Transdisciplinary Research: If it's so important, why aren't we all doing it?

From attractive conceptual notion to real-world applied practice

By

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Imagine you want to address an important but complex societal issue, a true wicked problem. And suppose you have access to the world's finest academics of various disciplinary backgrounds. They are willing and able to think about this issue in hopes of finding solutions. Even better, you can physically bring them together in one room for a substantial amount of time. Wow! What do you think might happen?

Most likely? Not as much will happen as you may have assumed. Contrary to commonly held beliefs, bringing together a group of smart and motivated academics does not automatically lead to an integration of their views. Disappointing, yes. But it's not surprising, nor difficult to explain.

In this article we argue for the importance of transdisciplinary research and a systems approach for addressing complex challenges. Mostly we want to discuss why it is so hard in real life and include you in the steps we are taking to bridge the gap between the inspiring theoretical concept of transdisciplinarity and putting it into practice.

Wicked problems require a systemic approach

Why wicked problems require systemic approaches which, in turn, require transdisciplinary research

> *"If you're not confused, you're not paying attention"*
> Tom Peters

In the midst of a climate and energy crisis, massive social and economic inequality, plummeting biodiversity, and a shifting geopolitical landscape, we see ourselves confronted with so-called 'wicked problems'. The complexity of these large societal issues is overwhelming, as the contexts and the various factors and actors at play are dynamically entangled. This makes it increasingly challenging to identify causal effects, which amounts to the realization that the potential effects of any intervention are unpredictable and unclear.

Therefore, the idea of a 'systemic approach' appeals to many; a way to understand the complexity of the problem better and more thoroughly and, based on that, draw up hypotheses on (the effects of)

interventions. Systems thinking[1] is a set of analytical skills that together improve the capability to reveal the underlying structure of systems and thereby: 1) Understand and predict behaviour of systems. 2) Devise modifications to those systems [i.e., transitions]. Academia - in addition to policymakers, societal organizations, industry, and citizens - is well-positioned to have an important role in supporting the transitions ahead by taking a systemic approach. Science offers the safeguard of well-considered experiments and approaches that lead to perspectives for action. This provides society with the much needed confidence to dare take the first uneasy steps towards transitions. Furthermore, many academics are intrinsically driven to contribute to societal issues and they themselves also urgently plea for the necessity to combine insights from different disciplines and sectors.

Transdisciplinary research

"The trouble with life is not that there is no answer. It is that there are so many answers"
Ruth Benedict

A systemic approach entails some serious adjustments to the 'standard ways of working' in academia and research institutes. In a systems approach, there is a focus on understanding the entire context and related issues before moving on to developing interventions. Much like laying out the entire puzzle before you focus on missing, damaged, or ill-laid pieces. Except wicked problems are far more complicated than any puzzle and you will never know for sure whether you have laid out the entire puzzle. The intention is not to 'solve the problem', as this is impossible in such complex causal chains, but instead to introduce incentives into the system that will positively support or (partly) initiate and accelerate transitions. It is like throwing stones, releasing fish, or even placing dams in a river, knowing that the subsequent ripples and blockages will influence the movement and direction of the water, creating new streams, alternate flows, or completely new river routes.

A systemic approach demands that a complex issue is understood from various disciplinary fields and societal sectors simultaneously; the transdisciplinary approach[2]. Through the crossing of disciplinary and sectoral boundaries, it integrates academic perspectives and the real- world context, stakeholders, and institutions as well as zeitgeist in its deliberations. It is important to distinguish transdisciplinary research from multi- and interdisciplinary research; in which academics from different fields collaborate. In multidisciplinary research academics work alongside each other, but no (or limited) integration of insights is attempted. Interdisciplinary research, on the other hand, allows an issue to be understood by integrating disciplinary 'lenses' that each understand the reality of complexity very differently. Within interdisciplinary research all the disciplines involved contribute equally to the research process[3]. As such, it offers the opportunity to transcend the individual disciplines, and enter the realm of unexplored avenues in research. Transdisciplinarity, finally, differs in that it includes involvement of needs and perspectives of actors from *outside* academia in the entire research process. These perspectives are part of the formulation of the research questions, throughout data collection and analysis, all the way up to the communication of results. The

[1] Arnold, R. D., & Wade, J. P. (2015). A definition of systems thinking: A systems approach. Procedia computer science, 44, 669-678.
[2] McPhee, C., Bliemel, M. J., & van der Bijl-Brouwer, M. (2018). Transdisciplinary innovation. Technology Innovation Management Review. From: https://timreview.ca/article/1173
[3] Repko A.F., & R. Szostak, *Interdisciplinary research: process and theory*. 4th edition. Thousand Oaks (VS): Sage Publications, 2021

research is thus situated *within* the societal issue that is addressed: it absorbs an entirety of causes and effects; the research results are still identifiable, but can hardly be seen as separate from the whole in which they function.

