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Understanding how institutions may support the development of transdisciplinary approaches to sustainability research

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Abstract

This article analyses the approaches of academics seeking to engage with private, public and community-based stakeholders through transdisciplinary research about pressing sustainability challenges and, in particular, climate change; it outlines aspects of the institutional factors which influence transdisciplinary research. A qualitative approach was employed in conducting 10 semi-structured interviews to analyse the challenges and motivations of academic researchers when working with a range of other stakeholders through transdisciplinary practice. Two key contributions are made through this work. First, this article adds to the existing literature on motivations and challenges for undertaking research with private, public and community stakeholders in a cross-disciplinary manner.

Second, the current institutional circumstances influencing such research practices are outlined, alongside potential ways forward. The research presented here has been undertaken in light of the experiences of the two lead co-authors as early career researchers coming from the disciplines of sociology and energy engineering, engaging in transdisciplinary research within a local community context in relation to a regional energy transition project.

Keywords transdisciplinary research; academic institutions; engaged research; collaboration; co-production; reflective practice; researcher training and development

Key messages

- Higher education institutions are increasingly seeking to incorporate inter/transdisciplinary approaches to research; however, greater clarity is needed about the values and motivations behind these initiatives.
- Transdisciplinary practitioners are often intrinsically motivated and, as such, mechanisms of support from higher education institutions should be suitably flexible to enable the greatest societal impact to emerge.
- Further investigation into the early career experience is needed to better understand the institutional settings and training/development opportunities that would allow such approaches to flourish.

Introduction

There is increasing recognition among researchers, stakeholders and funding bodies that co-produced knowledge can lead to enhanced opportunities for improved outcomes across policy, decision making and practice concerning sustainability issues (Arnott et al., 2020; Irwin et al., 2018). As outlined by Funtowicz and Ravetz (1995), given the high stakes and uncertainty presented by contemporary ecological challenges, a 'post-normal science' approach that seeks to incorporate experiential (for example, community, Indigenous, local) knowledge is appropriate. In parallel to this, and in a large part emanating from it, there has been growing recognition of the value of transdisciplinary (TdR) approaches to research to respond effectively to sustainability-related issues (Byrne et al., 2017a), including across higher education (Byrne and Mullally, 2016), and also to ensure that societal impact 'is most explicitly expressed in, and actively shaped by, transdisciplinary research programmes' (de Jong et al., 2016: 1397).

A recent study of 115 published cases of TdR found that institutional factors have a mostly negative impact on the effects of TdR projects (Pärli, 2023). There is a need to develop stronger institutional supports for researchers undertaking such research approaches (Holliman and Warren, 2017), due to the well-documented additional challenges of conducting transdisciplinary work (for example, issues with language [Jahn et al., 2012], disciplinary silos [Saviano et al., 2019], time commitment [Polk, 2015] and evolving researcher roles [Pohl et al., 2010; Wittmayer and Schäpke, 2014]). This research adds to this existing body of work, with a key focus on the challenges experienced by TdR practitioners in a university seeking to champion such approaches. It is guided by the question: 'What are researchers' experiences of engaging in transdisciplinary approaches to sustainability research, and under what institutional conditions is it currently practised?'

While Klein (2013: 189) posits that 'there is no universal theory, methodology, or definition of transdisciplinarity', it is useful to ground ourselves somewhere within the discussion, first through an understanding of the difference between multi-, inter- and transdisciplinary approaches; this has been developed previously within the work of Mullally et al. (2017). We can briefly summarise the discussion

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as such: interdisciplinarity is set apart from multidisciplinarity as requiring deep engagement between several disciplines. This includes an understanding of the respective terminologies and methods by the participants. It differs from transdisciplinarity, which seeks a 'radically open, pluralistic, contextual and global approach to the development of *new* and *emergent* knowledge' through 'meanings that *traverse* and lay *beyond* different disciplines' (Mullally et al., 2017: 32, emphasis in the original), while commonly involving 'not only multiple disciplines but also multiple *non-academic* participants (e.g., land managers, user groups, the general public) in a manner that combines interdisciplinarity with participatory approaches' (Stock and Burton, 2011: 1098). As Balsiger (2004) suggests, a transdisciplinary approach to research should move beyond any pre-established disciplinary frameworks, instead seeking to consolidate different forms of knowledge, both inside and outside the academy, to address the complex issue at hand.

It is now widely accepted that partnership and collaboration with both academic and non-academic (private, public and community) stakeholders are crucial to the goal of generating real-world impact. This has brought into focus the role of the researcher, with those pursuing such a transdisciplinary approach taking on a range of new roles, such as the reflective scientist, process facilitator, knowledge broker, change agent and self-reflexive scientist (Horlings et al., 2020). This greatly expands the expectations placed upon researchers in comparison with traditional roles, assuming responsibility for activities such as guiding collective learning activities (Pohl et al., 2010) or implementing sustainability solutions in practice (Loorbach et al., 2011). Thus, it is important to build a better understanding of researchers' experiences in these various roles in order to develop suitable training and development opportunities (Featherstone and Owen, 2020).

