

Transdisciplinarity: A Primer

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Transdisciplinarity MACAL

In the documentary on the gene editing process, CRISPR, called “Human Nature” (Bolt & Kirschner, 2019) Francisco Mojica, a Spanish microbiologist says, “When you are a student, you think everything is known, but there are places where no one else looked.” This statement is apt to introduce this short primer on Transdisciplinarity which is offered as a resource to support the kind of thinking and practice that is fundamental to the MACAL program with “learners who wish to shift from concern to informed action to address the pressing issues of climate change...an inter-sectoral and collaborative approach.” (Cox, 2019 p.1). For learners who will be designing and working through challenges and engaging in dialogue across and beyond disciplines regarding the complex issues of climate change, this primer addresses the questions:

1. What is transdisciplinarity?
2. Why is it important?
3. What are some strategies that can support applying a transdisciplinary lens?

In doing so, it traverses some of the theoretical and philosophical underpinnings as well as including the thinking of a number of those who have been engaged in and made significant contributions to this process.

What is Transdisciplinarity?

It is a process of inquiry. Mutual learning, exploration between and beyond disciplines, social responsibility, emergent knowledge, and possibility are all aspects of transdisciplinarity. Reynolds (2019) draws on Niscolescu’s framing of transdisciplinarity to describe it as “between, across, and beyond disciplines, as well as embracing nondisciplinary knowing and perspectives, i.e., life-world perspectives from civil society, government, and industry” (p.15).

The word itself appeared in France, in 1970, in the talks of Jean Piaget, Erich Jantsch, and André Lichnerowicz at the international workshop “Interdisciplinarity – Teaching and Research Problems in Universities,” organized by the Organization for Economic Co-operation and Development (OECD) in collaboration with the French Ministry of National Education and University of Nice¹ (Nicolescu 2010, p.10).

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Over the subsequent decades, with the surge of scientific innovation, as well as significant social change, the notion of transdisciplinarity became more prominent in the discourse of education theorists, physicists, social scientists, health scientists, philosophers and other researchers. More than one school of thought has developed. The two most noted of those are the Zurich and the Nicolescuian, the latter arising from the work of Basarab Nicolescu, an honorary theoretical physicist at the Centre National de la Recherche Scientifique (CNRS) Laboratoire de Physique Nucleaire et de Hautes Energies, Universite Pierre et Marie Curie, Paris (among other honorary positions and degrees).

Nicolescu's work in the quantum realm as well as in transdisciplinarity, is extensive and groundbreaking, even formulating a new theory of knowledge which frames knowledge as an "embodied phenomenon, where actors, embedded in these interdependent levels of reality transcend as they include the logic of separation and embrace apparently contradictory perspectives to more fully know their roles in co-visioning this dynamic, evolutionary universe" (Nicolescu as cited in Reynolds, 2019, p. 22). Nicolescu also provides this elegantly phrased and useful definition of transdisciplinary thinking: "humans come together in a space where they can temporarily hear and integrate respective perspectives with respective information, trusting that new, co-created, cross-fertilized knowledge will emerge." (Nicolescu as cited in Reynolds, 2019, p. 21). His approach to and understanding of transdisciplinarity is based on the theoretical foundations of quantum physics, such as quantum indeterminism and the principle of the superposition of quantum. He proposes, "a reality not at all ordered, but with an entity full of ambiguity with processes and relationships that are often conflicting, competing and complementary at the same time...a world of complexity and complexity thinking." Nicolescu, (as cited in Dieleman, 2012, p. 45¹). This world of complexity is the context for the MACAL program, oriented to developing learner capacities to work with the complex challenges inherent in climate change. These challenges are ones that can well be called "wicked problems", a term

¹ *NB: The article, "Transdisciplinarity at the Crossroads: Nurturing Individual and Collective Learning", (2018) from which the above is excerpted is a rich source of information regarding working in a transdisciplinary space, and therefore, highly recommended.

introduced by Horst Rittel and Melvin Webber (1973) and expanded upon by the Environmental Humanities Working Group (Stonybrook University, 2020) with the following list:

What is a wicked problem?

