners to leave comfort zones of their respective disciplinary and professional routines. In this case, most productive exchanges happened in the learning zone especially during team meetings when needs and concerns were openly voiced, and ways forward were negotiated. Thus, the collaborative experience recorded for this team indicates that they managed to largely remain in the learning zone in all four dimensions only moving to a discomfort zone in the symbolic and temporal dimensions for a short while. In the epistemic and social dimensions this team was at times located in the comfort zone. Table 3 provides a summary overview of the learning history of the Case 'Dancer'.

4.3. Case 'untapped': a Living Lab with untapped potential

The collaboration trajectory of this case started from an average position and moved slightly upward over the project's time (see Fig. 3 in the Annex). A key feature of this case is the open dialogue about the collaboration experience that took place between researchers and practitioners during the joint reflexive session in the final project phase. Individual and team reflections took place already earlier, but only within research and practice teams respectively. At the session, partners used the opportunity to jointly reflect on the issues that had never been discussed before despite good collegial relationships.

This Living Lab team learned almost equally in all three dimensions of knowledge, actions and relations. In the knowledge dimension, learning to experiment in Living Labs in practice, the need to align focal questions and activities with local dynamics and

Table 4
Summary overview of the learning history of Case 'Untapped'.

Aspect *Selected illustrative quotes*	Learning Dimensions	Collaborative epistemic living space dimensions
Dealing with the experimental component of Living Labs in practice *"Next time I would demand more concrete instructions from the work package leaders because. there was no sufficient structure to the Living Lab process. It was kind of up to us, which is good to a certain extent but …"* (Research partner 3)	Knowledge	Epistemic
Coping with diversity: recognising own and each other's positions and roles *"Normally I am a researcher, but in this project I felt more like a facilitator. … Sometimes I'm not sure if I as a researcher can contribute enough. … Whose role was to explain the Living Lab methodology? Ours? We are no experts in this too."* (Research partner 1)	Relations	Social Epistemic
Finding common ground *"We already worked together with all those stakeholders, but this time there were differing opinions and disputes going on. It was quite a complicated process."* (Practice partner 1)	Relations	Social Symbolic
Clarifying roles, priorities, and expectations in the project *"Probably we did not discuss enough within the Living Lab how we manage all these roles, functions and how we arrive at the outcomes we need."* (Research partner 1)	Relations Actions	Social Epistemic
"Our main job dictates when we can and cannot connect to the project easily or immediately. … It would be great if [the research partner] *team would tell us what to do and remind about the deadlines. We would then sit down, get all the work done and move on."* (Practice partner 2) *"But we do not like to communicate this way* [giving orders]." (Research partner 1)	Relations Actions	Social Symbolic Temporal
Aligning activities with local dynamics *"Our priorities were sort of 'artificial', there was no really burning problem for the practice partner. Just the funding was available. So, the issues we addressed were a bit imposed."* (Research partner 1)	Knowledge	Epistemic Temporal
Experimenting the way forward: flexibility & adaptation *"When the Living Lab was set up, goals were not the same. People were coming and going, and the Living Lab had to adapt to the new situation all the time. The strength is that we have re-focussed."* (Research partner 1)	Knowledge Actions	Epistemic Social
Decision-making and trust *Research partner 2: "We have never discussed that before. … I know that in* [public institutions] *the payment within the project is more difficult. Was that the reason why you involved external moderators?" Practice partner 1: "With our in-house resources it would have been very hard to prepare* [that policy document] *and related documentation. That's why it was decided to get an outsourced partner. But I completely agree, there were also some problems associated with it."*	Actions Relations	Symbolic Social
Institutional buy-in *"I would like local government to be more involved in project activities* [next time]*. They are the ones who can support project work,* [but this time] *they had quite a low interest in that."* (Practice partner 3)	Relations Knowledge	Symbolic
Politics inherent to collaborative work *"If we were to build a school within ROBUST, for example, we would have had much interest from [the practice partner institution]. People work on those big issues too [e.g. public food procurement] but many actual problems need to be solved first."* (Practice partner 1)	Knowledge	Symbolic
Transformative potential of joint work *"Last year I said that this* [policy document] *is needed. It was possible to convince people to engage in that. … It's a big step for the region."* (Practice partner 2)	Actions	Temporal
"This kind of projects push us to focus on new things that we wouldn't have done otherwise. … Most inspiring ideas and biggest learning were at the project meetings where colleagues from other countries shared best practices and failures. [Our research partners] *were very helpful in bridging and explaining."* (Practice partner 1)	Knowledge	Epistemic Social Temporal