This builds upon the notion of 'the honest broker' (Pielke, 2007), whereby the positionality of scientists in relation to policy formation is developed, with the honest broker developed in contrast to the science arbiter, the pure scientist and the issue advocate. The honest broker is characteristically defined through their 'effort to expand (or at least clarify) the scope of choice for decision-making in a way that allows for the decision maker to reduce choice based on his or her own preferences and values' (Pielke, 2007: 2–3). Building on this, the notion of honest brokering has been related to images of knowledge, rather than knowledge itself, addressing beliefs held about the nature of truth, the task of science, the task of academic and non-academic participants, and the task of transdisciplinary research (Pohl, 2011). The honest broker role has been critiqued for restricting the potential for the reflexive scientist (Durant, 2022).

This article supports the development of transdisciplinary approaches within university contexts by drawing out reflections from researchers within institutions seeking to champion such an approach to sustainability research. This is accomplished through a series of semi-structured interviews conducted with a diverse range of transdisciplinary researchers. As noted by Ni Shuilleabhain et al. (2021: 367), 'Universities in Ireland have not been immune to the international trends focusing on supporting, funding and embedding public engagement in university teaching, research and culture.' This study is based upon experiences within University College Cork, Ireland, which recently published an academic strategy placing a strong emphasis upon such approaches, with three of its six pillars being civic and community engagement, inter/transdisciplinarity and sustainability (University College Cork, 2018).

Literature review

Alongside the strong call for the emergence of more transdisciplinary research approaches to complex problems, such as sustainability and climate change, there is a growing literature on the challenges that such an approach entails. Transformations must move from deliberation to action (Bentz et al., 2022). At the most foundational level, how the issue at hand is framed is of critical importance, and it can often be a hurdle during the initial stages (Dunn et al., 2011), as it can impact the shaping of the project aims and objectives (Harris et al., 2009). Alongside these considerations is the challenge of team building (Lang et al., 2012). Within this, the legitimacy of actors involved, and an appreciation of those not represented

Table 1. Summary of challenges, motivations and ways forward for practitioners of transdisciplinary research within the literature

Challenges	Motivations		Ways forward
Different linguistic traditions (Jahn et al., 2012)	Difficulty gaining influence in policy (Stauffacher, 2010)	Advancement of common good (Guimarães et al., 2019)	New transdisciplinary research institutes (Bolger, 2021)
Tension between technical expertise and organisational structures (Jahn, 2008)	Career progression opportunities (Lauto and Sengoku, 2015)	Desire to engage with important issues (Guimarães et al., 2019)	Spaces for conversation on transdisciplinarity (Byrne et al., 2017a)
Use of traditional evaluation mechanisms (Mårtensson et al., 2016)	Funding for trust building (Lemos et al., 2018)	Sense of real-world impact (Guimarães et al., 2019)	Researcher and institutional leadership, as well as establishing a shared understanding of public engagement (Ni Shuilleabhain et al., 2021)
Specialised knowledge and disciplinary silos (Saviano et al., 2019)	Failing to acknowledge existing stakeholder engagement practices (Mach et al., 2020)	To inspire learning, develop researchers' skills; be ethical, accountable and transparent; make the world a better place; create a more efficient, dynamic and sustainable economy; enhance social cohesion and democratic participation; increase the quality and impact of research; and win support for science (Duncan and Oliver, 2017)	
Time requirements (Polk, 2015)	Evolving role of researchers (Pohl et al., 2010; Wittmayer and Schäpke, 2014)	Social responsibility and problem solving (Augsburg, 2014)	
Diversity of organisational expectations (Boon et al., 2014)			

within the project, becomes an issue of concern (Keller, 2011; Taverner-Smith, 2012). Following on from team dynamics, the importance of clarity about roles has been identified (Polk, 2014), with a lack of clearly defined actor functions being a potential source of contestation. If roles can be defined and team building successfully achieved, there are still challenges to overcome. Table 1 outlines some established challenges, motivations and ways forward for practitioners of transdisciplinary research approaches.

