sustainability

MDPI

Editorial

Overview of the Special Issue: Embracing the Messiness of Transdisciplinarity

Kimberley Crofts [1], Will Rifkin [2,*], Martin Espig [3], Robert Perey [4] and Heather Bray [5]

[1] School of Design, Faculty of Design, Architecture and Building, University of Technology, Sydney, NSW 2007, Australia
[2] School of Human and Social Futures, University of Newcastle, Callaghan, NSW 2308, Australia
[3] M.E. Consulting, Christchurch 8022, New Zealand; martin.espig.consulting@gmail.com
[4] Management Department, UTS Business School, University of Technology, Sydney, NSW 2007, Australia; robert_perey@knowledgeindex.com.au
[5] School of Biological Sciences, University of Western Australia, Crawley, WA 6009, Australia; heather.bray@uwa.edu.au
* Correspondence: will.rifkin@newcastle.edu.au

This Special Issue utilizes a transdisciplinary lens to analyse how environment-related problems are being framed and communicated in different settings. A drive for net zero greenhouse gas emissions, preserving biodiversity, or reducing pollution can challenge deeply entrenched values and interests in the status quo. These values and interests can affect how different people understand or frame questions about the environment [1]. They underlie societal debates and negotiations, and they affect how communication about environmental issues occurs and what bodies of knowledge are drawn on and given authority. These dynamics indicate that addressing such complex problems entails the development of new ways of sharing knowledge, coordinating practices, thinking, and experimenting to progress toward a joint purpose or resolution when an array of stakeholders is engaged. Our overview identifies some of these approaches as they have surfaced across this collection of articles.

The cases in this Special Issue address aspects of environmental and societal sustainability in city planning, soil fertility, education, water governance, and other settings. Essentially, these cases involve complex socio-technical-environmental systems where biological life and political life are intertwined through the interaction of multiple physical elements, a variety of actors, and different bodies of information, knowledge systems, life experiences, and beliefs. While not placing a sole emphasis on transdisciplinary communication itself (as conducted by Misra and Lotrecchiano [2], for example), each case study raises several obstacles and opportunities that practitioners and researchers face in communicating effectively within their given setting.

Another layer of complexity is added to these settings by the fact that the concept of sustainability is subject to a diversity of interpretations across scientific disciplines and societal institutions, based on a variety of bodies of knowledge, worldviews, and belief systems. These underlying elements are often well entrenched and hard to recognise as they influence how groups—such as scientists, farmers, or activists—communicate and engage with others. This attachment can result in resistance to accepting alternative interpretations of sustainability or to accepting the actions of others who hold a different view on what is sustainable.

Such situations are illustrated with examples from the articles in this Special Issue, ranging from climate change and biodiversity to more localised environmental concerns like water governance, urban planning, and biosecurity. The authors investigate their cases through different theoretical perspectives and methodological approaches. In doing so, they reveal common challenges often referred to as "wicked problems", which evade simple definition and resist conventional modes of problem solving [3]. Unlike tame or

check for updates

Citation: Crofts, K.; Rifkin, W.; Espig, M.; Perey, R.; Bray, H. Overview of the Special Issue: Embracing the Messiness of Transdisciplinarity. *Sustainability* **2024**, *16*, 9622. https://doi.org/10.3390/su16229622

Received: 14 October 2024
Accepted: 29 October 2024
Published: 5 November 2024

Copyright: © 2024 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

single-dimension problems, wicked problems are intertwined with other challenges, each problem being a symptom of another [4]. They feature a range of other characteristics that make wicked problems difficult or impossible to resolve, such as an inability to test solutions or to determine whether a remedy actually works. These factors are illuminated in the extensive literature on this topic.

Addressing wicked problems, such as those associated with sustainability, requires a range of strategies. For instance, complex systems theory provides tools that are well suited to navigating dynamic, messy structures [5]. Complex systems theorists consider wicked problems not through the individual components or systems of the problem but by addressing the collective properties that may have led to the creation of the problem as a whole. Transdisciplinarity is another approach that seeks to move beyond—or transcend—disciplinary boundaries to address inherently tricky and multilayered issues, such as climate change and other environmental or social challenges [6–8]. Both types of framing focus on the properties that emerge from patterns that result from interactions among multiple systems—for example, economic marginalisation in a community and the geographic distribution of air pollution—making them resistant to a reductionistic approach (i.e., simple technical solutions) and necessitating more sophisticated strategies.

To reveal insights emerging from this collection of articles, this overview synthesises their contributions by describing the concept of transdisciplinarity and providing a brief explanation of how it emerged in the editorial process. The analysis here places each of the articles within a thematic framework that expands from the three principles (or axioms) of transdisciplinarity proposed by Jantsch [6] and further developed by Nicolescu [7]. These principles are: (1) a recognition of different levels of—or lenses for viewing—reality; (2) the development of a middle ground; and (3) the acceptance of complexity. A fourth principle, which is supported by the cases in this Special Issue, is added to suggest a heuristic for practitioners who work in such arenas: (4) engaging through solidarity. The principles resonate with recent explorations into contemporary challenges in science communication that were identified by scholar-practitioners [9]. Their examples include combatting misinformation that prevents some people from seeking COVID-19 vaccinations or overcoming vested interests in carbon-based industries.

The synthesised overview presented here can thus help to identify common approaches to communicating and working within transdisciplinary settings. Here, we provide a background on these concepts to preface the individual contributions to this Special Issue.