Wicked problems and fixes that fail

What are the consequences of not engaging in transdisciplinary research?

"When you make the complicated simple, you make it better. When you make the complex simple, you make it wrong"
Dave Snowden

There is a growing demand to bring together what science has to offer, and what society urgently needs. The complex nature of many societal challenges and associated needs, thus implies an increased demand for transdisciplinary research. At the same time however, transdisciplinarity is time consuming, cost intensive, and it is also plain hard work and often frustratingly slow. This may lead one to wonder whether transdisciplinary research is worth all the fuss. The best way to justify this effort, is to judge the outcomes of approaches to wicked problems that do *not* attempt to understand the complexity of the entire system.

Many interventions that aim to address complex problems result in a treatment of symptoms which get us out of the frying pan, into the fire. An example is the introduction of plastic in the 19th century, as a replacement for ivory, metal, and wood, which was welcomed as a revolution and as a contribution to the environment; it would after all reduce the use of natural resources. Though plastic lived up to these expectations, the effects of the production and consumption of plastic turned out to be equally disastrous for the environment. Mammals and birds suffocate in plastic litter, microplastics in our food and water make us ill, and our oceans and soils are polluted with undecomposed plastic waste. These 'fixes that fail', seem to be a solution at first, but eventually lead to an aggravation of the problem because the root cause of the problem has not been addressed, and what is worse, it has had the opportunity to fester under the protective blanket of the symptom-treatment. Partial solutions and 'symptom relief' almost always lead to unintended consequences elsewhere. Not taking the entire playing field into account amounts - at best - to a waste of time and resources, but at worst, to an exacerbation of the problematic dynamics in a system.

The reality of transdisciplinarity in practice

"If a man will begin with certainties, he shall end in doubt; but if he will be content to begin with doubt, he shall end in certainties"

Francis Bacon (politician and philosopher)

Is any of this new though? No, of course it's not. We've known about wicked problems and the subsequent need to integrate and transcend disciplines for decades. A great deal has been written about the conceptual and philosophical foundations of what transdisciplinarity is. And many a researcher has been involved in transdisciplinary teams for long. Why do experts wish to be in that position in the first place? We hear continuously that though transdisciplinarity is hard work, it is

also great fun! It gives pleasure to get to know new perspectives, to exchange ideas with others, and to walk new paths. This kind of work brings academics together as professionals, but also as citizens. We hear that the drive to participate comes from the deep desire to contribute to the wicked problems of our age. And it is believed that this is the way to do it.

Despite this enthusiasm, teams tend to divert rather than converge. And here is why.

In practice we encounter difficulties in implementing the conceptual ideas on transdisciplinary research, as practical tools and hands-on methodologies that make systemic thinking workable are lacking[4]. Or, because the methods get so practical, that they lost their bedding in the core of systemic thought[5]. We see that aspirations to engage in transdisciplinary research frequently do not meet their potential, or they ultimately revert into a multidisciplinary reality[6], possibly tweaked with a few 'transdisciplinary upgrades'.

Through the grapevine, we hear from academics that many serious attempt to engage in transdisciplinary research are frustrated by (a combination of) time pressure, work culture, financial incentives, and/or a lack of knowledge, training and support. And so, many of us fall back in the ways of working that we know and that our organization supports.

This needs attention, as we need to increase the efficacy of the substantial volumes of research fundings that are spent on addressing the pressing challenges we face and the many research groups that are attempting to work in this way. And though there is a whole body of theoretical knowledge on the workings of transdisciplinary science, hardly any of this is translated into practical guidance for researchers.

The challenge of integrating perspectives

"We do not see things as they are, we see things as we are"
Rabbi Shemuel ben Nachmani, as quoted in the Talmudic tractate Berakhot (55b.)