Materials and methods

A series of semi-structured interviews was conducted with a range of researchers involved in research with private, public and community-based stakeholders. To identify relevant participants, an email was sent to researchers within the research institution (which hosts over four hundred researchers from a diverse range of disciplinary backgrounds across the university) with the explanatory outline provided below. From this, 10 respondents came forward as having relevant experience, meeting the criteria as outlined by the authors. As Rubin and Rubin explain (2011: 5), 'qualitative interviewing is appropriate

when the purpose of the research is to unravel complicated relationships', deployed here in relation to researchers, academic institutions and TdR. A range of disciplines was included to capture the diversity of experiences in this cross-disciplinary investigation. By opting for a purposeful sample (Patton, 1990), the research findings have more depth than other approaches, such as convenience (Etikan et al., 2016) or snowball (Emmel, 2013) sampling. Purposeful sampling enabled in-depth conversations to be facilitated with the interview respondents selected using the following criteria, guided by our understanding of transdisciplinary research, as outlined in the 'Introduction':

> potential participants should have experience of working with industry, communities, policymakers, NGOs [non-governmental organisations] etc. in a collaborative, engaged, co-produced and two-way approach, e.g. stakeholders are actively involved in research design, in the research work itself and in the implementation of research findings post-project.

The participants represented several different disciplinary perspectives: government and politics, ecology, civil engineering, energy engineering, business and marketing, economics, geography and sociology. This also covered a range of career stages, from earlier postdoctoral, up to research fellow and professorship. A summary of the research areas of the interview participants is provided in Table 2.

The use of semi-structured interviews was selected as a suitable format as this approach enables conversational flexibility to facilitate understanding of challenges and motivations from the interviewees' perspectives. The guiding questions employed are provided in Table 3.

Table 2. Overview of the interviewees' areas of research

Background	Number of participants
Deliberative and participatory governance	1
Energy policy	1
Climate adaptation	2
Community energy planning	1
Lived experience of energy/climate change	2
Food security and sustainability	1
Sustainable agriculture	1
Wildlife conservation	1

Table 3. Semi-structured interview questions

Number	Question
1	How would you define the research approach you take? (For example, collaborative, engaged, transdisciplinary, interdisciplinary, action research)
2	What motivates you to undertake research in this way?
3	What is your experience of working in this manner to date?
4	What are your experiences of working in this manner within the host university/research institution?
5	What are the key challenges you face with relation to this research approach, specific to your department?
6	What are the key challenges you face with relation to this research approach, at an institutional level?
7	How can this research approach be better supported?
8	Do you work with other disciplines as part of this research approach?

Recorded and transcribed interview data were analysed thematically using the constant comparative analysis method to code data into themes (Braun and Clarke, 2006; Hewitt-Taylor, 2001). Within this method of analysis, raw data from transcribed interviews were grouped together based upon common attributes, and from this a structure was formulated across groups to build theoretical findings. The coding processes began through comparing and connecting individual snippets (open coding). Once initially coded, categories were created around different themes where similarities and overlaps were present across different interviews (axial coding). Following this, connections were made across categories to create a core category (selective coding). This approach has been used to develop theoretical insights from the correlative interviews, rather than to focus upon points of difference between them.

Results

Building on the body of work outlined in Table 1, the results below shed light on some of these challenges, as well as indicating a number of additional considerations. Specific focus is given to four areas and associated emergent themes, utilising the constant comparative analysis method, as outlined previously, to code data into themes. The four areas were: (1) challenges associated with involving a range of different stakeholders in research; (2) benefits and motivations; (3) institutional challenges emanating from new research practices; and (4) suggested paths forward. Throughout the following subsections, relevant quotations from participants are integrated within the text, with the interview participants (IP) referred to as IP1 to IP10.The key findings of the following subsections are summarised in Table 4, with reference to the literature outlined in Table 1, as follows:

- added – *new reflections* unique to this study
- expanded – *offers greater detail*, or stronger explanations or theory, about issues already available in the existing literature
- supported – *confirms existing knowledge* and cites the relevant studies, or *demonstrates known issues in new settings or fields*, in a form that is similar or dissimilar to that reported by earlier studies
- contradicted – *refutes earlier work*, whether that work reports empirical findings or existing theory.

Challenges associated with involving private, public and community-based stakeholders in research

While there has been significant momentum for private, public and community-based stakeholders to be involved in research in relation to sustainability and climate change in recent times, this is not a new concept (Odum and Barrett, 1971):

> although it's not as new as you might think, this has been around for decades, but what is new is the current drive to have elements of interdisciplinary or transdisciplinary across most of the research. (IP3)

Well established interactive research practices with long traditions of methods, practices and empirical research are often crowded out by 'the jargon of co-production' (Mach et al., 2020: 31). These approaches are not new, but rather there is a new and growing emphasis placed upon them. This creates an issue whereby researchers with no previous experience of these practices or traditions undertake these new roles without recognising this existing knowledge:

> you want to bring in other disciplines, but then I suppose you want there to be enough people within a project who understand how this knowledge making works or else you have people reinventing the wheel and suggesting the collaborative community engagement work is some brand new radical type of thing, which it isn't, it has been around a long time. (IP10)