Transdisciplinarity began to gain traction in the early 20th century as political movements, such as post-normal science and other critical fields, started to question the dominance of existing educational, knowledge, and democratic systems [10]. As a concept, transdisciplinarity was defined and gained prominence in the 1970s through the work of Piaget, Jantsch and Lichnerowicz [7]. For these scholars, transdisciplinarity refers to going "beyond" disciplines, capturing both academic forms of knowledge and other bodies of knowledge. This formulation aligns with a parallel body of work differentiating pure versus applied science, as promoted by Nowotny, Scott and Gibbons [11] and others. They differentiate between "mode 1", research aimed at contributing to academic knowledge, and "mode 2", applied research aimed at a multi-disciplinary policy or managerial audience.

In the cases here, descriptions of the need for transcending disciplinary boundaries and the centrality of communication in that process have facilitated the achievement of the goals of this Special Issue. These goals were framed in the original call for papers: (1) to explore communication that involves contestation or unexpected synergies among multiple stakeholders about environmental problems; (2) to address challenges when different ways of knowing (science-based and ways that are not science-based) are exposed and begin to influence how problems are framed; and (3) to use these examples to advance transdisciplinary theory and practices in communication.

Assembling this volume required the submitting authors, reviewers, and Guest Editors to "walk the talk" of transdisciplinarity. Authors were asked to ensure that their contri-

butions were rigorous within their disciplines but accessible to the journal's readers, who come from a range of disciplines often outside the authors' fields or sub-fields. Similarly, reviewers needed to be accepting of research methods that they might not use themselves, e.g., a biologist needing to recognise the value in an ethnographic case study. Incongruity in paradigms between each author and at least one of their reviewers was evident for most of the manuscripts submitted—creating an engaging tension that suggested that an interesting and worthwhile shared space was being formed. The shared space was cultivated by the Guest Editors, and occasionally the journal's regular Academic Editor, interpreting specific criticisms as, at least in part, representing such paradigm differences and suggesting or endorsing methods to address such differences. This accommodation could range from steps as simple as re-ordering or re-labelling sections to citing conceptual works in qualitative methodologies.

These paradigmatic disagreements provided real-world examples of the difficulties of communicating across disciplinary boundaries, albeit in the highly structured format of the peer-review process. In less well-defined settings, the complexity of interrelationships and interactions amongst actors in transdisciplinary arenas where boundaries between bodies of knowledge are rife makes the means, assumptions, successes, and failures of communication a critical factor in determining the success of these encounters [2]. The intriguing challenges presented by this complexity suggest why *Sustainability*'s Editorial Board asked to have communication as the focus of this Special Issue.

The key points from the various contributions to the Special Issue are summarised below, followed by a reflection on the insights that a transdisciplinary lens on communication and the environment offers across these settings. Understanding this set of articles as a collection emphasizes the importance of transdisciplinarity in the arena of environmental issues; the collection highlights the shared elements of successful approaches while also revealing the pitfalls encountered in other cases. Read together as a collection, the contributions in this issue highlight themes that can enable more effective applications of transdisciplinarity—in policy and practice—across a diverse range of settings.

In synthesising ideas across the articles in this issue, the focus is on how authors or their subjects of study have navigated challenges in communicating and engagement across and beyond disciplinary boundaries in conducting their work, whether it is empirical research, implementing policy, or responding to stakeholders, or in other contexts. An analysis of these varied cases suggests four principles for approaching wicked environmental problems:

(i) Embracing complexity;
(ii) Surfacing differences through reflexivity;
(iii) Communicating across epistemic difference;
(iv) Engaging through solidarity.

While not all four principles are evident in every article, there was sufficient commonality to suggest a trend indicating that these principles are arising implicitly, if not explicitly, in many of these settings. This outcome could be expected, as it aligns with the transdisciplinary axioms identified by Nicolescu [7] and the common themes arising in certain types of science communication—messiness, epistemic asymmetry, and reflexivity—as identified by Rifkin et al. [9]. These principles are defined in the sections below, where we demonstrate how each one, in turn, applies to certain contributions in this Special Issue.

As highlighted by many of the settings studied across the 12 articles, the complex interplays between these principles in practice mean that transdisciplinary inquiry is not a simple endeavour. Rather, it requires researchers and practitioners to step outside their familiar disciplines in pursuit of both developing holistic understandings of wicked problems [12] and taking effective steps to resolve them. As mentioned previously, a synthesis and explication of common approaches can enable more effective applications of transdisciplinarity. Each of these four principles may be considered as heuristics or systematically derived "rules of thumb" that can guide transdisciplinary ways of working.

(i). Embracing complexity—Wicked problems are characterised by complex interactions fuelled by different worldviews and differences in preference regarding different bodies of knowledge, e.g., different areas of science or lay experience [12]. Such complexity can often be considered a negative to be overcome instead of a dynamic that is always present in wicked problems. Attempts for simplification may thus occur because people seek ready and familiar solutions to novel challenges. These approaches can often include adhering to certain worldviews and methods for knowledge construction, prioritizing some over others [12]. For instance, one might prioritize gathering stakeholder input through surveys rather than through interviews.

Yet, as many of the articles in this issue conclude, the complexity introduced by the wicked characteristics of many contemporary environmental problems requires a corresponding complexity of methods and factors in analysis (such as examining belief systems). This intentional complexity is fostered through transdisciplinary approaches to communication processes and other shifts in education and institutional activities. The articles' authors recognise the potentially positive value of complexity, a complexity that welcomes contributions by different disciplines to enable a greater understanding of a system's elements. Fragmented thinking in disciplinary siloes should give way to "pertinent knowledge", as stated in a later work by early transdisciplinary theorist Morin [13], where subjects and problems are studied in context in all their complexity.

