

Sustainability Transformations Practice as a Transdisciplinary and Metadisciplinary Field

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Keywords: systems change, transformations, transdisciplinary, action research

Abstract

What does a “transformations practitioner” do to change systems, how do they do it, and what abilities do they need to do it well? Drawing from 56 practitioner interviews of members of the Transformations Community, we explore how transformations practitioners bring about a just transition toward a more sustainable future. We identify how the field is rooted in three core transdisciplinary capacities: participatory diagnosis, expertise in knowledge co-production, and collective action. The capacities primarily rely on ‘people skills’ such as interpersonal communication, personal empathy, and interactional capacity. We also describe how practitioner work is not only transdisciplinary but also metadisciplinary, in that they seek to take what they learned in individual projects and initiatives to advance the field of transdisciplinary research through specific techniques and practices, integrative leadership practices, training, and reflexive theorizing on the nature of their practice. We identify how the Transformations Community supports each of these domains to expand the scope and reach of transformations practice.

Introduction

The Transformations Community (see next section for a description of the community) is an association of action researchers and reflective practitioners who seek to foster a just transition toward a more sustainable future. So, how do they implement these vital systems changes, and what abilities do they need to do it well? In this paper, we consider the kinds of projects that transformations practitioners do and what skills and competencies they need to pursue them. This is the first effort to investigate what transformations practitioners have in common by asking 56 of them to describe their practice. Prior empirical work on this topic has made inferences from large-scale literature reviews of transformations projects (Rose and Wanner 2018) or examined research and practice in specific initiatives (Bulten et al. 2021; Hilger, Chien 2022).

The social-ecological systems (SES) research community defines transformation as enabling a system to emerge that may include elements of the previous system while having wholly new

relationships and behaviors (Walker et al. 2004, Folke et al. 2010). In another article in this special edition with Social Innovations Journal (Goldstein et al. 2022), we explore how members of the Transformations Community define transformations not only as a process and outcome but also as a way to improve personal awareness and as an ethical commitment to action. They described transformations work as an engaged and embodied practice grounded in their ability to undergo personal change. This enhanced their ability to understand the complexity of systems change and act across multiple scales to bring about fundamental, morally grounded systems change, often in alliance with marginal actors and communities.

When we asked them to dig deeper and describe what they do and the skills they need to do it, their responses revealed three core transdisciplinary capacities that engage with this expansive view of transformation: *participatory diagnosis, expertise in the co-production of knowledge, and collective action*. Practitioners also identified what abilities they needed to be effective in these three domains, with particular emphasis on ‘people skills’ such as interpersonal communication, personal empathy, and interactional capacity.

In addition to this project-specific transdisciplinarity, many transformations practitioners described broader aims to improve their transdisciplinary practice that we call ‘metadisciplinary,’ in which a field or discipline reflects on itself through its theory and practice (Alisat 2019). This came in four varieties: 1) taking what they learned in individual projects and initiatives to advance the field of transdisciplinary research by developing specific techniques and practices, 2) engaging in ‘weaving’ or integrative leadership practices, 3) developing systems change education programs, and 4) exploring the contours of transdisciplinary practice.

We conclude by noting how the Transformations Community is building capacity in these metadisciplinary arenas.

What Is the Transformations Community?

The Transformations Community is a global community of action-oriented researchers and reflective practitioners who support transformations to a sustainable and regenerative future. The community consists of experienced academics and professionals who work in a wide variety of organizations, including sustainability-oriented academic programs, government, and intergovernmental agencies, research institutes, agile non-profit organizations, consulting firms, and foundations. The community began in Norway in 2013, with the first Transformations conference hosted by the University of Oslo to explore how to bring about a deliberate, ethical, and sustainable transformation in response to climate change. Since then, Transformations conferences have taken place at Stockholm University in Sweden, The University of Dundee in Scotland, and The University of Chile in Santiago, Chile, online in 2021, and the University of Technology in Sydney, Australia, in 2023. In addition to the conference series, the

Transformation Community organizes dialogues, workshops and communities of practice to enable practitioners to bring desirable transformations to life.