Moreover, there is the question of the variety of different roles that researchers must be prepared to fill, which is well documented in the literature (Pohl et al., 2010; Wittmayer and Schäpke, 2014). An additional

Table 4. Summary of challenges, motivations and ways forward for practitioners of transdisciplinary research based on the results of this study

Challenges associated with involving private, public and community-based stakeholders in research	
Failing to acknowledge existing stakeholder engagement practices	Supported
Risk of tokenistic or box-ticking engagements	Expanded
Language	Supported
Variety of roles undertaken by researchers	Supported
Importance of interpersonal skills	Added
Career progression opportunities	Expanded
Funding gaps	Expanded
Benefits and motivations	
Real-world impact/usable knowledge	Supported
Pressing need for action	Expanded
Desire to engage with issues/problems that transcend disciplinary/academic boundaries	Supported
Challenges inherent to higher education institutions emanating from new research practices	
Communication between disciplines	Supported
Evaluation metrics not suitable	Expanded
Impact on career opportunities	Expanded
Early career researchers find it more difficult to pursue TdR	Added
Importance of high-level institutional support	Added
Communication between disciplines	Supported
Evaluation metrics not suitable	Expanded
Impact on career opportunities	Expanded
The path forward	
Topic-focused, inter/transdisciplinary oriented research institutes	Added
Creating space for less formal interactions, interdisciplinary learning	Expanded
Rethinking funding cycles	Expanded

point that must be acknowledged is that some people will be more suited to the role than others: 'There is something that no one ever says. The importance of being a nice person is key' (IP6). Many of the necessary skills for engaging with a range of people are 'soft' interpersonal traits that cannot be developed with conventional training.

It has been claimed that through working with researchers, other stakeholders are 'rewarded with new knowledge, capacities, and "voice" by taking part in research networks' (Klenk and Meehan, 2015: 743). There is a danger, however, in starting from an assumed position that beneficial outcomes will be achieved simply through the engagement process. This evidence may be influenced by the form of practice being implemented on the ground, whereby a tick-box logic is applied to stakeholder engagement. Several participants noted that often within projects working across a number of disciplines, the social science elements (or engagement of stakeholders more generally) is added on to the physical sciences or engineering, rather than being itself embedded within the core of the research process. The risk is that under pressure to work with private, public and community-based stakeholders, these tokenistic inclusions may take place:

> a project I was involved in previously which had stakeholder engagement aspects … it was lip service … it was just that we have a report on social acceptance here it is, grand, that is that box ticked. (IP2)

Evaluation of public engagement activities is thus increasingly important (Reed et al., 2018).

All parties involved must be clear about the purpose of working in this manner. It was noted that there is a requirement for funding to enable stakeholders and researchers time to build trust and solidarity (Lemos et al., 2018):

> You really try and establish that you are not there with a big agenda to extract information. You are there to show a sense of solidarity as much as anything else, and then bit by bit you entrust. (IP7)

This, however, is something currently not facilitated through typical two- or three-year project time frames, with tight delivery deadlines and narrowly defined goals.

Challenges inherent to higher education institutions

First, the issue of communication between actors is of crucial importance. Coming from different disciplinary backgrounds or professional settings results in many linguistic styles of specialisation (Jahn et al., 2012). It can become a difficult challenge to communicate complex findings using simple language (Tress et al., 2005). The tension between different knowledge types, technical expertise and organisation structures (Jahn, 2008), as well as within this language, represents one of the core challenges for research moving from disciplinary to transdisciplinary (Jahn et al., 2012; Kantamneni et al., 2019).

In the words of Saviano et al. (2019: 1551), despite the growing importance being placed upon transdisciplinarity, 'science has continued to follow a vertical pathway through the development of increasingly specialized knowledge, thus generating fragmentation and divides that make dialogue among disciplines difficult'. Alongside this, often the proxy variables used in the evaluation of research practices do not include elements related to transdisciplinary approaches (Mårtensson et al., 2016). The time required to coordinate meaningful stakeholder engagement is severely underappreciated. Related to this, it was suggested that 'what happens often is that the social science component is bolted on' (IP10). Beyond how knowledge is integrated, and in relation to the definition of roles, time (Polk, 2015) and levels of commitment (Boon et al., 2014) become important considerations. As noted:

> one of the things is that people don't understand the time it takes to do this work, and the fact you have to develop relationships with people and you have to understand what they want. (IP6)

Researchers must balance the tension between levels of commitment from societal actors, the necessity of producing findings that are practical to these actors, and the need for research outputs.