exposure to the need for institutional buy-in for transformative outcomes and being mindful of how politics can interfere with the Living Lab work were key. In relations dimension, the partners, to a different extent, learned about own and each other's positions and roles (although less on how to cope with this diversity in the given collaboration to achieve their goals) and became aware of how essential open communication about decisionmaking is, which otherwise might lead to partners' frustration and decreasing trust. In the final project stages, both partner teams started reflecting and learned what remaining flexible and adaptive while experimenting and progressing with joint work means practically (actions).

In terms of the collaborative epistemic living space, epistemic, social and symbolic dimensions seem to be interwoven more closely in this case than in the two others. As for the epistemic dimension, both partners acknowledged in individual interviews that their Living Lab had "artificial priorities". This means that although the funding for the Living Lab work was available, the challenges seen as real issues in the region were either not sufficiently considered in the design and the initial project phases or, also due to changing team members having differing expertise, not appropriately addressed later. As no pressing issues for the practice partners were identified within the project's framework, they struggled to articulate their expectations for the project and, as a result, needed research. At the same time, the researchers were hesitant to proactively propose own research directions. Although the Living Lab team managed to re-focus their work plan later, joint work seemed to still drift towards two separate research/practice agendas.

In the social dimension, imprecise identification of the focal Living Lab questions relevant to both partner teams backfired on their relations during knowledge co-production. Consequently, most researchers in this team felt they were losing their identity in the project where "research is abandoned". Instead, they found themselves in a new facilitator role, which they felt they were not trained for. Although researchers' frustration with the situation was rising as the joint work went on, they did not voice it to the practice

partners openly to avoid possible tensions. Building on the lessons learned with the Living Lab approach in ROBUST, the research team expressed they would discuss expectations openly and clearly define roles and task distribution in future collaborations.

The collaborative experiences related to epistemic and social dimensions were aggravated by differing partners' priorities, implicit power dynamics and a series of corresponding decisions taken – all related to the symbolic dimension. Without a prior discussion, practice partners decided to hire external consultants to perform a range of both facilitation and research tasks. While outsourcing is typical of public institutions, the lack of communication on the rationale increased the unvoiced frustration on the side of the researchers. This in turn contributed to further alienation: 'areas of responsibility' were gradually demarcated implying a rather sole responsibility of the researchers for project-related work, while the practitioners continued carrying out "work in the region".

In this case, the symbolic dimension was also manifested at a higher, institutional level through the lack of buy-in from senior leadership in the practice partner institution. An important insight provided by one of the practitioners pointed to the mismatch between the issues the Living Lab focussed on and the mandate of the practice partner. Consequently, this meant that institutional interest in project activities remained low no matter how hard the practice partner team working in ROBUST tried to keep senior leadership updated and engaged.

The temporal dimension of the collaborative work was, like in the other two cases, manifested in the pressure to deliver research outputs and the lack of time to reflect on the direction and quality of the joint work, the experiences as a team and the quality of internal communication. The need to balance between more immediate and tangible outputs (e.g. policy document) and long-term, potentially more impactful outcomes (e.g. increased buy-in and continuous support of decision-makers in public institutions, mobilising local stakeholders, trust-building, new partnerships) was also expressed on different occasions. The research team felt disoriented and struggled to find the balance between the project deliverables and the work in the region, especially considering that the issues addressed in the lab were of no urgency and little relevance to local policy and practice.

Coping with these collaborative experiences was challenging – largely because they were unvoiced until the final project phases despite several reflexive activities carried out at the project-level. These experiences did not allow the team to achieve as much as they could have in terms of formulating relevant questions leading to more transformative outcomes. The findings indicate that the members were largely in the discomfort zone related to all four dimensions of the collaborative epistemic living space. The team was closer to the learning zone in the epistemic and social dimensions due to some learning that helped them to understand problematic issues and cope with them to a certain extent. Table 4 provides a summary overview of the learning history for this case.