Remember the societal issue that you wanted to address with the group of accomplished academics? Perhaps you envisioned grand results as you imagined the experts bringing together their knowledge and skills. Through our experience however, we learned that more often than not, simply bringing together knowledgeable experts will not suffice. They will most likely enjoy a rich and expansive conversation, bombard each other with endless facts and figures, and perhaps even enter the philosophical realm. But most often, they will prove unable to truly grasp the other mental models, adjust their own, and start to collectively construct new ideas through the integrated mental models in that room. And that is not to the fault of those individuals.

Why it is so hard to integrate mental models?

The mental models of experts (their worldviews; how they see and interpret the reality around them) often differ quite a bit. In fact, they may differ so much, that it takes substantial time,

[4] Ulmanen J, Bergek A, Hellsmark H (2022). Lost in translation: Challenges in creating new transformative innovation policy practices. PLOS Sustain Transform 1(10): e0000031. https://doi.org/10.1371/journal.pstr.0000031
[5] Hoverstadt, P. (2022). *The Grammar of Systems, from order to chaos and back*. SCiO publications. Page 4
[6] Schot J, Steinmueller WE. Three frames for innovation policy: R&D, systems of innovation and transformative change. Res Policy. 2018; 47:1554–1567. https://doi.org/10.1016/j.respol.2018.08.011

disciplined dedication, and focused methods to integrate their perspectives. Researchers inadvertently bring their disciplinary tradition and related mental models to the table; how they see the world, what they consider to be 'true' and how they can uncover those 'truths'. Beyond these 'professional' bases, their perspectives are also grounded in their values, social and cultural background, positions of power, and even in their personality type.

In our attempts to cross the boundaries of our own mental models, we often get stuck. Integrating mental models is not the same as what we would normally call 'learning'. It is not just adding new information to an existing database of knowledge. Opening up your mental models for other, conflicting models is often associated with 'un-learning' and restructuring the knowledge you previously held as 'true'. It is about rethinking the distinctions, relations, part-whole structures, and perspectives on your ideas[7]. It often comes with much experienced discomfort and unease, as 'your world is turned upside down'.

So, integrating mental models is pretty tough for any person. On top of that, there are certain contextual obstacles that further hinder crossing the boundaries of mental models. See if you recognize any of our observations listed below:

How we use language: the first noticeable red flag that there are conflicting mental models, is that we notice the differences in how language is used. Mismatches in academic language are often seen as a 'problem' in itself, but are in fact a symptom of deeply entrenched and fundamentally different worldviews that do not fit seamlessly. The same word for different connotations or different words for the same concept… it does not make it much easier to understand one another.

How we value knowledge: how we value knowledge (or the lack thereof) is very decisive for our ability to engage in transdisciplinary work and exchange perspectives. To begin with, in academia, different forms of knowledge are not necessarily regarded as equivalent; the natural and technical sciences are often given a higher, more absolute, value than the social sciences. In turn, other types of knowledge than from academia – think for example of practitioners' or indigenous knowledge – are oftentimes regarded as inferior and thus less relevant. In addition, admitting to not knowing or not understanding something, is considered a clearcut certificate of incapacity in academic culture. These often spoken and unspoken rules of the game make it very hard to cross disciplinary boundaries.

Transdisciplinary research requires skilled mindsets

"The more we trust, the further we are able to venture"
Esther Perel

Transdisciplinary collaboration requires a different attitude and mindset from what researchers are commonly trained in: disciplinary modesty, deep listening, postponement of judgement, asking questions instead of giving answers. And perhaps most challenging: accepting the discomfort of experiencing the limitations of one's own knowledge[8]. We are even evolutionarily programmed to

[7] Cabrera, D., Cabrera L, Powers, E. (2015). A Unifying Theory of Systems Thinking with Psychosocial Applications. *Systems Research and Behavioral Science*
[8] Ison, R. (2017). *Systems Practice: How to Act. In situations of uncertainty and complexity in a climate-change world.* 2nd Edition. Springer & The Open University. PP21-22

avoid the discomfort associated with not knowing and not understanding[9]. This means that it requires effort and skill to overturn our innate reflexes to understand our world so we can feel confident about what we know. In addition, it may be necessary to acknowledge that integration is a skill, that may call for permanent positions for integration experts in research efforts.[10]

Lastly but vitally, how academia are organized is suboptimal for facilitating transdisciplinarity. Specialization is recognized and rewarded strongly, both in career opportunities as well as in funding for research. Crossing boundaries has merits to some extent in various nooks, but is not mainstream. This makes it hard to build an acknowledged scientific career when you engage in transdisciplinary teams. Anecdotal evidence informs us that this leads to talented and ambitious researchers, especially earlier on in their career, to opt for specialization.