Literature review

Transformations practitioners place themselves in the tradition of action research and reflective practice grounded in the work of Kurt Lewin (1946) and John Dewey (1938). Action research offers the promise not only of co-production that can support real-world change but also the possibility that social relations of scientists and nonscientists can shift and develop through mutual association (Greenwood and Levin 2007). In that sense, action research is a form of praxis, as defined by Freire (1970), in which learning flows through action and action through learning to raise awareness of our collective condition and transform structures that oppress us. Praxis reframes a knowledge-centered view to an engaged and interpersonal practice of organizing. In this, personal change is continuous with systems-wide change, and problem-solving relies upon posing critical questions and fostering dialogue, not providing answers. This dialogue produces information and knowledge and builds mutual recognition and trusting relationships that can transcend the limitations of the status quo. As Gramsci (1999: 36 and 126) noted, praxis is a “concrete form of reasoning” that leads these practitioners to “a higher conception of life” in which taken-for-granted institutions are challenged and disrupted, and deeper shifts are set in motion.

Action-research-based approaches are common within sustainability transitions and transformations (Schot and Geels 2008, Avelino 2011, Loorbach et al. 2011, Audet 2014). This work is transdisciplinary and process-oriented since rather than just providing knowledge to society, researchers collaborate with stakeholders to identify a common research object, produce knowledge together, and critically and self-reflectively evaluate how the knowledge can enable scientific and societal progress (Jahn et al. 2012; Miller 2013). Transformations researchers have explored both the way that transformations action research takes place in novel settings (e.g., real-world laboratories, learning networks, and transformations labs) and action researchers’ process-oriented roles. These include knowledge broker (connecting knowledge production and use), process facilitator (enhancing communication), change agent (motivating and empowering participants), learning expert (assisting others to become better learners), and reflexive facilitator (encouraging reflexive practices) (Pohl et al. 2010; Turnhout et al. 2013; Wittmayer and Schöpke 2014; Fazey et al. 2018).

Methods

This project began as a joint effort between the University of Colorado Boulder Masters of the Environment Program (MENV) and the Arizona State University (ASU) Graduate Programs on Sustainability. We embarked on this project to:

- Provide students interested in systems change an opportunity to engage with members of the Transformations Community.
- Check-in with the Transformations Community membership on how the community can better serve them.
- Use the Transformations Community as a case study to develop and share our understanding of the emerging field of transformations-in-practice.

In August 2021, the Transformations Community solicited interview subjects in our quarterly newsletter, which is sent to approximately 1500 transformations practitioners, most of whom had attended one or more of the five conferences convened by the Transformations Community biennially since 2013. We screened the 80 responses to this request to obtain a broad representation and diversity of perspectives and selected 60 subjects for interviews, four of which were not completed. The 56 members of the Transformations Community that we interviewed:

- Were about equally divided between males (26) and females (30) (note that we did not ask them for this information and our estimate is based on their online biographies).
- 22 identified an academic institution as their organizational affiliation, 20 were from non-profits/government or private sectors, and 14 were from both.
- 29 were from the U.S. and Canada, nine from Latin America and the Caribbean, eight from Europe, six from Australia/Oceania, three from Asia, and one from Africa.

This sample is more heavily weighted towards the U.S. and Canada than the Transformations Community as a whole, perhaps because they were more likely to volunteer to be a part of a project conducted by two U.S. universities and U.S.-based graduate students. Of those who were associated with academic institutions, most gave their field/discipline affiliation as one of the fields where social and ecological systems are jointly studied. These included Anthropology, Applied Ecology, Environmental science, and Geography. Table 1 lists the terms they used to describe their applied research and professional practice domain.

Table 1: Domains of applied research and professional practice

Adaptive management	Organizational change
Biodiversity conservation	Organizational learning and change process
Climate adaptation	Permaculture design
Climate change adaptation and resilience	Policy and governance
Community-based policy development	Policy research and analysis
Corporate responsibility	Polycentric governance
Creative arts	Public Participation
Ecosystem management	Reducing social inequality
Ecosystem services	Regenerative economics
Environmental governance	Social entrepreneurship and social innovation
Food sovereignty	Social-ecological resilience

Inter-organizational collaboration	Sustainability
Management and governance transitions	Sustainable Food systems
Monitoring and evaluation	Urban agriculture
Natural resource management	Urban/smallholder agricultural systems
Network management and governance	Visioning and futuring
Organizational behavior	

The two lead authors organized interviewing teams of three graduate students each, two from MENV and one from ASU. Student groups were able to select their interview subjects from the pool of 60 practitioners based on their alignment with their interests on a first-come, first-served basis. On each campus, faculty trained the students in semi-structured interviewing techniques, including opening the interview, establishing rapport, and probing for details and examples.