5. Discussion

The study results demonstrate that teams' *positions in the collaborative epistemic living space are not static* – all three teams were moving between different zones over the project's time. In the discomfort zone, learning was blocked ultimately affecting team performance. This dynamic position within the collaborative epistemic living space corresponds to the basic idea of adopting process-oriented approaches. Collaboration then becomes a fluid phenomenon. In the following, we discuss important factors (in 5.1) and conditions (in 5.2) that led to differing learning histories. We then derive lessons learned from the three cases for the design of TD collaboration in Living Labs (in 5.3). We do *not* aim to compare the three cases or assess how successful they were, but to provide a more encompassing understanding of the complex dynamics underpinning individual and group learning processes in TD research.

Factors conducive to developing a capacity to learn to collaborate in TD research: Reflexivity through facilitation and informal learning.

5.1. Factors conducive to developing a capacity to learn to collaborate in TD research: reflexivity through facilitation and informal learning

A "reflexivity-learning spiral" was documented for the three cases: reflexive activities (in some cases crises *and* reflexive activities) triggered and fostered significant learning on how to collaborate; and the other way around – insufficient reflexivity in the team – resulted in limited learning. The results demonstrate that the teams with higher learning capacity could manage their collaboration more effectively (see Fig. 2 and learning histories of each case). In the cases 'Dancer' and 'Untapped', learning across the three dimensions was more balanced compared to the Case 'Drift', where the relations dimension gained prominence. We observed that the relations dimension was central for all cases. The two teams that relied mainly on project-level activities to reflect on their collaboration ('Drift' and 'Untapped') tended to learn less across the three dimensions and could not stay in the learning zone as much as the partners from the Case 'Dancer' did. These findings indicate that formal learning mechanisms such as systematic monitoring at the project level are not always sufficient to stimulate and support partners' capacity to learn to collaborate. Comparable, and perhaps more informal, learning mechanisms need to be established at the Living Lab level too (see Svare et al., 2023).

Based on our findings, we would suggest that professional facilitators could have helped to address multiple issues arisen, especially in epistemic, social and symbolic dimensions, and could allow the partners to more productively engage in collaborative work and solution finding. In two cases ('Drift' and 'Untapped') facilitators were engaged midway through the project but they were not sufficiently competent to support the teams. Engaging professional facilitators in particular is suggested to create safe spaces with appreciative atmosphere and a high level of trust, transparency of communication and decisions taken, balancing needs of both partners as well as making power imbalances explicit and addressing them (Schauppenlehner-Kloyber & Penker, 2015). However, facilitators need to be familiar with the complexities of TD sustainability research, such as epistemic, power-related and interpersonal aspects, as well as with the constraints of Living Labs funding lines and expectations.