In conclusion, in transdisciplinary research it takes a lot of time and effort to understand each other and to see where the complementarities lie. To be able to integrate worldviews successfully and create mutual understanding, we need to find a way of work (a methodology) that incorporates the appropriate set of skills and mindset, and a supportive organizational context that will help cross boundaries. Transdisciplinarity requires highly advanced individual and group competences that allow for experts to make their differences productive towards the common goal.

From theory to practice

"Don't look at the world, look at your lens"
Edward W. Said in 'Orientalism'

Onwards then! But, how?

Recognizing the hurdles and difficulties of transdisciplinary science in practice, we have taken steps to bring the promises of transdisciplinary research closer to reality. We feel it is unrealistic and unfair to expect researchers to bridge this gap by themselves. So, we have started designing programs that are aimed at supporting and facilitating transdisciplinary work. These programs vary in nature. Some have a focus on developing the necessary transdisciplinary mindset and skills, others include how to orchestrate a supportive organizational context for this type of work. In the programs, we offer a testing ground that not only provides physical space and resources, but also a 'safe' area in which researchers can experiment and explore what works for them and what doesn't.

CUCo offers financial support as well as training and coaching to strengthen cross-disciplinary competences and attitudes as well as events in which issues in academic contexts are addressed (failures, for example) and where early and mid-career academics can meet each other to explore new ideas for research. Throughout our efforts, we are experimenting with alternatives for teamwork and leadership; less hierarchical, more supportive, more inclusive, and more equal.

At TNO we are developing a methodology (including a step-by-step handbook) with practical tools that support a group of researchers to engage in transdisciplinary work with the ambition to generate systems innovations for urgent societal challenges. The focus of this program is not only to offer ways to systemically approach a wicked problem, but also to help the group move from an

[9] Korteling, H. & Toet, A. *Cognitive biases*. In S. Della Sala (Ed) Encyclopedia of Behavioral Neuroscience (2nd ed,), Elsevier, pp 610-619, 2021. (https://doi.org/10.1016/B978-0-12-809324-5.24105-9).
[10] Hoffmann, S., Deutsch, L., Klein, J.T. *et al.* Integrate the integrators! A call for establishing academic careers for integration experts. (2022). *Humanit Soc Sci Commun* 9, 147 (https://doi.org/10.1057/s41599-022-01138-z)

assembly of individual experts to a group with the ability to contribute their perspectives to a larger whole.

In both of our programs, researchers work in a context that enables them to develop the necessary competences, and to embark on the journey that stimulates and facilitates them to integrate and transcend their individual perspectives.

Did this story spark your curiosity, and do you also work in or with academia to address wicked problems? Then we may be looking for you! We are committed to strengthening the community of practice around transdisciplinary research with likeminded researchers. To explore the matters, we describe in this article together, to learn from each other's efforts and to share experiences about how to engage in transdisciplinary work in meaningful and effective ways.

'If you don't like the road you're walking, start paving another one.'

Dolly Parton

About TNO

TNO connects people and knowledge to create innovations. This is how TNO strengthens the competitiveness of companies and the welfare of society in a sustainable way. TNO is an independent, not-for-profit Research & Technology Organization (RTO). It is the largest RTO in the Netherlands and one of the largest in Europe. TNO works for a wide variety of customers: governments, SME's, large companies, service providers and NGO's.

About CUCo

The Centre for Unusual Collaborations (CUCo) aims to create a space that supports diverse early and mid-career academics to come together in unusual collaborations to address pressing challenges. CUCo supports the process of collaboration financially, as well as through training, coaching and with tools and approaches. CUCo is part of the alliance between Technical University Eindhoven, Wageningen University and Research, Utrecht University and University Medical Center Utrecht

Our collaboration

Our first acquaintance stemmed from mutual curiosity; another player in the field that is making transdisciplinary research practical! Still in the early days of our own process, we decided to write this joint paper in which we want to share our insights so far. It is our ambition to reach out to all the other researchers that are engaged in systems thinking and transdisciplinary work, and that are struggling with *how* to do it.