Wicked problems are seen to share the following characteristics:

- 1) They do not have a definitive formulation.
- 2) They do not have a “stopping rule.” In other words, these problems lack an inherent logic that signals when they are solved.
- 3) Their solutions are not true or false, only good or bad.
- 4) There is no way to test the solution to a wicked problem.
- 5) They cannot be studied through trial and error. Their solutions are irreversible so, as Rittel and Webber put it, “every trial counts.”
- 6) There is no end to the number of solutions or approaches to a wicked problem.
- 7) All wicked problems are essentially unique.
- 8) Wicked problems can always be described as the symptom of other problems.
- 9) The way a wicked problem is described determines its possible solutions.
- 10) Planners, that is those who present solutions to these problems, have no right to be wrong.

Unlike mathematicians, climate action involves real world problems and solutions. This means that those enacting climate mitigation and adaptation strategies need to be thoughtful about the potential– intended and unintended consequences their actions may have. In other words, those enacting climate actions need to be accountable for the consequences of those actions for affected populations (Stonybrook, 2020).

With wicked problems there is a slipperiness, high levels of uncertainty, and high stakes. Given this, the cognitive distance from wicked problems to complexity theory and transdisciplinarity is not a big jump. Positivist monodisciplinary approaches may not be enough when trying to find ways to address climate change, poverty, racism, and other complex or wicked challenges. Acknowledging uncertainty and looking for patterns in complexity when attempting to make some sense of the behaviour of systems operating at the

edge of chaos as they adapt, are where transdisciplinarity, with its intention of generating new knowledge and possible new action, can provide benefit.

We are living in a time where wicked problems abound, including the COVID-19 pandemic, the climate crises, systemic racism and inequity, and the ongoing challenges and paradoxical conflicts presented by current economic models and sustainable development goals. We are also living in a time of rapidly emerging and shifting knowledge within and between disciplines and the everyday world. The need to adapt has become commonplace in this time of uncertainty and crisis. In response to the COVID-19 pandemic, we have seen businesses pivot and norms shift. We have grocery stores and banks with plastic dividers and stickers showing where to stand; people wearing masks (or not); people social distancing (or not), hybrid models of education (online, distanced face to face), and new economic, political and collective priorities. Whether these are temporary or sustained, we have no way of knowing. In the context of the complexity of the 21st century, transdisciplinarity is emerging as a necessary lens as experts, politicians, and citizens from various disciplines and orientations and worldviews race to generate new knowledge and actions to address these wicked problems.

Interdisciplinary, Multidisciplinary, Transdisciplinary

To better understand what something is, it can be helpful to consider what it is not. Multidisciplinarity moves beyond a single discipline to consider several disciplines at once, place value in the perspectives offered by multiple disciplines. From this perspective or orientation, a discipline is enriched by the thinking from another discipline, but this is always framed within the home, or primary disciplinary framing of a concept or a problem; in other words, the goal of multidisciplinary work is still to frame the work within a single discipline while including ideas or concepts from other disciplines.

Interdisciplinarity is concerned with the transfer of knowledge, concepts, and models from one discipline to another (Padurean and Cheveresan, 2010). From this perspective, disciplinary boundaries can be blurred. Think of the crossover in the class Venn diagram. That crossover space is interdisciplinary and sometimes represents a new discipline. For example, neuroscience and biology crossover in the

interdisciplinary field of neurobiology; economics and anthropology cross over in the new field of economic anthropology.

Transdisciplinarity, on the other hand, concerns “that which is at once between the disciplines, across the different disciplines, and beyond all disciplines. Its goal is the understanding of the present world.” (Nicolescu, 2010, p.10). Transdisciplinary thinking brings insights, concepts, models from multiple perspectives and disciplines to understand and conceptualize complex concepts. From this orientation, the disciplinary boundaries are no longer distinguishable or discrete.

The summary below may provide a further way of distinguishing between five different approaches to research. They reflect differing worldviews, on a continuum from a more reductionist, positivist standpoint, to one that is more consistent with a worldview that reflects a quantum lens:

- Intradisciplinary (or mono-disciplinary) working within a single discipline
- Crossdisciplinary: viewing one discipline from the perspective of another.
- Multidisciplinary: people from different disciplines working together, each drawing on their disciplinary knowledge.
- Interdisciplinary: integrating knowledge and methods from different disciplines, using a real synthesis of approaches.
- Transdisciplinary: creating a unity of intellectual frameworks beyond the disciplinary perspectives. Stember (as cited in Jensenius, 2012).