The principle of embracing complexity is reflected in several articles. For example, Contribution 1 notes that meaningful collaboration between local stakeholders and planning professionals in a brownfield redevelopment in Amsterdam is achieved through the acceptance of congruence rather than striving for consensus. The congruence for them described in Contribution 1 emerges through negotiation as "contextual agreement on collaborative action", where difference is maintained alongside areas of agreement to enable action and inquiry to move forward. Similarly, Contribution 6, which focuses on public engagement with climate issues through social media, promotes an embrace of congruence (for them, a form of consistency) over consensus (a degree of agreement). They cite disagreement as a potential resource to help address climate challenges because surfacing—rather than suppressing—multidimensional perspectives is crucial for addressing the wicked problems associated with climate change, such as economic drivers that may hinder energy transitions and the existential threats faced by island nations as sea levels rise.

The ability to view a problem in more than a single dimension is also addressed by Contribution 12, which analyses a region's need to transition away from coal mining through a speculative design lens, one that enquires into the potential, possible, and plausible futures. This speculative lens expands the complexity of the problem space to include avenues that may have otherwise remained obscured.

Contribution 10 notes that complexity increases when it comes to defining exactly who is recognised as having a "stake" and, therefore, who should be included in "stakeholder engagement". Ensuring that a sufficient number of perspectives is explored to identify potentially viable ways forward means broader inclusion to encompass an array of actors both human and, some would argue, non-human. For example, the articles in this Special Issue variously suggest including a wide range of stakeholders, including children, scientists, First Nations peoples, residents, government staff, advocates, and in some instances, non-human species such as whales, as highlighted in Contribution 9.

The integration of an apparent logic that is recognised as non-human, e.g., the responses of natural systems or animal species or plant species, is a potential direction for future investigation in transdisciplinary practice, particularly in relation to the connection of First Nations groups with land, water, and air. The involvement of a range of perspectives in such cases might be more effective in revealing a broader view of the complexities of the problem space, recognizing conflicts among worldviews and belief systems, and considering more potential options compared to a traditional or bureaucratically led approach. It is also an argument for procedural rights to enable input from a wider array of voices.

Assessing how contextual factors affect communication is raised in Contribution 11 to show that situations may be more complex than described through the perspective of a single knowledge source, whether from an expert or a relative non-expert. When policy-making experts were hosted informally on farmlands in Kazakhstan, the farmer hosts were able to express their resistance to officially prescribed methods in ways that were not possible before. The understanding of government experts, who had been influential in past policies, was expanded to include a more complex level of detail than they had seemed ready to accept. That shift was seen as potentially enabling the consideration of a greater range of solutions for addressing rising salinity in soils.

Thus, these articles embrace complexity in defining problems, identifying optional responses, and determining who, or what, is worth paying attention to, all of which can potentially influence practice.

(ii). Surfacing differences through reflexivity—Reflexivity is essential for conducting ethical, participatory research because it asks researchers to consider power and how positionality affects methodological choices, the subsequent interpretations of findings, and the resulting knowledge [14]. Reflexivity in practice enables recognising that the different value systems that people operate under may influence the way they understand and communicate about an environmental issue. Stirling [15] emphasises that reflexivity thus entails a more thorough consideration of issues by reflecting on a wide range of possible consequences that may affect others.

As a form of "self-awareness", in these settings, reflexivity is required to attend to the ways in which subjective views may shape interpretations of the object under consideration. This self-awareness could mean, for instance, coming to the critical realisation that identifying the consequences of using a new technology may depend on the point of view and expectations of a specific individual or group.

Such reflexivity can occur at a micro-level in transient moments when hierarchical relationships are suspended, according to Rifkin and Fulop [16]. At this micro-level, the command of a conversation can shift among participants, in that some are granted by others a more authoritative and secure participation status [17]. Higher participation status can lead to an ability for the voices of the less powerful to be heard, to focus the conversation on topics that they need addressed, and to increase the likelihood for their inputs to be heeded. These shifts can induce greater feelings of safety and a reduced sense of vulnerability among the less powerful and, importantly, among the more powerful, enabling the latter to be more circumspect [9]. Collins and Ison [18] argue that this form of dialogue can support the social learning needed to address complex socio-environmental challenges. Without reflexivity, differences will not be surfaced and contestation can continue to limit the types of strategies employed, hindering the achievement of desired outcomes.

Reflexivity is approached in several ways in the articles of this Special Issue, for example, through learning dialogue, making difference visible, enabling creative expression, establishing visceral experiences, representing of local knowledge, and conducting multi-party meetings. These cases illustrate instances where tactics, such as enabling creative forms of expression (such as drawing), or meeting in places that the powerful are less accustomed to meeting (such as on a farm), can enable reflexive dialogue to emerge, which is also highlighted by Steelman et al. [19]. Contribution 10 states that if power imbalances are not made visible, they remain easy to exploit, and the interests of powerful actors will remain a priority. Understanding differences in power is therefore crucial in adapting policy responses in ways that correspond to the needs and expectations of different audiences. The reflexivity of the researcher and author can foster greater reflexivity among the decision-makers they study and, one hopes, among those to whom they reportas well.

Another common theme is that the externalisation of different framings and meanings is crucial in multi-stakeholder arenas. Contribution 1 and Contribution 3 suggest, for example, that involving community members in framing environmental issues reduces the possibility of conflict arising because of differences in perspective. Contribution 2 shows how scientists, citizens, and artists in a citizen science project in Milan used a field notebook

as a boundary object to help negotiate their diverse approaches. In Contribution 7, the creation of a "design wall" in the classroom where children's sketches are displayed is an example of externalising knowledge, making it available for others to discuss, critique, and build upon. Visualisation was also crucial in Contribution 12 as the authors' architecture students used diagrams, maps, and other visual methods to create a "common language" for diverse groups to engage in discussions about what potential futures in a coal mining area might "look and feel like".