Working in a team that includes a range of different actors, coming from different institutions/organisations, may prove a challenge due to the differing performance expectations and goals within those institutions/organisations (Boon et al., 2014). The transdisciplinary team becomes its own entity, but one in which different actors must meet very different performance indicators. Within an academic setting, the importance recently placed upon transdisciplinary approaches to managing complex issues is still at odds with the structural expectations created within academia:

> when it comes to your own personal career, it doesn't really provide … academic outputs will suffer if you are doing this kind of engaged research properly, so I think that has to be reflected. In some respects, people look down … I am not saying that happens across the board … but it is considered lesser possibly than academic research, which I would very much argue against. (IP6)

Importantly, as Lauto and Sengoku (2015) note in relation to barriers to TdR within universities, career advancement opportunities remain more focused upon singular disciplinary approaches, due to the

historical development of disciplinary traditions throughout the twentieth century. As noted in an interview:

> essentially the currency is journal publications … yes, there are lots of scholars that do this kind of work and are held in high esteem, but you need to be publishing journal papers. (IP10)

This lack of recognition for TdR in career progression was reflected in the degree of ease with which participants could pursue this approach. There was a clear distinction between permanent teaching posts, with the freedom to explore interests, and earlier stage researchers, who lacked this certainty and security. As noted by a permanent senior staff member:

> I just did my own thing. There was never any issue. The fact of the matter is, given my seniority, you kind of work your way into a position of privilege. (IP7)

Linked to this issue of funding is the challenge of maintaining capacity within a research group:

> You need to have continuity, but our structures don't allow for that. When I say 'our', I mean academia more widely. You can recruit as many students as you want, you get in postdocs, and they are there for a period, then move on. The knowledge is lost, it's hard to retain capacity in research groups. There are very few, if any, [permanent] places within the research side of it. (IP3)

This is of particular importance when it comes to the need for a very specific skill set, such as is necessary for experts in sustainability challenges and stakeholder engagement, as discussed in the section on 'Challenges associated with involving private, public and community-based stakeholders in research', above.

Despite the current difficulties, several interviewees highlighted the significance of the fact that senior university management, and policies, are now calling for TdR:

> I think the current senior management in the university value it a bit more than previous ones. So it is a bit easier to do when you are getting kudos for it from senior university people. (IP8)

For some participants, this is in stark contrast to how they had previously been 'looked down upon'. However, it does not come without concerns; there are questions about the motives of this new agenda, and whether it is truly in the spirit of seeking to establish new relationships and knowledge:

> Then the other part, I suppose, is that generally it [host research institute] does recognise this work, but it tends to be for social media and that stuff. (IP6)

The path forward

Counterbalancing the challenges represented through the interview process, there were also some clear motivations expressed around engaging with private, public and community-based stakeholders:

> These issues are wicked problems that mean you have to work across the boundaries. (IP5)

Similar to the findings of Cerrato et al. (2018), we found that researchers' motivations were not led by an emphasis upon funding, but rather facilitated by an emphasis to act upon personal feelings towards what research should seek to achieve in this space. As noted by one participant:

> at the end of the day, that is what we are trying to do, make something useful, make a contribution. We are dealing with real-life issues that require an immediate response. (IP4)

Within the established literature, intrinsic motivations outlined include: an urge to work towards the improvement of society through contributing to the advancement of the common good, a desire to engage with issues/problems that transcend disciplinary/academic boundaries, and a sense of fulfilment

based upon having an impact upon the lives of both the researcher and the participants (Guimarães et al., 2019). The potential impact of research within society is an important consideration:

> You want your research to be used … It is also you want to make some kind of good happen in the world in a way as well. There is those motivation as well. There is very little research done that is not useful. But to actually make it usable you have to cross the divide into practice and seeing, well, how do we take this useful information and make it useable. (IP6)

The importance placed upon a move to usable knowledge is of central importance with regard to sustainability science, climate action and engaged research, and it can be seen as a key driver in the institutional push highlighted through the funding calls noted in the 'Introduction'.

The benefits of working in topic-focused, inter/transdisciplinary-oriented research institutes, which can facilitate the bringing together and merging of expertise, was noted in some interviews:

> We have had sociologists, architects, geographers, ecologists, so it is very mixed TdR membership. That is something that is quite typical in research institutes or environmental institutes. I think that's a strength in terms of promoting TdR. (IP4)

Such institutes offer space for the building of relationships, sharing of experiences and collaborative learning:

> I think the structure of having research centres on thematic areas rather than disciplines like we have here … That is a good way forward. (IP5)

However, one participant highlighted that a key challenge in the development of these transdisciplinary-oriented research institutes is that they cannot be built upon the same foundations as previous research institutes. New (fit for purpose) institutes would require a restructuring of universities to support new ways of coordinating and administrating research:

> All of our research centres have to belong to a college. You are in here [host research institute], it's one of our flagship institutes, it has PIs [principal investigators] from across the university, but yet it must belong to one college. So it is under the College of Science Engineering and Food Science (SEFS), that's for resource and reporting structure … This then means that academics from outside SEFS are less encouraged to engage with it and contribute, because the benefits don't go to their schools or college. (IP3)

These new research institutes could help to overcome the structures within academia that hinder progress in the development of transdisciplinary research outlined above: funding procedures, career advancement opportunities, evaluation criteria and so on (Bolger, 2021).