Students scheduled an initial meeting to meet the other members of their interviewing team and then coordinated with the practitioners to schedule one-hour interviews in October 2021. Before the interview, students emailed their interview subjects an informational memo and consent form that stated that the interview data would not be publicly shared and that we planned to publish and distribute the results of the interviews without personal attribution. Students informed respondents that they could choose not to answer any questions and could request at any time that they leave the study and have their data deleted.

One student conducted the 90-minute interview, one managed the Zoom platform, and the final member of the team took notes and identified key moments for later analysis. Questions from a semi-structured interview protocol examined these themes:

- What do they understand transformations practice to be, and how do they show up in their lives and work?
- How did they develop their capacity to engage in transformation practice personally and professionally?
- What are their challenges to achieving transformation, and how do they address them?
- How do the institutions they are currently engaged in support or hinder their transformations work?
- How could the Transformation Community help them become more professionally and personally fulfilled?

Students created an automated transcript which they corrected and uploaded onto a shared Google drive folder. By the end of November 2021, student groups prepared a memo containing their insights and reflections on their career development, which they discussed in class. The contents of these memos were not analyzed further or incorporated into this analysis.

During Spring 2022, the authors coded and analyzed the interview transcripts using Delve content analysis software. Grounded Theory (Corbin and Strauss, 2015) guided analysis of individual cases, emphasizing identifying emergent themes and insights (Law, 2004). We edited

the transcripts to enhance their clarity and enable them to stand alone in this format. We limited these edits to changing tense or pronoun and removing elements characteristic of verbal speech (e.g., phrases like “um” and “well”).

This article is one of four articles created from this analysis that appear in this special issue – the other three examine the meaning of transformations (Goldstein et al. 2022), how to become a transformations practitioner (Navarrete et al. 2022), and the challenges that transformations practitioners face (Balakrishna et al. 2022).

Results

This results section develops a picture of a transformation practitioner by describing what they do and the skills they need to do it. We present ideas derived primarily (although not exclusively) from analysis of codes derived from practitioner responses to the first theme listed above:

- What do they understand transformations practice to be, and how does it show up in their lives and work?

We also include quotations from the practitioners that exemplify and illustrate these ideas. We organized these results into two sections, the first identifying three features associated with their practice and the second identifying the skills and capacities they identified as essential for conducting this work.

1. Transformations In Practice

When transformations practitioners described their work, it was usually not in terms of scientific practice, or even as action research. Instead, they focused on all the roles required to sustain complex social change organizations, including designer, organizer, facilitator, mediator, organizer, expert, and boundary-crossing policy advocate. Practitioners repeatedly emphasized that their work was not just for the benefit of people undergoing transformative change within the system. It was in close association with these people who were full partners in every component of their effort to the extent that there was a knowledge-making practice at the core of what they described as transformation. They more often described this as a collective effort to support the knowledge-making of others. That knowledge-making has a reciprocal relationship with action through repeated rounds of an action-learning cycle.

This collaborative systems change work has three central features, as listed below:

1.1. Participatory diagnosis

Practitioners often described how they engaged stakeholders to develop a shared understanding of what systems changes were needed:

- “I’m working with conservationists who are trying to map out a future for jaguars in the Atlantic Rainforest of Brazil.”

While practitioners were oriented toward fundamental change, they also described their work as a response to urgent needs and crisis conditions, either in response to shock or stress or in the face of change to long-established ways of life:

- “I worked with a community of 20 families that lost their houses, their animals - everything, including loved ones. They needed to transform for that not to occur again.”
- “We were working with communities in a region called the Latrobe Valley, which provides a lot of the brown coal for major power stations in Australia. They are coal-dependent, and they’re trying to work out how to transition our community to a more sustainable future.”

They often focused on identifying alternative social-ecological futures in areas like these or where highly valued social-ecological systems were in rapid decline:

- “I just finished an impact evaluation that looked at the impact of climate change on smaller farmers.”
- “I was in charge of an initiative for creating mining exclusion zones by talking to different organizations doing similar work and conducting comparative work integrating legal frameworks from different countries and power groups.”