Attempting reflexivity in practice can be challenging. There are different experiences and lifeworlds that must be made known and respected, as underlined in the forest biosecurity issues addressed by the New Zealand school in the case study from Contribution 7. Multiple perspectives are considered in this article, including Western scientific and indigenous knowledge, adult perceptions, and those of the schoolchildren. In slowing down the engagement between the researchers and children, the authors suggest that engaging in a less frenetic and more natural (less structured) fashion allows for new perspectives to emerge through a less confrontational dialogic process. The importance of an accommodating posture emerged across other articles where scientific experts of various types were engaging with non-academic participants. A respectful cadence to knowledge making therefore appears to be an essential element in transdisciplinary practice.

Contribution 5 suggests that taking people out of their usual settings—or perhaps, more correctly, enabling them to encounter familiar settings in new ways—can assist in making different perspectives more visible and available for interrogation. To do so, the authors employ what they call "city walks" as a creative format for climate communication. Participants can encounter their surroundings in new ways and reflexively re-familiarise themselves with their city and local climate change-related issues.

This focus underlines the common thread across the articles about the importance of recognising how distinct stakeholder groups or demographic segments might differently frame what they see and experience as changes are made to their environment.

(iii). Communicating across epistemic difference—After embracing complexity and highlighting the differences in problem framings, values, and world views, the next challenge of transdisciplinary work is to coordinate practices, thinking, and experimentation to enable moving toward a purpose jointly defined by participating stakeholders.

The challenges inherent in this effort closely align with third-order thinking about science communication described by Irwin [20]. Irwin notes the deficiencies in one-way communication about science (first-order) and in narrowly defined engagement practices, labelled as "dialogue" (but is often observed as being implemented as cursory "consultation"), involving limited groups of stakeholders (second-order). Irwin argues for a greater acknowledgement of the complexity of the context in which one-way and two-way communication about science and the environment tend to occur [20]. This argument highlights how institutions, policy settings, discipline-based dynamics, and power differences among stakeholders shape both what can be said and the influence of those statements [21].

Using a transdisciplinary perspective to jointly define the problems and the purposes to be served in resolving them requires moving beyond one- or two-way exchanges; it requires communication that is not just to or from but amongst an array of actors with different bases of knowledge, experience, and values. For this type of third-order communication to be meaningful and effective, it should occur early on and continue throughout efforts to address environmental issues, starting from the first stages in collaborative problem framing [22].

To transcend disciplinary boundaries, the authors in this Special Issue created, implemented, and analysed a variety of approaches to bridge the deep chasms between disciplines and actors, including hybrid methodologies, arts-based practices, and the use of "boundary riders". In contrast, some authors explored how more narrow approaches appear to be trapped within boundaries defined by knowledge or access to other forms of power, such as government mandates.

Contribution 1 indicates that different settings (e.g., formal institutions or laboratories) have different consequences for how successfully actors are able to develop congruence. Contribution 1 also contends that methodological plurality is required to suit different epistemic preferences. Some prefer a more "fixed" boundary (e.g., to define an expert argument) and others prefer more "fuzzy" boundaries (e.g., to express values and be exposed to the values of others). In achieving a suitable and effective balance, as with Irwin's more general reference to third-order communication, there is no single correct approach. Returning to the idea of "pertinent" knowledge [13], progress comes from highlighting what needs to be known and recognising how the context might shape the development of someone's understanding and how it can influence their communication about that understanding.

Contribution 2 defines what they consider "fitness for purpose" regarding the tools they employed, creating "hybrid activities" from the approaches of different fields. In bringing artistic practice together with science and humanities, they aim to expose the reductionism inherent in conventional science and to nurture other ways of being and knowing that include more-than-human communities (i.e., from nature). Their careful approach to knowledge production is, however, not without its problems. Some scientists in their group expressed frustration with the qualitative and reflective methods of social scientists, viewing them as less rigorous than their own scientific methods.

Contribution 10 contends that more "hybrid" means of decision-making have emerged in managing natural resources as less top-down approaches have superseded previously bureaucratic, top-down methods. In these forms of hybrid governance, stakeholders collaborate to manage common-pool resources like water, land, and the atmosphere. What shapes the effectiveness of communication and people's ability to engage in these hybrid spaces is the person's access to different types of capital (e.g., social, cultural, financial). As with the previous principle that calls for reflexivity, Contribution 10 notes the importance of developing mechanisms to transparently surface and evaluate these differences in access. If imbalances are not known, what is communicated will not be reflective of the diversity of stakeholders' needs and interests.

Contribution 1 and Contribution 2 suggest that less formal communication spaces contribute to the successful co-development of problem framings and joint definitions of purpose. Arts-based practices are a common thread across other settings covered here to nurture informality. For example, the authors of Contribution 7 used graffiti-style murals on shipping containers and "design walls" (large pinboards for sketches and artworks) to re-engage primary school children in New Zealand with forest management. The externalisation of knowledge through arts-based practice is a key support for transdisciplinary work in that setting. As one of the children remarked about the design wall, "It was the first time I forgot what work was mine. . . All of it was our story". The arts-based practices used by the authors of Contribution 2 helped to bridge linguistic gaps and provided a "common ground" for members from different backgrounds and disciplines as part of a participatory process to assess soil fertility in the urban area of Milan, Italy.