Such a radical re-imagining of university structures will require time. Moreover, some participants suggested that perhaps this was misguided, and that the best place for these collaborative ventures to occur was outside of formal structures:

> The nature of academic work now means sometimes it is hard to find a little bit of time for blue-sky thinking, and thinking the thoughts that lead to a research question that leads to some output. (IP1)

Ultimately, what is needed for these new, creative ideas to emerge is the space for meaningful discussions to take place and an understanding/relationship to be built (Byrne et al., 2017b). These are far better facilitated through less formal interactions, coming from a place of humility and respect to discuss each other's interests:

> You start talking to all sorts of people across the university, and you start conversations with people. Building trust with people that they feel comfortable in a space. These things can't be rushed, and they certainly can't be institutionalised. (IP7)

While challenges exist for these forms of research practice, both at the level of the institution and in practice, there are clear intrinsic motivations for researchers committed to TdR, which can be enabled through supports, considered further in the 'Discussion' section, below.

At a higher level, above how funding within the research institute may be coordinated, there is the question of the funding itself. As outlined by Pohl et al. (2021), there are three key stages to a TdR project: problem framing, problem analysis and exploring impact. Current funding mechanisms generally call for all three of these elements to take place within the confines of a two- or three-year project. It is suggested here that more appropriate calls would involve a staged approach, with dedicated strands for exploratory design to build an improved understanding of problems, and trust among the stakeholders, as well as, much later, evaluation of the impact of previous projects. First:

> Research design is very important. Often it's the bit left to the last minute, and sometimes it's retrospective, on larger studies, it's very rushed. A lot of time is spent doing the research, but not enough planning it and conceptualising what it is you ought to do. There is a saying, measure it twice and cut once, get it right. (IP3)

And second:

> You need to show impact. Environmental, economic, social, technological. That is the requirement. It is not an aspiration. (IP2)

However, the lifetime of a research project is extremely short relative to long-term societal transitions, so impacts are unlikely to be clear until several years after the work takes place.

Discussion

Definitional diversity in transdisciplinary practice

Through the interview process, the participants were asked to discuss the different research approaches which they take to their practice, based upon the initial outline which was used to recruit interviewees:

> potential participants should have experience of working with industry, communities, policymakers, NGOs etc. in a collaborative, engaged, co-produced and two-way approach, e.g. stakeholders are actively involved in research design, in the research work itself, and the implementation of research findings post-project.

In response to this, 13 different terms emerged in the interviews to describe the research approaches, fitting with the established literature in this space, whereby terminological diversity and uncertainty is often common. Table 5 provides an outline of the different terms which were presented through the process, with examples of definitions provided for them within the literature. This is done not with the intention of providing definitive clarity, but rather to highlight the diverse approaches and traditions which researchers invoke when conducting transdisciplinary research. In some cases, a requirement has been created for engaged forms of sustainability research through emphasis upon it in funding calls. However, funding agencies are often not clear about what is expected, resulting in a wide diversity of interpretations by researchers. This confusion, and the diversity of disciplinary interpretations, was highlighted by the range of different research approaches mentioned by the interview participants.

Institutional barriers

Throughout the interview process, several emergent institutional barriers to co-produced, transdisciplinary research were referenced, both across disciplines and with private, public and community-based stakeholders. These include barriers to career progression, the rigidity of disciplinary structures, coordination and administration difficulties, and the incumbent structure of university schools in relation

Table 5. Research approaches highlighted in interviews, with an overview from literature