They often began by asking about what was important to people to untangle how to pursue change in ambiguous, complex, and often-confusing settings. This dialogue enabled them to both understand the context and identify what specific issues demanded immediate attention:

- “I have learned a lot by bringing people together and listening and seeing what’s important and what are their priorities. It’s not about what I think should be the priorities; it’s what they want. Going into a situation with an open mind, ideally without preconceived notions of what is or what should be. Actually, seeing what there is on the ground and gathering the information as best as I can without those preconceived ideas.”

This effort to identify what people cared about and what was at stake enabled practitioners to build trusting working relationships. They often used community visioning techniques to be both responsive and accountable:

- “I employ participatory approaches that engage decision-makers with local and Indigenous people.”
- “The Transformation Lab developed a process that enabled people to gain agency by seeing how they were able to improve system conditions.”

Another focus was on project evaluation, which is difficult to conduct when goals are hard to identify, multi-causal, and often change:

- “We worked with the Australian Renewable Energy Agency to fund clean energy research and development and demonstration projects. They wanted to understand what impact they were having, and measuring impact is difficult. So we brought in approaches to evaluation that are more principle-focused and developmental; even a little bit of blue-marble evaluation thinking [see <https://bluemarbleeval.org/>], all of which I learned through engaging with the Transformations Community.”
- “I’m a co-leader of a community of practice that does transformational evaluation.”

1.2. Expertise in the co-production of knowledge

Some practitioners saw their role as assisting communities to develop knowledge and awareness about the prospects for change and the opportunities for action, rather than just providing them with external knowledge and expertise:

- “I started out using the more classic research methodology, so like doing interviews and surveys and whatever, and hoping to also somehow support transformative change. Then I started developing new methodologies that are more directly focusing on stimulating reflection among people about what they do, what they aim for, what they have done, what direct actions result in, and whether it’s still valuable in the light of the longer-term ambition of system change.”
- “I am working on reducing the reliance on experts.”

However, they were not suggesting that they uncritically accept whatever information is on offer. Instead, they suggested that practitioners play a crucial role in identifying appropriate knowledge sources, guiding evaluation, and avoiding groupthink and efforts at deception and manipulation:

- “You need critical thinking to challenge received wisdom.”
- “Critical thinking is vital, particularly in this day and age of misinformation.”

The expertise they most often cited was their ability to engage and hold together innovation processes where invention and experimentation take place, engaging stakeholders to identify what they know and need to learn:

- “We did a future democracy project before the last election, where we brought in experts, journalists, social scientists, and rap singers to talk about what they thought the future of democracy might be, which at that time was pretty dark.”
- “We weave together a constellation of artists and creative practitioners committed to social-ecological transformation. Their work is a spark to get academics and practitioners to think outside the box and find new avenues for systems change.”

For practitioners who conducted research, they usually described it as a practically-oriented investigation into what actions they and their collaborators could take to bring about systems change:

- “In a review of management practices, they incorporated recommendations from my Ph.D. on how to integrate collective action into policy.”

1.3. Collective Action

Transformations practitioners preferred iterative and collective action rather than engaging in analysis and critique. They oriented their efforts toward exploring the possibilities of pursuing joint action in ways that integrate community values and different forms of knowledge, as well as connecting what could be done to those with authority to do it. For example, some practitioners described their efforts to create communities to transform economies, including focusing on new economic models that promoted community well-being and incorporated measures of ecological health:

- “We are working with communities that are trying to form ‘next economies,’ based on values of stewardship, using holistic metrics, and oriented towards well-being and flourishing, not just wealth.”
- “We were working to create an alternative economy that was respectful of local cultures – they were working with wood – while also giving them an alternative livelihood that enabled them to conserve the forest.”

Other members focused on the conservation of nature and natural resources. What distinguished this work from conventional resource management was a focus on identifying levers for change, such as reshaping practices, laws, norms, and beliefs that inform natural resource management, rather than just on the efficient pursuit of pre-established managerial objectives:

- “For over a hundred years in Australia, we have had a system where we fine people for not doing their weed control. I developed recommendations on how we could transform that system by not relying on enforcement or compliance.”
- “Our work in Spain involves looking at degraded landscapes and trying to restore or return inspiration to the landscape.”
- “I work at WWF, the global conservation organization. My job is to create projects that could catalyze transformation within the conservation sector.”

Their work may be community and place-based or with policymakers at higher system levels:

- “I worked with an indigenous community to help them develop a marketing strategy for their ecotourism program.”

- “I worked at the international level, with UN Environment Assembly, on mineral resources policy and sustainable infrastructure.”