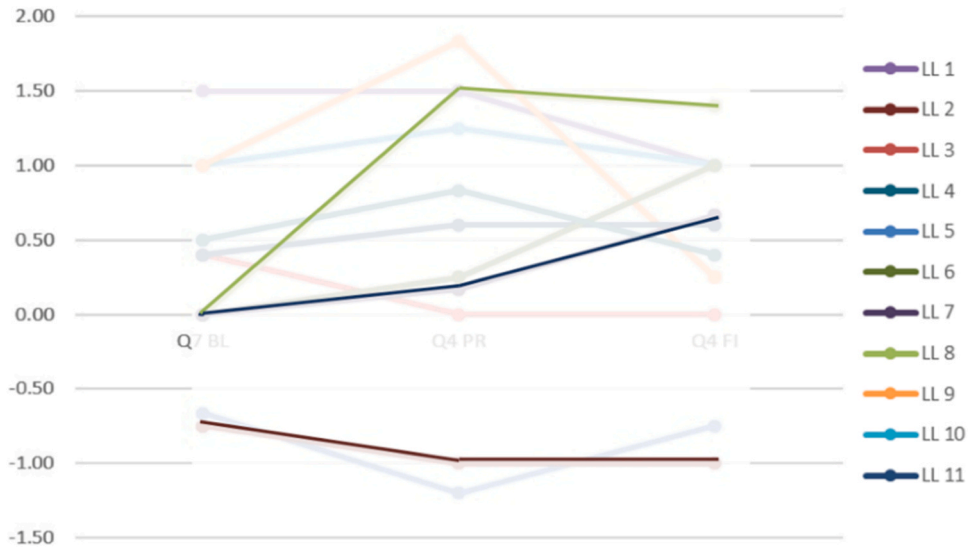

Fig. 3. Three Living Labs selected as case studies – 'Drift' (brown), 'Dancer' (green), 'Untapped' (blue) based on Living Lab members' perceptions of the functioning as a team over the four years of the project. Abbreviations: LL – Living Lab; Q – question.

5.2. Conditions to support learning to collaborate in Living Labs as collaborative epistemic living spaces

All three teams struggled (although to a different extent, in one of the teams it was explicitly recognised as a strength – Case 'Dancer') with dealing with diversity in positions, roles, perspectives and approaches. This is indicative of the need for creating conditions to foster learning and cultivating capacity to collaborate by intentionally expanding *"the zone for learning, between an understimulating comfort zone and an overly disruptive discomfort zone"* (Freeth & Caniglia, 2020). Below we discuss some of these conditions.

5.2.1. Fostering knowledge pluralism (epistemic)

Although in the three cases partners reported different levels of complexity of the real-world issues addressed (from rather 'technical' to more 'political'), our study shows the significance of the epistemic differences between research and practice partners. Further, it shows how demanding it is to move towards joint visions, feasible work plans and co-produced knowledge. Indeed, as emphasised by numerous studies, epistemic differences arising from disciplinary training and professional backgrounds should be taken seriously as diversity brings valuable insights to TD collaboration but can also tear it apart (Singer-Brodowski et al., 2018). It is thus important to support research and practice partners in developing a capacity for knowledge pluralism as the ability to appreciate and work with multiple kinds of knowledge and ways of knowing (Caniglia et al., 2021). Knowledge pluralism could be fostered through hybridisation (Knickel et al., 2021c), that is by leveraging social learning when recognising mutual differences in knowledge, perspectives and socio-cultural identities as strengths and by strategically valuing them.

5.2.2. Cultivating safe and adaptive spaces (social)

In our study, the social dimension largely manifested through the need to build 'safe spaces' allowing for partners' capacity to learn to collaborate and affecting this capacity in all dimensions. Lack of safe space in 'Drift' manifested in tense emotional dynamics, one dominant voice in the discussions, limited possibility for a constructive debate and not sufficiently appreciated partners' expertise demonstrated how detrimental it might become for learning processes and navigating collaboration. A need to establish safe spaces resonates with existing work in TD sustainability research that emphasises the need for safety from psychological to social and political difficulties characterising science-society collaborations as embedded in real-world contexts (Edmondson, 1999; Haire-Joshu & McBride, 2013). This may practically mean being sensitive towards specific needs of individual participants and groups and treating opposing views, interests and values with respect. Further, as Living Labs operate in dynamic socio-economic and socio-political contexts, our results show that those teams that managed to adapt their work plans and strategies to changes in local politics, societal developments and shifting priorities reaped more benefits from their TD collaboration. This is consistent with numerous studies arguing that TD research design and implementation need to be responsive to the context (Jahn et al., 2012; Zscheischler & Rogga, 2015).

5.2.3. Explicitly addressing power dynamics and unlearning (symbolic)

Power imbalances with their effects on learning process and collaborative experiences were particularly problematic in 'Drift' and 'Untapped'. In both cases, power dynamics were not explicitly reflected upon, which hindered the development of a capacity to learn to collaborate. In 'Dancer', the safe space that the team managed to establish and the overtly practised co-leadership helped to tackle

tensions, even without professional facilitators. Molinengo (2022) suggests more power-sensitive and process-oriented analysis of collaboration to elucidate "flows of power". Further, researchers and practitioners in the three cases tended to engage in the collaboration assuming their roles "as usual"(i.e. intrinsically joining a new initiative with old expectations as to working relationships) which led to ambiguous power dynamics. To address this issue, Alonso-Yanez et al. (2019) suggest engaging in deliberate processes of "social unlearning" described as "a shared, intentional departure from previous routines and systems of meaning associated with … individual professional practices" (idem, p. 4).