According to Bernstein (2015), in his comprehensive rendering of the origins of Transdisciplinarity as a term, a process and a philosophy “Transdisciplinarity today is characterized by its focus on “wicked problems” that need creative solutions, its reliance on stakeholder involvement, and engaged, socially responsible science. (p.6, p 1).

Summary

So, drawing from this work, transdisciplinarity can be thought of as the cultivation and practice of a mindset and orientation that approaches boundaries between disciplines and between disciplines and the

world outside them, as recursively permeable, creating spaces and places to make transformative connections in understanding and generating knowledge that is intended to have positive impact on humans and society. It is tempting to use the metaphor of many people studying parts of an elephant with transdisciplinarity being the whole elephant, but this would miss something important. How is the elephant changed? And how does this change have a positive impact on society?

Why is Transdisciplinarity Important?

Given an understanding of transdisciplinarity as not only a way of doing research, but also as a methodology with a particular mindset and orientation, a way of being that has engagement with and contribution to the world we live in, the following answer to the question “Why is Transdisciplinarity important?” is worth considering. Hadorn et al (as cited in Hyun, 2007, p 12) describes the modern world as one of “uncontrollable transnational globalization, ever increasing numbers of natural disasters worldwide, and the awakening realization of real-life problems that are complex, deeply interconnected, and interdependent in multidimensional modes.” These authors go on to describe the recent and ongoing shift to incorporate transdisciplinary learning, thinking and research within education (K-12 and Higher Education) as a response to that complexity. This call is taken up in the [video](#) produced by Michigan Tech University that argues for the need for transdisciplinary thinking in the context of global problems such as climate change.

Transdisciplinarity and Education

The public school or K-12 education systems in most countries are organized into subject areas that are called English, Art, Mathematics, Science, Social Studies, and the like. Higher education also continues to reflect these disciplinary division with faculties, departments and courses that are, in general, rather precisely categorized into specialties. As Nicolescu (2010) describes, “ [a]ll the various tensions-economic, cultural, spiritual – are inevitably perpetuated and deepened by a system of education founded on the values of another century, and by a rapidly accelerating imbalance between contemporary social structures and the changes which are currently taking place in the contemporary world“ (p.20). Calling for a different

orientation, Nicolescu describes the need for a new approach to education that “takes into account all the dimensions of the human being” (p. 20).

Transdisciplinary approaches to curriculum design can provide this new approach, supporting students capacity to think about and articulate complex or wicked problems from a socio-ecological (human/ecology) perspective; engage in complex and creative problem solving; and develop new knowledges that transgress national, cultural, and disciplinary boundaries and support resilience, wellbeing and equality in pluralistic societies” (Hyun, 2007).

In trying to respond to the question: Why is transdisciplinarity important? One might well reframe it to: Can an understanding of and working within transdisciplinarity lead us to the kind of knowledge and subsequent actions we need at this time in our history? Evidence is growing that the answer to that question, is yes.

Transdisciplinarity and Research

There is a growing call for transdisciplinary research, particularly in response to research in areas such as climate change, where there is both a need for knowledge and input from multiple disciplines and stakeholder and rights holder groups, and problems that are characterized by incomplete information and uncertainty. This call for transdisciplinarity, in part responds to the need for more contextually specific and socially accountable research practice, or as Vilsmaier (n.d.) describes the need for research on complex problems that takes into account multiple perspectives and makes stronger connections between research, practice and transformative social agendas (para. 1).

Transdisciplinarity should not be seen as a replacement for more traditional scientific research approaches and the depth of knowledge generated in uni-disciplinary research. Rather, it pushes up against the positivist understanding of objectivity by integrating diverse perspectives and knowledges using both qualitative and quantitative research methods. As Dieleman suggests, transdisciplinarity has an inclusive orientation to knowledge such that the “goal of transdisciplinarity is to restore the unity of knowing, not by means of abolishing scientific knowing (or any other forms of knowing) but to see all forms of knowing as

complementary making up one complex reality.” (p.47). Transdisciplinary research is another tool for understanding and contributing to societal transformations to address wicked problems, by drawing on and valuing the participation and perspectives of multiple rights-holders and stake-holders and busting some of the intransigent silos that exist in traditional knowledge production and action (Vilsmaier, n.d.).