Their work focused on integrating change efforts across scales, through communities of practice or learning communities:

- “I’ve been running a working group for the PECS (Programme on Ecosystem Change and Society). We have active participants in twenty different countries, all looking at collaborative governance in these different places and making comparisons between them.”
- “In our community of practice, we’ve got more than 100 people who are focused on bringing transformational systems change to their regions, industries, organizations, and communities.”
- “We do network weaving to bring together groups of changemakers to share insights and resources and collaborate.”

This cross-scalar work focuses on cultivating small-scale innovation at the community scale while promoting institutional changes that enable these innovations to scale up to system-wide impact:

- “I run ‘Regenerate Change,’ a national organization supporting changemakers to apply ecological design thinking for social change. We weave this network of changemakers to share insights and resources and to collaborate.”
- “I operate at the interface between science and society, working with small communities on the local level, and at the national level with decision-makers.”

These cross-scalar, multi-sited innovation efforts operate across the entire spectrum of the three dimensions of their work, from cross-scale diagnoses to knowledge co-production and collective action. These catalytic organizations (Waddock and Waddell 2021) integrate what a community has identified as what they value and what needs to change with the knowledge required. The goal is to enable these communities to explore the domain of possible effective action and then take action to activate systems change, but with the humility to recognize that this is a long-term effort and that the target and goal might change.

2. Skills and Capacities

When asked about what skills and capacities were most essential to effective transformations practice, the most common answers were ‘people skills’ including communicating effectively, empathizing with others sincerely, building trust, and interacting with others to develop productive relationships. Practitioners placed greater emphasis on interactional and communicative capacities than instrumental or technical skills or theoretical knowledge:

- “Transformations work requires skills that are not normally part of traditional discipline-specific training as a researcher. For example, you may not learn the kinds of communication and dialogue skills that you need to work with communities.”
- “Enhance your communication skills more than abstract thinking. Leave the readings behind and try to understand how you come through to people outside academia.”

One core challenge they identified was the difficulty of making the complexity of systems change accessible and compelling:

- “I’m still working on communication skills because systems change concepts can seem simple, but on another level, they can be really difficult and challenging to communicate.”
- “You need to communicate at a high level to get across the concepts and issues of sustainability work because they’re super complex.”

Beyond their capacity to engage and communicate, practitioners emphasized that their work required leadership and facilitation skills to engage diverse communities with the hard choices and paradigm shifts needed to catalyze transformative change:

- “Facilitation has been a very valuable skill set for me in all the collaborative activities and partnership-building activities I’ve had to do.”
- “It’s a real skill to be able to facilitate group dialogues, which is fundamental to having a system-wide transformation because you got to have key stakeholders on board.”
- “The way we would coach them through their innovation projects was to help them to collaborate to define the challenge, not from their perspective, but from the perspective of the people they were aiming to help.”

Practitioners highlighted self-knowledge as essential to do their work:

- “Since creativity is central to my practice, I think what is most important is knowing yourself, and then having the sense of curiosity that leads to creative thinking.”
- “It is about understanding the implications of one’s actions and the actions of others in multiple time horizons.”

Finally, practitioners emphasized the importance of emotional intelligence to develop the empathy and capacity needed to connect with people facing disruptions associated with transformative change:

- “To become changemakers you need to develop empathy and then go into the world or the local community and empathize with those suffering from social injustice.”

- “If we want to be effective change agents, we have to look at ourselves and what our abilities are and what we can actually affect. We need to be more aware of the personal influences that we have on other people. “

Noting that the existing educational system neglected developing the ability to lead and participate in systems change efforts, practitioners were not only committed to embodying these skills and capacities in their own work but also to developing novel educational programs and practices:

- “We are working to critique the knowledge and learning system that is in place, which needs to be transformed because it’s not working at all.”
- “I ran a school for three years, and deeply studied and reimagined the whole process of what is learning and the creation of knowledge.”

Discussion

Transformations practitioners are both action learners and catalysts for collective action through diagnosis, expertise, and joint action. Collectively, they operate in stressful and often conflictual settings to perform the full array of tasks required to launch transformations initiatives, including:

- Framing the systems change challenge through dialogue with communities toward ends that are both practical and visionary.
- Co-producing knowledge with experts and communities to identify opportunities for change.
- Anticipating conflict and resistance and probing for opportunities to build coalitions and enhance the possibilities of what can be done now.