The authors of Contribution 12 used visual methods, common in their field of architecture, to explicitly demonstrate the links between current situations and "yet-to-exist" possible, plausible, and probable futures, making these possibilities seem more concrete for community stakeholders. Through diagramming connections between multiple issues of a coal transition in a rural area in Australia's Hunter Valley, architecture students revealed potential alliances between unlikely industry and disciplinary partners. These diagrams offered previously unseen avenues for hybrid programmes to effectively address the complex and wicked problems associated with a fossil fuel transition.

Contribution 11 describes a culturally based apprenticeship model, which implies that knowledge is not merely explained but demonstrated in context. They characterise a situation where Kazakhstani farmers hosted workshops with policymakers in their villages, as noted earlier. In these familiar settings, farmers were more comfortable communicating to policymakers the challenges presented by official programmes and regulations

(e.g., problems with a subsidy scheme). This example suggests that the physical location of transdisciplinary work can effectively shape the communication of knowledge across disciplinary boundaries.

Contribution 1 raises the importance of facilitators in multi-stakeholder processes, particularly those who are able to balance the individual needs of participants with the common good of the community and society. Facilitators adapt methods to emerging project goals and create environments where diverse areas of knowledge can be gathered and considered to foster social learning. Contribution 1 uses the term "phronetic management" to describe this facilitation role. It involves reflexivity that leans toward "pragmatic action", drawing upon Loeber and Vermeulen [23], who have brought together the instrumental objectives of project management practice with the Aristotelian concept of "phronesis", or practical wisdom [24].

Intermediaries are also present in Contribution 10, the city walks article on water governance, where their use is less than successful, and Contribution 3, which discusses the climate resilience effort in Dayton, Ohio. Teachers in school settings can also be seen to play that facilitator role in the English eco-schools described by Contribution 4 and the New Zealand school described in Contribution 7. Whale scientists in Ecuador documented in Contribution 9 have positioned themselves at the junction between international conservation networks, national ministries, and local communities (including operators of whale watching cruises) to represent the perspective and interests of whales, leading to policies that benefit a wider array of stakeholders.

These cases suggest a need for—and the potential effectiveness of—carefully aimed and intentional approaches to facilitating transdisciplinary communication. These approaches include not just a shift in mindset but an openness to unusual methods and locations, and roles for intermediaries who can facilitate interaction and foster productive engagement.

Communicating across epistemic differences is also illustrated by Contribution 8 and Contribution 6, which contrast with the mainly qualitative and ethnographic work in the other ten articles. These two articles employ statistical methods to analyse large data sets of speeches on climate change by political elites (e.g., politicians in Contribution 8) and to assess responses to climate NGOs on social media (Contribution 6).

The authors in each case provide commentary on how their quantitative analysis can be informed by qualitative fieldwork, such as interviews, and how their conclusions can build on qualitative characterisations of specific settings to explore more general trends. This commentary provides a contrast with the framing of the qualitative articles, some of which illustrate a measure of "scientific-ness" in order to appeal to more technically minded reviewers and readers.

Both approaches underline the notion—evident across the set of articles—that in each setting, different bodies of knowledge vie for priority, suggesting that one is not just crossing a boundary but also subsequently finding a slot in a hierarchy. Transcending boundaries requires naming the paradigms that shape how different disciplines operate [13] so that their limitations might be made more explicit. In making them explicit, limitations can potentially be overcome by relying on other, complementary bodies of knowledge. That means, for example, recognising that while quantitative correlations between factors do not identify a cause–effect relationship, they can indicate a need for qualitative investigation. Conversely, qualitative investigations will provide deeper insight around causation, but they may lack the trend indicators that quantitative research uncovers.

The consideration of these quantitative analyses as "outliers" in this Special Issue underlines the potential value of this transdisciplinary principle of communicating across epistemic differences. Powerful insights can be gained through being open to the interplay between qualitative and quantitative work, as noted by Lee and Liebenau [25] in relation to their field of management information systems. A wilful transgression across these epistemic boundaries indicates the final principle for handling transdisciplinary wicked problems in the sustainability arena: engaging through solidarity.

(iv). Engaging through solidarity—It is almost a tautology to say that crossing disciplinary boundaries is common in multi- or inter-disciplinary approaches. In contrast, in transdisciplinary work, the aim is also to integrate the knowledge of people in non-academic roles and outside traditional professions through participatory engagement approaches [22,26]. The term "engagement" in sustainability arenas can be understood to imply boundary crossing, which can be achieved through various approaches.

When engagement between scientists and a range of sectors of public audiences is approached as a one-way delivery of knowledge from an expert to a non-expert audience, it is known as the deficit or public understanding of science model [27–29]. Subsequent theoretical developments have sought to engage stakeholders in two-way dialogue, or to cede almost full control from experts or corporate and government officers to the affected people [30,31]. However, this third-order trend in communication, which has been cited above, faces challenges.

Kankaria and Chakraborty [27], for example, explain that these "improvements" continue to locate engagement within hierarchies of power, where it is still an expert cohort making the judgement of what capabilities and methods would benefit the non-expert audience. Such positioning reduces the value of events that promote diverse inclusion to a mere instrumental "ticking of the box" approach to engagement [32]. That is, a broad, though constrained [33], range of types of stakeholders are included only to give the impression of engagement and not to make an authentic effort to comprehend or respond to their situations, understandings, needs, and perspectives.

In transdisciplinary work, engaging through solidarity means that diverse actors are valued for their different contributions, not just for their attendance. They add richness to the understanding of complex systems. Contribution 7, for example, states that children should be afforded the same respect as adults with the recognition that though they may have goals that differ from those of adults, they are nonetheless equal as eco-citizens. For working with children, Contribution 7 offers four key practices related to epistemic justice, the notion that all people should be respected as knowers [34]: (1) the development of equitable relationships; (2) giving opportunities for deep engagement; (3) giving spaces for both individual and collective thinking; and (4) granting adequate time for deliberation and reflection.