From this perspective, formal and informal research inquiry is both contextualized and case-specific and needs to involve those affected by the issue in the inquiry. However, the assumption of those elements contributing to a better understanding, does not necessarily translate to having found the perfect form of research to transform the world we live in. Transdisciplinary research, as with other forms of research has its limitations and needs to be subjected to critical thinking and review just as are other research modes.

The completion, in November 2019 in Germany, of an extensive and comprehensive comparative analysis looking at how different modes of research influence both societal and academic outcomes, found that when non-academic participants were involved very early in the research process, societal outcomes benefited (with later involvement, not so much), although academic performance was at times negatively affected. These researchers found that careful project design in a transdisciplinary inquiry was critical in reducing the potential negative effects (Newig et al, 2019).

In the present global reality, it may well be possible that humanity is in the position of not knowing what we need to know, nor knowing what we don't know. In the context of trying to adapt to currently occurring eventualities and crises, transdisciplinarity is an acknowledgement of that understanding. Hyun (2007), referring to the complexity of the social and ecological challenges characteristic today, suggests that in this context of uncertainty and not knowing there is a need for transdisciplinary thinking and the skills and creative and flexible orientation or “mindsets” that are characteristics of transdisciplinary thinking (p.10).

What are some strategies that can support applying a transdisciplinary lens?

Since the Graduate Master of Arts in Climate Action Leadership (MACAL) program fosters and supports a mindset oriented to ever-developing fluency in challenge-based learning in a time of complexity, and the integration of multiple perspectives on the complex challenges of climate change specifically, the

benefits of understanding and working in a transdisciplinary space seem evident. At the same time, employing a transdisciplinary approach to learning and sharing knowledge has its own challenges. These include logistical, political, structural and any number of other possibilities that arise when bringing forward a newer way of thinking into systems designed on and by systems of thinking that are siloed, disconnected, and increasingly specialized. The goal of encouraging transdisciplinary thinking relies on what may seem like new strategies and practices of thinking, but in fact are strategies that we already use to engage with the world. When we think of the ocean, for example, we are thinking about an abstract, transdisciplinary concept that is informed by concepts, perspectives, and models drawn from a wide range of disciplines as varied as ecology, biology, physics, chemistry, philosophy, poetry, anthropology and many others, and our own direct and indirect experiences of this thing we call “ocean.”

Design Thinking

Applying transdisciplinary thinking to wicked problems allows us to see more of the ‘whole picture’ or the ‘gestalt’ of a challenge, and it can encourage a distributed ownership of the problem and contribute to equitable benefits from the application of strategies to resolve the challenge. There is no single method for applying a transdisciplinary lens to inquiry, however [Design Thinking](#) offers one useful approach. Design thinking describes a user-centered, or human-centered approach to design that emerged in response to a need for designs and decisions that are more responsive to the needs of users or those who are directly impacted by decisions. It has been taken up in a broad range of contexts including the context of climate action because of the complexity of the challenges, and the need for innovation and context-specific solutions. Design thinking processes (and there is no single approach) share some common elements including spending time with problem identification and framing, a process that relies on empathizing with and understanding the perspectives of end users, stakeholders, and rights holders; problem analysis which includes creative thinking pushing beyond what is known to what may be possible - thinking outside the box; and solution iteration, the process of identifying a potential solution or ideas, prototyping those in the real

world, evaluating their efficacy and impacts, and then moving forward or discarding and going back to generating new solutions, prototyping and evaluating in this action-reflection-evaluation-redesign cycle.