Term used by researchers	Description
Deliberative processes	Provides guidance based upon relevant scientific evidence, interpreted wherever possible with context-sensitive scientific evidence and, where not, by the best available local evidence (Culyer and Lomas, 2006). Deliberative processes can provide 'decision supports' in local contexts (Webler et al., 2016).
Civic/community engagement	Relates to the civic sphere and citizenship, and the ways in which actors participate in community life to improve conditions for others, or to help shape the community's future (Adler and Goggin, 2005; Brabant and Braid, 2009).
Co-design/production/ creation	A cluster of participatory and transdisciplinary research approaches that are context-based, address meaningful goals by bringing together diverse forms of knowledge, and do so in an interactive engagement process (Norström et al., 2020). Co-design emerges through the field of 'design thinking', co-production initially comes through in the public administration literature, and co-creation comes from the management literature.
Co-learning	Researchers and practitioners acting as participants in processes of education, through engagement in action and reflection (Wagner, 1997).
Engaged research	Researchers deliberately working jointly alongside non-academic practitioners, policymakers or community members with different types of knowledge on a shared problem (Brandt et al., 2013; Graybill et al., 2006).
Multi-actor/stakeholder approach	A form of stakeholder governance that uses democratic practices to develop regulatory mechanisms, such as metrics and standards, usually involving a public/private sector partnership (Bäckstrand, 2006; Konefal, 2015).
Collaborative	Working alongside other stakeholders to produce new knowledge, including assistance in the overall research design, collecting and analysing data, or writing publications (Aboelela et al., 2007; Tress et al., 2009).
Action-oriented	Researchers working alongside practitioners and community partners to inform practice, programmes, community development and policy, while adding to the scientific knowledge base (Small and Uttal, 2005), connecting social science knowledge with public issues.
Multidisciplinary	'features several academic disciplines in a thematically based investigation with multiple goals … aiming to share knowledge and compare results from the studies there is no attempt to cross boundaries or generate new integrative knowledge' (Stock and Burton, 2011: 3).
Interdisciplinary	A mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice (National Academy of Sciences, 2006).
Transdisciplinary	'involving not only multiple disciplines, but also multiple non-academic participants (e.g., land managers, user groups, the general public) in a manner that combines interdisciplinarity with participatory approaches' (Stock and Burton, 2011: 1098). A *process* through which the production of knowledge is opened up to a wide variety of perspectives and viewpoints (Darian-Smith and McCarty, 2016).

to establishing thematic research institutes. Within the literature, there is a range of contributions about the institutional challenges associated with transdisciplinarity (Gaziulusoy et al., 2016) and engaged research (Baker et al., 2020). The suggestion can be made that these challenges emanate from the established structures and procedures, particularly in relation to the evaluation of performance within academic institutions. The need for substantial support for researchers working with private, public and

community-based stakeholders within departments is noted (Zimmerman, 2019). Within this, however, difficulties are faced from a cross-disciplinary perspective. Situations in which one department supports the approach while another does not create power imbalances within the cross-disciplinary structure of the research project.

As previously outlined in the section on 'Challenges associated with involving private, public and community-based stakeholders in research', there is a great risk associated with the mandate across research to pursue these approaches; there are questions to be asked about the motives behind this push, and careful consideration needs to be given to the purpose of involving stakeholders in research. There is a lack of recognition within funding bodies that genuine co-production with communities is very time-consuming and, if it is required, it needs to be resourced properly across a number of fronts (for example, financially, new skill sets, flexibility in being able to compensate communities, and the time required to build trust). The danger of burnout has been referenced in relation to qualitative research as a whole (Clark, 2008), and, as funding continues to prioritise these approaches, research fatigue may increase, with the potential to act as a counterproductive force in relation to both climate action and scientific legitimacy (Warren et al., 2018). There is a thin line between cultivating co-production and data mining communities to suit the needs of researchers, which must be focalised.

The institutional challenge of transdisciplinary research relates to its position within academia. While this position has the advantage of strengthening links at the interface between science and society, it suffers institutionally through a failure to advance theoretical and conceptual developments, coupled with a lack of reflexivity. As such, transdisciplinary research is often perceived as a 'scientific service', rather than as something of genuine interest within established disciplines (Wiesmann et al., 2008). Its position within academia must be strengthened at the levels both of research and of teaching, so as to enhance its development. For practitioners of transdisciplinarity, the benefits and motivations of such an approach must be kept at the forefront of the mind, in light of institutional barriers present. Here, the importance of conversations within academic settings which are 'undertaken in good faith and humility, with the intention of gaining new insights from other disciplinary perspectives and sources of knowledge in order to be better equipped to develop appropriate questions on sustainability related issues' (Byrne et al., 2017b: 237) is a crucial starting point in the journey towards working in a cross-disciplinary manner that can engage with the wider public on the complex challenges of contemporary society.

Reflections from early career researchers

Here, the two lead co-authors present their reflections on undertaking a TdR approach through their PhD research project, informed by the experience of conducting this research, in line with the importance of the reflexive researcher in TdR practice (Durant, 2022). Coming from energy engineering and sociology, while engaging with a common regional transition project, the experience of undertaking research in this manner presented a number of challenges when compared with more traditional approaches. A pathway for future engaged researchers is an important consideration to encourage TdR moving forward (Holliman and Warren, 2017). A prominent issue emerging from the interviews was that transdisciplinary research has yet to cement a place within academia, and it remains poorly recognised or understood, despite high-level demand from research policy and funding bodies. Consequently, there are tensions inter alia concerning funding, time constraints and reporting/outputs requirements. Here, we reflect on these findings, and offer three key needs to support early career researchers: greater recognition for outputs other than journal articles; training and development opportunities; and network building.