Respect for other forms of knowledge is also represented, according to Contribution 11, when scholars acknowledge that their understanding has developed from both expert and non-expert or local sources. Extending understanding, respect, and solidarity amongst individuals and among different disciplinary fields suggests procedural fairness and related ethical dimensions to transdisciplinary practice, as noted in Contribution 2. In seeking participants to volunteer, the authors of Contribution 2 created a large team whose members had a wide range of areas of expertise, bringing both "strong motivations and valuable knowledge". The integration of this value-based dimension led to the construction of knowledge that was more "socially robust", which they define as responsible, inclusive, and relevant. Contribution 1 notes that understanding the ethics and values of actors is crucial in working across difference in what she calls "in-between spaces". In these arenas, allowing for different values to coexist can be seen as part of the respect for different sources of knowledge and insight and the solidarity required for collaborative work on wicked problems. This notion can also be seen to underlie the focus in Contribution 1 on congruence rather than consensus.

In Contribution 3, solidarity is seen through the recognition of how systemic injustice—such as racial discrimination, poverty, unemployment, homelessness—affects a person's ability to respond to and recover from natural disasters. In their case study, although public officials recognise such chronic stressors as problematic, they do not attend to how stressors might affect public responses to long-term resilience planning. Residents, on the other hand, see that these stressors need to be addressed as part of community resilience building to avoid perpetuating inequity. This perception relates to the call from Contribution 10 to

make imbalances of power and access to social, political, and financial capital more evident so that they might be addressed.

Contribution 7, Contribution 2, Contribution 11, and Contribution 9 can be seen to promote the rights—or at least highlight the interconnection with social and political systems—of non-human species and ecosystems, such as whales, forests, and soil. Engaging in this work of solidarity introduces broader understandings of what communication and engagement may entail in addressing complex environmental issues. The whale populations described in the case study from Contribution 9 can be understood to break out of the enclosure of an economic paradigm (i.e., as a tourist attraction) to transform them into governable subjects worthy of ethical care, as is provided for humans.

In sum, the solidarity principle of transdisciplinarity that seems to emerge here suggests that, in addition to recognising complexity, reflecting on differences in sources of knowledge, and respecting those who rely on different sources, one needs to authentically engage across boundaries [35]. Engagement here implies not merely presenting to the "other" or ticking the box that they are in attendance but joining them in tackling the problems being faced.

One can conclude that the contributions in this Special Issue raise several challenges for practitioners and researchers who may want to be more transdisciplinary in practice, such as highlighting differences in values and beliefs, imbalances in capacities, and power differentials. To help in meeting these challenges, this synthesis article has distilled a conceptual understanding of transdisciplinarity based on the case analyses in the contributions.

The diversity of approaches presented in this Special Issue do not offer plug-and-play solutions. However, they provide several lessons for practitioners and researchers addressing sustainability that can help them to critically engage and possibly adjust how they undertake and explain their own work. These lessons can be summarised under the four principles described above.

i. Embracing complexity
   - Include a breadth of perspectives that match the complexity of the problem space.
   - Surface differences without forcing consensus. Move forward on those aspects on which you can agree.

ii. Surfacing differences through reflexivity
   - Involve a wide array of relevant actors (those with a stake) in framing the problem space.
   - Develop a respectful cadence to knowledge making. Slow down to allow for a less confrontational atmosphere.
   - Develop methods that support participants and allows them to feel safe to share their perspectives.
   - Make differences in framings and meanings visible so that they might be interrogated. Do so through tangible methods (e.g., posters, diagrams, design walls).
   - Offer a deliberate change in context. For example, go for a walk or create a mural.

iii. Communicating across difference
   - Meaningful (third-order) communication amongst stakeholders should occur early on and throughout.
   - Highlight what needs to be known and develop multiple strategies for use across different settings to communicate understanding (tools that are "fit for purpose").
   - To be inclusive, resist rigid formality in the setting as it can evoke historical differences in power.
   - Evaluate how differences in social, economic, and political capital can affect the potential of different stakeholders to engage effectively.

iv. Engaging through solidarity
   - Strive for epistemic justice, which includes respecting different bodies of knowledge.
   - Recognise how historic stressors might affect a person's capacity to participate.

While far from being comprehensive, this list reflects a diverse array of useful insights from the wicked problems and the approaches to address them that are described in this Special Issue. As with any list of heuristics, one can see a pragmatic flavour, such as in the "Celestial Emporium of Benevolent Knowledge" from Borges [36] that contains animal types such as mermaids, animals that belong to the emperor, and stray dogs. In this practical framing, the twelve articles have revealed the challenging messiness of engaging in transdisciplinary practices. Embracing this messiness and its potential to nourish the emergence of more meaningful environmental communication is a crucial step toward "being transdisciplinary".

Author Contributions: Conceptualization, K.C., H.B., W.R., M.E. and R.P.; methodology, K.C. and W.R.; formal analysis, K.C., W.R. and M.E.; writing-original draft preparation, K.C., W.R. and M.E.; writing-review and editing, K.C., W.R., M.E. and R.P.; project administration, W.R. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest: The authors declare no conflict of interest.