5.2.4. Balancing control and flexibility (temporal)

The demanding (e.g. time- and resource-intensive) nature of collaboration was stressed in all three cases. In our study, all three teams were torn between too much pressure to deliver at the project level and too much flexibility (often referred to as lack of clarity) on how to do the work at the Living Lab level. At the same time, all teams also admitted that apart from producing project outputs, they had acquired new knowledge and skills for future comparable collaborations, established new relationships and had a rewarding experience of doing research that has a positive impact on their regions. The work of Schauppenlehner-Kloyber and Penker (2015) on social learning and group processes suggests the need for supporting team self-development and for providing direction and guidance through the difficulties of TD work. The teams expressed that having project-level reflexive activities was very helpful and they would have liked to have more space and opportunities for that in future projects.

5.3. Implications for the design and management of TD sustainability research in Living Labs

From the discussion of findings from the case study analyses in Section 5.2, we draw five main implications for the design and management of TD sustainability research, which are presented below.

- Professional facilitation can help to cope with challenges in collaboration, for instance, when: setting up a new project; fostering open dialogue about interests, concerns and expectations; attempting to rebalance power dynamics; working productively through conflicts.
- Clarifying roles and expectations (e.g., practitioners expecting directions) and allocating responsibilities (e.g., researchers performing different roles) from the project start is essential as the lack of attention towards these issues shows as a recurring problem.
- Fostering equal collaboration and co-leadership as "a truly lived co-leadership" (as in 'Dancer') can allow teams, even very diverse ones, to deal productively with tensions and conflicts.
- Reflexivity can help partners to remain in the learning zone, both as officially organised at the project-level and as informal activities.
- Adaptive management is central as TD research does not operate in a vacuum and it is important to be aware and responsive to local and broader dynamics of change.

6. Conclusions

In this article, we systematically investigated whether, how and to what extent research and practice partners in TD research developed a capacity to learn to collaborate when navigating the challenges of collaborative work in three different Living Labs. Though new and challenging, our analysis shows that Living Labs represent promising approaches linking research and societal needs. When intentionally focusing on and fostering social learning in collaborative spaces, TD research may help develop the learning capacities needed to adaptively and creatively address the uncertainties and complexities of our world. In doing so, this kind of research promises to enrich our current understandings of how to create in the present the conditions for more inclusive and sustainable futures.

The three Living Labs prototyped new strategies to work towards more sustainable rural-urban futures in real-world situations. Their examples show the challenges and opportunities of science-society collaborations to contribute to more plural and democratic futures. Importantly, the three case studies in this article also illustrate that neither researchers nor practitioners were sufficiently aware of what TD collaboration entails, especially in terms of its complexity, timing and feasibility. The way researchers and practitioners worked together in the past, and the related expectations, including of a hierarchical relationship, still have a major influence. Overall, the analysis of the three case studies reinforces claims about the importance of intentionally fostering social learning in TD research. For TD research to continue to grow and thrive, it will be important to dedicate energy and resources to foster individual and groups' capacities supporting collaboration across difference when dealing with uncertain knowledge towards more sustainable futures.

Our analysis shows how inseparable learning and collaboration are: in more successful cases, learning and collaboration reinforced one another, and where learning was not happening, this directly affected the achievement of more transformative goals. To play to the strengths of partners means recognising the enormous potential of bringing diverse actors and their knowledge together and, at the same time, paying attention to the inherent dynamics and tensions in processes of social learning and collaboration. In this way TD collaborations might find orientation to contribute to shaping more sustainable futures without getting lost in a haze.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Annex

The longitudinal analysis in ROBUST is based on about one-third of questions that remained the same in the three survey rounds. The values for Likert scale questions in all three surveys were re-coded from 1 to 5 Likert scale values to − 2, − 1, 0, 1, 2 to capture the mean team view. In the recoding, views of each Living Lab member were included. The re-coded mean values allow to explore changes over time for each Living Lab team. The graph shows that the Living Labs started from different points and that their evolution differed significantly (Fig. 3).

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