Crucially, the obvious importance placed upon academic articles, and often conflicting metrics of impact, must also be acknowledged as an issue (Sauermann et al., 2020; Schneider et al., 2019). This is of particular relevance for early career researchers, and it highlights a need for more flexible evaluation criteria and metrics in the pursuit of transdisciplinary research. As two early career researchers, we initially struggled with the tension between producing outputs that contribute to our academic profiles, while also being of use to our partners outside of academia. We have sought to achieve this through

developing, in parallel, academic articles and learning briefs (Boyle et al., 2021; McGookin et al., 2020, 2021; Watson et al., 2021) throughout our PhD journey. To some degree, however, this has restricted our time in relation to pursuing further upskilling opportunities within the university, which may impact our careers later. Despite this, through implementing a collaborative TdR approach to our PhD research, we both succeeded in delivering a large number of academic articles (five lead author articles each, one co-authored article, and one book chapter each) in tandem with community outputs. However, the journals interested in publishing articles in the space of TdR have, on average, lower impact factors than publications with a single disciplinary focus. This may have impacts for early career researchers.

Structural issues remain. If TdR continues to have less impact in journal article metrics than other forms of scholarship, it will be difficult for capacity and skills to develop in this area, as early stage researchers must eventually prioritise a narrower focus. Yet, in light of the emphasis being placed upon it at a European Union, and indeed global, policy level, there is great promise for the future of this research space. Given the high-level mandate in research policy and funding, the responsibility falls upon transdisciplinary researchers, who must seize the opportunity to shape an accommodating landscape and overcome existing institutional barriers. We feel that one essential element will be dedicated training and development opportunities to support those who wish to explore TdR. As was highlighted by the range of terminologies applied to research approaches, as outlined in Table 5, this is a semantically confusing landscape. This is particularly challenging for early career researchers trying to understand how their work is placed within the existing literature.

As early career researchers conducting transdisciplinary research, we are often faced with a feeling of being outsiders when compared with our disciplinary-focused peers. Opening up a wider space for conversations would be fruitful in expanding our professional networks. Some of the options we have identified for strengthening transdisciplinarity within the institute lie in cross-university gatherings on the topic, facilitated through conferences, seminars, publication projects or university-wide teaching initiatives. These offer important training and development opportunities for early career researchers, while also giving credence to the need for change by building a network and strengthening transdisciplinary practice. However, in light of the emphasis on conversation as a starting point, detached from the institutional pressures inherent within the disciplinary focus of university settings, it is suggested that other informal, more socially oriented gatherings are also key, such as postgraduate reading groups or 'meet-ups'.

Conclusion

This article has explored the production of knowledge with private, public and community-based stakeholders in a transdisciplinary manner in relation to sustainability challenges and climate action. One key finding of this research is that there is still a crucial gap between the terminology of funding programmes and the reality of practising transdisciplinary research in universities. The emphasis on traditional research outputs and journal publications is often misaligned with TdR processes; however, some improvements in the associated metrics are occurring over time due to increased emphasis upon such approaches in funding calls. Several interesting reflections, missing from the established literature, have been represented through this research process. As two early career researchers, this process has helped us to focalise some of our own experiences of undertaking transdisciplinary research, while exposing us to a broad range of issues related to the topic not directly experienced within our situation. Some limitations exist within this work. The criteria for selection brought suitable respondents for an investigation of the challenges faced by practitioners. However, the criteria did not include challenges or perspectives of those who cannot, or choose not to, do this type of research. Also, the range of forms that collaboration takes in different transdisciplinary projects can lead to different challenges. This would be an interesting area for future research: to investigate the different realities experienced through different collaborative modalities.

The present work highlights several existing institutional challenges that hinder progress with the practice of transdisciplinary methods. This merits further investigation into the values and motivations of higher-level institutions that are placing an increasing emphasis upon the pursuit of these methods. If transdisciplinary approaches are to be effective, then there is a need to reimagine the structures of our universities, research institutions and funding. In light of this institutionalisation of the need for research to work alongside private, public and community-based stakeholders, a greater understanding of the changing role of practising researchers, and associated training and development needs, is warranted. For practitioners, awaiting the necessary institutional changes, but driven by a motivation towards working in this manner, an emphasis must be placed on creating space for conversation, adding rigour to practice by highlighting learnings from failure alongside success, and building transdisciplinary research networks, both within research institutes and more broadly across institutes.

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Declarations and conflicts of interest

Research ethics statement

The authors declare that research ethics approval for this article was provided by University College Cork Social Research Ethics Council ethics board.

Consent for publication statement

The authors declare that research participants' informed consent to publication of findings – including photos, videos and any personal or identifiable information – was secured prior to publication.

Conflicts of interest statement

The authors declare no conflicts of interest with this work. All efforts to sufficiently anonymise the authors during peer review of this article have been made. The authors declare no further conflicts with this article.

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