List of Contributions

1. Abraham, S. Your Sustainability Is Not My Sustainability: In-between Spaces for Meaningful Collaboration between Local Stakeholders and Planning Professionals to Construct Congruent Frames over Contested Meanings. *Sustainability* **2023**, *15*, 4179.
2. Criscuolo, L.; Bordogna, G.; Barbara, L.; Benessia, A.; Bergami, C.; Calastri, E.; Capocefalo, V.; Caretto, A.; Cavallo, C.; Chakraborty, A.; et al. Developing a Participatory Process for Soil Fertility: A Case Study in an Urban Area of Italy. *Sustainability* **2024**, *16*, 4882.
3. Fernando, F.; Maloney, M.; Tappel, L. Perceptions of Urban Community Resilience: Beyond Disaster Recovery in the Face of Climate Change. *Sustainability* **2023**, *15*, 4543.
4. Gelmez Burakgazi, S.; Reiss, M. Perceptions of Sustainability among Children and Teachers: Problems Revealed via the Lenses of Science Communication and Transformative Learning. *Sustainability* **2024**, *16*, 4742.
5. Hartmann, E.; Geneuss, K.; Hoppe, I. Dialogue and Disruption at the Doorstep: Participant Perceptions during a City Walk as a Climate Communication Format. *Sustainability* **2024**, *16*, 4490.
6. Kim, E.; Hara, N. Identifying Different Semantic Features of Public Engagement with Climate Change NGOs Using Semantic Network Analysis. *Sustainability* **2024**, *16*, 1438.
7. McEntee, M.; Thomas, K.; Mullen, M.; Houghton, C.; Harvey, M.; Craig-Smith, A. Addressing Epistemic Injustice: Engaging Children as Environmental Communicators to Support the Long-Term Sustainability of Forest Ecosystems. *Sustainability* **2024**, *16*, 3124.
8. Mah, A.; Song, E. Elite Speech about Climate Change: Analysis of Sentiment from the United Nations Conference of Parties, 1995–2021. *Sustainability* **2024**, *16*, 2779.
9. Tatar, B. Advocacy, Ecotourism, and Biopolitics of Whale Conservation in Ecuador. *Sustainability* **2023**, *15*, 1608.
10. Whitley, H. Exogenous, Endogenous, and Peripheral Actors: A Situational Analysis of Stakeholder Inclusion within Transboundary Water Governance. *Sustainability* **2024**, *16*, 3647.
11. Féaux de la Croix, J.; Samakov, A. Moving beyond the Framing Impasse in the Aral Sea Delta: Vernacular Knowledge of Salinization and Its Potential for Social Learning towards Sustainability. *Sustainability* **2024**, *16*, 8605.
12. Spurr, S.; Carrasco, S. Architecture for Complexity: Speculative Design as Enabler of Engagement in Co-Designing Post-Mining Futures in the Hunter Valley. *Sustainability* **2024**, *16*, 6842.

References

1. Dryzek, J.S. *The Politics of the Earth: Environmental Discourses*, 4th ed.; Oxford University Press: New York, NY, USA, 2022.
2. Misra, S.; Lotrecchiano, G.R. Transdisciplinary communication: Introduction to the special series. *Inf. Sci.* **2018**, *21*, 41–50. [CrossRef]
3. Rittel, H.W.J.; Webber, M.M. Dilemmas in a General Theory of Planning. *Policy Sci.* **1973**, *4*, 155–169. [CrossRef]
4. Rittel, H.W.J. *On the Planning Crisis: Systems Analysis of the 'First and Second Generations'*; Institute of Urban and Regional Development: Berkeley, CA, USA, 1972.