Heuristics

With respect to the kinds of skillsets that transdisciplinary thinking and research require, there may be some surprises. Most if not all academic research requires communicative and collaborative skills similar to those expected in business. In an environment of transdisciplinary inquiry, however, a more situationally focused awareness becomes useful. This approach is based in heuristics, a “method of solving problems by finding practical ways of dealing with them, learning from past experience” ([Oxford Learner’s Dictionary](#)). Heuristics, in other words, are the mental maps, intuition, and prior experience that we draw on to inform our thinking about and response to problems. One example is scarcity heuristics, the idea that if something is rare or scarce, it is more valuable. Or the rule of thumb or educated guess heuristics, which people employ to make decisions without having to do exhaustive research.

The economist, Herbert Simon, made significant contributions to a number of fields of study. His interest in decision-making, innovation, and heuristics is influential. Simon described heuristics and intuition as “natural ways of understanding and relating us with the world, and of creating a base for decision making” (as cited in Dieleman 2012, p. 72-3). Heuristics draw from and on prior experience and observation, and these mental maps and intuition provide ways of taking action or making decisions in situations where we do not have (or make the efforts to have) comprehensive information and evidence. Katri Huutoniemi and Petri Tapio (2014), scholars of transdisciplinary research, assert the appropriateness of heuristics in transdisciplinary inquiry:

“While scientific reasoning is mostly guided by disciplinary traditions, transdisciplinary research rests on other cognitive strategies. As it does not have a ready-made stance toward problems, figuring out what the puzzle is and what the answer might look like are crucial aspects of transdisciplinary inquiry... By focusing on heuristics, rather than on methods, concepts, or general guidelines...a problem-centered approach often resists the rigor of methodology. Learning from experience

provides valuable "rules of thumb," checklists, and other cognitive schemes for making ill-defined problems more tangible." (Huutoniemi&Tapio, 2014)

Doctors use heuristics as tools in making life and death decisions when time is of the essence and certainty is not present, (Katsikopoulos KV. 2015 pp.195-203). Similarly, in the context of climate action we are always operating in the context of uncertainty and incomplete information, and yet we still need to make decisions and take urgent action, and we do this by drawing on the knowledge that is available

Institute for Sustainable Futures Ways of Working

The Institute for Sustainable Futures is a transdisciplinary research institute established in Australia in 1997. In the context of that institute, practitioners from diverse disciplinary backgrounds have focused on conducting transdisciplinary research on sustainable futures. They propose ways of working with a transdisciplinary lens that are useful to include here, in full:

- Purposive: positive change within a wicked situation is an explicit goal of the research.
- Holistic: it engages with the past, present, and future of whole systems and transgresses disciplinary and governance boundaries.
- Participatory: given that diverse stakeholder perspectives (beyond academia) are necessary to achieve progress on wicked problems, it allows us to see more of the whole picture and encourage ownership of, and equitable benefit from, responses.
- Innovative and experimental: it enables testing of ideas through real-world interventions and action research.
- Dynamic: the research plan adapts to the changing context and new knowledge.

more than research; it is an integrated process of research, learning, collaboration, and action. It incorporates cycles of action and practice that inform research and theory development, which in turn inform new practice. These cycles are connected by a constant process of reflection and sensemaking, that supports innovation and deepens both theory and practice."

(Riedy et al., 2018).

Transdisciplinary Leadership

A new type of leadership, distinct from those previously applied, is transdisciplinary or transleadership. McGregor and Donnelly (2014) describe this kind of leadership as “a process rather than a role, a process that can be shared among the participants in a more substantive and embodied way that distributed leadership where the capacities and skills are needed, are developed in concert with others involved” (p.160). From their perspective, transdisciplinary leadership is seen as a necessary way of working, because it weaves together different knowledges and contributes to actions that are more relevant and effective in addressing complexity and diversity. The authors propose that a “special form of leadership is required, one that respects complexity, emergence, inclusiveness, rigor, and pragmatism—transleadership is suggested as a concept to scaffold future philosophical, intellectual and pragmatic debate, dialogue, discourse, and deliberations.” (McGregor and Donnelly, 2014, p. 169). They also suggest a set of capacities they believe are necessary to transdisciplinary leadership and to transdisciplinary processes:

- valuing doubt and resistance to new ideas, viewing them as a resource,
- seeing merits in vagueness, uncertainty and unpredictability as prompts for possibilities,
- understanding the need for constant adaptation and resiliency,
- balancing current needs and responsibilities and being future-oriented
- solution focused
- iteratively deconstructing and reframing issues/challenges
- supporting, including and understanding multiple perspectives and worldviews as ways of stimulating dialogue, idea generation,
- capitalizing on the creative potential of the tensions that emerge from divergent perspectives

Dialogue

Underlying and fundamental to the process of transdisciplinarity is dialogue. Dialogue does not mean debate, nor discussion, nor collaborative decision-making, although all of those would certainly come into play, but to come to the kind of understandings required in transdisciplinarity, dialogue is an essential

element. Dialogue comes from the Greek word dialogos. Logos means 'the word' or in our case we would think of the 'meaning of the word'. The term dialogue doesn't imply any specific number of people, one can have a dialogue with oneself, or with a larger group, sharing meaning making.

Having the capacity to sustain dialogue in an atmosphere that is highly charged, with people who have strong knowledge, beliefs and opinions is one of the most challenging interpersonal processes of human interaction. It is not always possible, especially when the outcome has high stakes and people's lives, present and future, may depend on it.

A group involved in a process of Design Thinking in a transdisciplinary inquiry will need to interact at every juncture of the process. Having generative and sustainable dialogue is essential. Within that process tensions may arise. As Riedy et al (2018) suggest, some of the challenges of transdisciplinary approaches is the "trade off" between depth and breadth of knowledge, and the challenge of supporting people who bring in distinct and often very different perspectives and values, seeing the value in and the need for those multiple perspectives in addressing wicked problems (McGregor and Donnelly, 2014, p. 171). Understanding and being able to cultivate dialogue as opposed to debate or discussion then, is a critical tool in transdisciplinary processes.

The object of a dialogue is not to analyse things, or to win an argument, or to exchange opinions. Rather, it is to suspend your opinions and to consider the intersections and convergences across multiple perspectives and search for and cultivate shared appreciation for the meaning that arises from and is informed by this diversity. Dialogue makes the emergence of new understanding possible (Bohm, 1990). This may be the most significant purpose of transdisciplinarity, the emergence of new understandings. From the Institute of Sustainable Futures once again, comes an acknowledgement of the importance of dialogue in the transdisciplinary process. They propose dialogue as a crucial, innovative practice because it creates space for collective, reflective learning. Such learning frequently takes place in spaces we call "crossroads". These are formal and informal spaces where practitioners who have been on their own transdisciplinary learning journeys (experiencing diverse tensions and applying diverse approaches) come together in dialogue to

share, reflect, critically and constructively question, imagine, challenge, and synthesize their experiences into collective organizational learning” (Fam et al, 2018).

The ability to engage in dialogue is not necessarily a natural capacity for us as human beings. It is challenging and difficult, but fortunately, a capacity that can be developed. There are numerous individuals and organizations engaged in teaching dialogic processes. It would be beneficial for those embarking on a transdisciplinary undertaking to engage in joint learning and capacity building in this regard. Practicing the skills of engaging in and facilitating dialogue, design thinking, and transdisciplinary thinking is about, in part, looking to “the places where no one else [has] looked” (Mojica as cited in Bolt and Kirschner, 2019).

This primer is intended as an entryway to a field of study and action that is distributed across many sectors, disciplinary fields, and job roles and functions. Climate adaptation and mitigation are complex, challenging and inspiring fields of inquiry and action. The fact that two of the main thinkers referenced here in this primer on transdisciplinarity are quantum physicists (Bohm and Nicolescu) is not coincidence. Their investigations in the quantum realm bring an orientation to exploring knowledge beyond what we see in our dimension of reality, analogous with transdisciplinarity and its intention towards understandings not yet realized.

How might a visual image of a process of transdisciplinarity look? Might it be a multiple Venn Diagram on wheels? Or, maybe an artist might paint it as converging streams, like Bohm’s metaphor for dialogue, flowing and winding through different locations, being altered by them, changing them as well, picking up other streams and debris as it goes, winding back, moving on, becoming a river, or not, changed by the seasons, contributing to the fertility of the land, or not, but always in movement, always transforming, with the hope of enriching and sustaining life on this planet in the Anthropocene.

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