Individually, these findings dovetail with previous efforts to understand the roles that transdisciplinary action researchers assume in sustainability efforts, as noted above and best captured by Wittmayer and Schöpke’s (2014) typology of knowledge brokers, process agents, and change agents. These roles may not be fixed or predetermined at the beginning of an initiative. Instead, the way that transdisciplinary researchers engage with sustainability transformations can emerge over time through interaction with stakeholders and identification of their needs, the broader social and ecological context, as well as the individual experience and abilities of the researcher (Wittmayer and Schöpke 2014; Wittmayer et al. 2017).

We extend this analysis by noting that not only are these roles emergent, but they are also mutually supportive. In the absence of one, the other two cannot succeed. If transformations practitioners only address expertise and engage in action – ignoring the need to diagnose the problem through dialogue – their actions can be fully informed but not relevant to the community they serve or responsive to the most compelling opportunities for change. If they

only engage in diagnosis and action but ignore the need to pull in available forms of expertise, their actions can be uninformed and oblivious. If they only engage in diagnosis and pull expertise together – ignoring the need to engage powerful actors and act – they risk producing reports that sit unread or innovative models that are never implemented or replicated, regardless of how right they look on paper.

The way that transdisciplinary researcher roles are socially constructed, negotiated, and interdependent underscores how complex and difficult it can be to be an action researcher. Transformations practitioners spoke about the magnitude of this and other challenges, which are captured in a companion article in this special issue (Balakrishna et al. 2022). Recognizing the challenges to their own practice, practitioners described how their focus was not only partnering with communities and contributing to individual transformations initiatives, but also on building the field of transdisciplinary research by developing and disseminating new methods and practices.

This latter point is critical and is under-appreciated in the literature on transdisciplinary research for sustainability, which is primarily derived from the review of the project literature and focused investigations of a small set of initiatives. There is an inherent tension within transdisciplinary research between analyzing problems, contributing to theoretical knowledge, and focusing on practical solutions to these problems, which requires designing, facilitating, and engaging in collaborative change processes (Wiek 2012; Miller 2013). Action research classically resolves this tension through learning by doing since the way to better understand the system of concern is by trying to change it and reflecting on these efforts. Many transdisciplinary researchers take praxis one step further by expanding their research interests beyond the confines of individual projects to advance the field of transdisciplinary research itself, or put differently, by developing knowledge about change processes. Their approach to transdisciplinary research is like the relationship between single and double-loop learning (Argyris and Schon 1980); they engage in project-scale course correction using established procedures and engage in the modification or elaboration of these procedures across multiple projects and among the members of the emerging field.

This work is more than transdisciplinary. It is metadisciplinary (Alisat 2019); transdisciplinary researchers are reflecting on their own practice and developing process knowledge that transcends the bounds of a discipline or specialization. There are four types of metadisciplinary research:

1. *Testing and developing new processes* (e.g., project evaluation/assessment or community visioning techniques) in specific projects to apply in other transdisciplinary projects.
2. *Weaving* (designing, facilitating, and managing) supportive spaces for these transdisciplinary efforts (e.g., see the articles on the Pathways Network (Benedum et al. 2022) and the Savory Network (Frankel-Goldwater and Kingdom-Smith 2022) in this special issue, as well as an article on social change networks (Plastrik 2022).

3. Building *reflexive and theoretical knowledge* about the nature of transdisciplinary practice and practitioners to support the development of the field. This is “triple-loop learning” or learning about the structures of learning in a field (Flood and Romm 1996) and includes this paper.
4. Increasing capacity for transdisciplinary research through *systems education*.

Implications For the Transformations Community

Each type of metadisciplinary work is essential to meet the critical need for capacity to enable sustainability transformations to occur. Accordingly, the Transformation Community supports work in four arenas.

For the first of these, *testing and developing new processes*, we are supporting work in specific domains by conducting casework, sharing exemplary research and practitioner documents, and developing communities of practice in conjunction with our biennial conference. These specific domains are elaborated on below.

- **Organizational Structure and Form:**
 - What organizational structures are appropriate to engage diverse communities and address different transformation challenges?
- **Process Design:**
 - What are the most effective techniques and processes to engage teams and communities?
- **Leadership:**
 - What skills, capacities, and awareness does leadership – or weaving – of transformations organizations require?
- **Knowledge practices:**
 - How can we contribute to decolonizing knowledge practice?
 - How can we engage in the co-production of knowledge, identity, and the social order?
 - What is the role of the Arts?
 - How can we frame effective narratives?
- **Evaluation/Assessment:**
 - How to evaluate transformations processes and outcomes/impacts?
- **Inner Transformation & Well-being:**
 - How can we cultivate the well-being of members to support inner transformations and embody new systems?