5. Cilliers, P. Complexity Theory as a General Framework for Sustainability Science. In *Exploring Sustainability Science: A Southern African Perspective*; Burns, M., Weaver, A., Clark, W., Kates, R., Eds.; AFRICAN SUN MeDIA, SUN PReSS: Stellenbosch, South Africa, 2008; pp. 39–57.
6. Jantsch, E. Inter-and Transdisciplinary University: A Systems Approach to Education and Innovation. *High. Educ.* **1970**, *1*, 7–37. [CrossRef]
7. Nicolescu, B. Transdisciplinarity: Past, present, and future. In Proceedings of the II Congresso Mundial de Transdisciplinaridade, Vitória, Brazil, 6–12 September 2005; pp. 1–24.
8. Hewitt, R.J. Crossing the wicked frontier. Why sustainability science needs integrative research. *R. Soc. Open Sci.* **2024**, *11*, 240210. [CrossRef] [PubMed]
9. Rifkin, W.; Badullovich, N.; Bailey, L.; Bray, H.; Espig, M.; Kershaw, A.; Longnecker, N.; Manyweathers, J.; Nurse, M. Messiness, Epistemic Asymmetry, and Reflexivity: Exploring Third-Order Communication in the Wild. In *Science Communication and Trust*; Fage-Butler, A., Ledderer, L., Nielsen, K.K., Eds.; Springer Nature: New York, NY, USA, 2025.
10. Klein, J.T. Discourses of transdisciplinarity: Looking back to the future. *Futures* **2014**, *63*, 68–74. [CrossRef]
11. Nowotny, H.; Scott, P.; Gibbons, M. *Re-Thinking Science: Mode 2 In Societal Context. Knowledge Creation, Diffusion, and Use in Innovation Networks and Knowledge Clusters. A Comparative Systems Approach Across the United States, Europe and Asia*; Praeger Publishers: Westpro, CT, USA, 2006; pp. 39–51.
12. Brown, V.A.; Harris, J.A.; Russell, J.Y. (Eds.) Collective Inquiry and Its Wicked Problems. In *Tackling Wicked Problems Through the Transdisciplinary Imagination*; Taylor & Francis Group: London, UK, 2010; pp. 61–83.
13. Morin, E. (Ed.) *Seven Complex Lessons in Education for the Future*; UNESCO Publishing: Paris, France, 2001.
14. Sultana, F. Reflexivity, Positionality and Participatory Ethics: Negotiating Fieldwork Dilemmas in International Research. *ACME Int. E-J. Crit. Geogr.* **2007**, *6*, 374–385.
15. Stirling, A. Precaution, Foresight and Sustainability: Reflection and Reflexivity in the Governance of Science and Technology. In *Reflexive Governance for Sustainable Development*; Voß, J., Bauknecht, D., Kemp, R., Eds.; Edward Elgar Publishing Limited: Cheltenham, UK, 2006. [CrossRef]
16. Rifkin, W.; Fulop, L. A Review and Case Study on Learning Organizations. *Learn. Org.-Int. J.* **1997**, *4*, 135–148. [CrossRef]
17. Goffman, E. Footing. *Semiotica* **1979**, *25*, 1–30. [CrossRef]
18. Collins, K.; Ison, R. Jumping off Arnstein's Ladder: Social Learning as a New Policy Paradigm for Climate Change Adaptation. *Environ. Policy Gov.* **2009**, *19*, 358–373. [CrossRef]
19. Steelman, T.A.; Andrews, E.; Baines, S.; Bharadwaj, L.; Bjornson, E.R.; Bradford, L.; Cardinal, K.; Carriere, G.; Fresque-Baxter, J.; Jardine, T.D.; et al. Identifying transformational space for transdisciplinarity: Using art to access the hidden third. *Sustain. Sci.* **2019**, *14*, 771–790. [CrossRef] [PubMed]
20. Irwin, A. Risk, science and public communication: Third-order thinking about scientific culture. In *Routledge Handbook of Public Communication of Science and Technology*, 3rd ed.; Bucchi, M., Trench, B., Eds.; Routledge: Abingdon, UK, 2021; pp. 147–162.
21. Hajer, M.A. Setting the Stage: A Dramaturgy of Policy Deliberation. *Admin. Soc.* **2005**, *36*, 624–647. [CrossRef]
22. Espig, M.; Finlay-Smits, S.C.; Meenken, E.D.; Wheeler, D.M.; Sharifi, M. Uncertainty in and around biophysical modelling: Insights from interdisciplinary research on agricultural digitalization. *R. Soc. Open Sci.* **2020**, *7*, 201511. [CrossRef] [PubMed]
23. Loeber, A.; Vermeulen, T. Reflexive project management in high-ambition projects: Exploring the competencies for managing innovative sustainable designs. *Soc. Bus.* **2016**, *6*, 15–37. [CrossRef]
24. Kinsella, E.A.; Pitman, A. (Eds.) *Phronesis as Professional Knowledge: Practical Wisdom in the Professions*; Sense Publishers: Rotterdam, The Netherlands, 2012.
25. Lee, A.S.; Liebenau, J. Information systems and qualitative research. In *Proceedings of the IFIP TC8 WG 8.2 International Conference on Information Systems and Qualitative Research, Philadelphia, PA, USA, 31 May–3 June 1997*; Springer: Boston, MA, USA, 1997; pp. 1–8.
26. Stock, P.; Burton, R.J. Defining Terms for Integrated (Multi-Inter-Trans-Disciplinary) Sustainability Research. *Sustainability* **2011**, *3*, 1090–1113. [CrossRef]
27. Kankaria, S.; Chakraborty, A. Scientific temper: Towards an alternate model of science-society relationships. *J. Sci. Commun.* **2024**, *23*, Y03. [CrossRef]
28. Simis, M.J.; Madden, H.; Cacciatore, M.A.; Yeo, S.K. The lure of rationality: Why does the deficit model persist in science communication? *Public Underst. Sci.* **2016**, *25*, 400–414. [CrossRef] [PubMed]
29. Wynne, B. May the sheep safely graze? A reflexive view of the expert-lay knowledge divide. In *Risk, Environment and Modernity: Towards a New Ecology*; Lash, S., Szerszynski, B., Wynne, B., Eds.; SAGE Publications: London, UK, 1995; pp. 44–83.
30. Arnstein, S.R. A Ladder of Citizen Participation. *J. Am. Inst. Plan.* **1969**, *35*, 216–224. [CrossRef]
31. Irwin, A. Risk, science and public communication: Third-order thinking about scientific culture. In *Routledge Handbook of Public Communication of Science and Technology*, 2nd ed.; Bucchi, M., Trench, B., Eds.; Routledge: Abingdon, UK, 2014; pp. 160–172.
32. Mercer-Mapstone, L.; Rifkin, W.; Louis, W.R.; Moffat, K. Company-community dialogue builds relationships, fairness, and trust leading to social acceptance of Australian mining developments. *J. Clean. Prod.* **2018**, *184*, 671–677. [CrossRef]
33. Mercer-Mapstone, L.; Rifkin, W.; Louis, W.; Moffat, K. Power, participation, and exclusion through dialogue in the extractive industries: Who gets a seat at the table? *Resour. Policy* **2019**, *61*, 190–199.
34. Fricker, M. *Epistemic Injustice: Power and the Ethics of Knowing*; Oxford University Press: New York, NY, USA, 2007.

35. O'Connor, M.P.; Douguet, J.M. Working deliberat(iv)ely with(in) wicked problems: The existential, epistemological and ethical nexus of imperfect knowledge. *Futures* **2024**, *163*, 103436. [CrossRef]
36. Borges, J. The Analytical Language of John Wilkins. In *Other Inquisitions 1952*; University of Texas Press: Austin, TX, USA, 1937; pp. 101–105.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.