Weaving, the second arena, is more than just the sum of everything in the first because it requires the ability to effectively hold space for the collective work of transdisciplinary researchers and the communities they serve. These interactive spaces – or transformations catalysts (Waddock 2022, Waddock and Waddell 2021) – are explorative, creative, and practical places to engage with ways of knowing and experiment with new social relations and forms of transformative

action to nurture sustainability transformations. Designing, facilitating, and managing these spaces requires maintaining a productive tension since participants may understand the core sustainability challenge differently. Done right, these spaces enable participants to take creative advantage of this tension to test the systems-changing potential of everything from new paradigms and conceptual frameworks to rules, regulations, and embodied practices. The setting requires that we maintain the tension between the need to set the space apart from powerful actors who may oppose change and the need to engage with the dominant status quo. These spaces support dialogue, reflection, and reflexive learning, while reframing issues in ways that allow solutions that can leverage fundamental change to be co-created and tested before attempting to scale them up to system-wide interventions; something that may require sustaining capacity over the indeterminate time before the opportunity for change occurs, remaining sensitive for when the moment for action has arrived and being able to mobilize quickly and effectively.

The third of these activities, *reflexive and theoretical knowledge*, involves understanding and supporting transdisciplinary research – such as the development of approaches to transition management (Loorbach et al. 2011) – are particularly common among the longest-engaged members of the Transformations Community. The people have developed and sustained the field over the years by holding workshops, convening conferences, and training new active members.

Finally, recognizing how this approach to knowing and change-making runs counter to current learning institutions, many practitioners also take part in innovative *systems education* efforts. They also design and lead programs that aim to develop this capacity in others, often through pedagogies that mirror the emphasis on praxis within transdisciplinary research by offering students ‘real-world’ learning opportunities and opportunities to engage in knowledge co-production (Fadeeva et al. 2010, Gil et al. 2022, this issue). Gil et al. also note that some programs have curricula designed to enhance reflexivity and manage complexity, which is critical to developing capacity for weaving noted above. Many of these programs – over 115 as of the writing of this article – are contained within an online searchable database maintained by the Transformations Community, which both aids students in identifying the right program and enables programs and educators to understand better the emerging field of systems change education.

Conclusion

Across 56 interviews, practitioners associated with the Transformations Community described three core transdisciplinary capacities that they shared:

- Participatory diagnosis: Full partnering with engaged communities from the very beginning of the systems analysis to jointly define the context, the objective, the obstacles to change, and the strategies to exert leverage.

- Expertise in the co-production of knowledge: A collaborative effort to identify what is known and what remains to be learned, engaging scientists and other forms of expertise in the service of a culture of open prototyping and experimentation.
- Collective action: Guiding efforts toward doable action, engaging the community's creativity with those with the authority and ability to make a change, and aiming high with humility, recognizing that change-making is often ambiguous to define and challenging to achieve.

When asked to identify the capacities and abilities needed to be effective transformative systems change practitioners, they emphasized the importance of ‘people skills’ such as interpersonal communication, personal empathy, and interactional capacity.

In addition to this project-specific transdisciplinarity, many transformations practitioners were also metadisciplinary (Alisat 2019); they also sought to take what they learned in individual projects and initiatives to advance the field of transdisciplinary research. This included developing specific techniques and practices, such as project evaluation, as well as the integrative leadership practices required to initiate and maintain supportive spaces for transdisciplinary initiatives. More broadly, practitioners described their efforts to develop programs and pedagogies to train systems to change agents, as well as their contributions to understanding the nature and scope of transdisciplinary practice. We describe each of these areas of multidisciplinary, while noting how the Transformations Community is working to grow and strengthen our capacity to support sustainability transformations.

Acknowledgments

Sincere thanks to the Fall 2021 cohorts of graduate students enrolled at the University of Colorado Boulder Masters of the Environment Program, and the Arizona State University Graduate Programs on Sustainability, and to the members of the Transformations Community for generously participating in this study. We would also like to thank our research assistant Chukwuma Paul, and the Reviewers for their time, effort, and careful and insightful reviews.

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