From communication to co-creation? How digital infrastructures can support science-policy advice on SDGs

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Science has played and will continue to play a crucial role in the negotiations around the 2030 Agenda. It is expected not only to inform decisions on sustainable development but also to generate knowledge that challenges existing normative tenets, create solutions with policymakers, and help implement them. Sustainable development is highly complex, involving expertise from a wide range of disciplines and policy fields, with researchers who are not necessarily accustomed to working together. A few years ago, Germany launched a platform for knowledge co-creation between researchers and policymakers - The Dialogue between Scientific Councils (Beirätedialog). The initial years of operation have shown that merely bringing together researchers and creating a space for interaction is insufficient. Expertise often remains within traditional disciplinary boundaries and is not adjusted to sometimes conflicting findings from other fields. Through four years of participatory observation of the Beirätedialog, we identified the need for a more integrated, holistic, and standardized framework to enhance co-creation between researchers and policymakers. We use this insight to elaborate on the obstacles hindering co-creation and reflect on how such a framework could be established. We particularly focus on the potential of digital infrastructures and propose three aspects that are crucial for designing a co-creation framework: a structured central access point to expertise, a common classification of outputs, and improved skills among researchers and policymakers. This paper does not present a final scheme for such a framework but serves as an impetus to further reflect on how existing practices and resources can be leveraged to improve science-policy co-creation in sustainable development.

Introduction

Science is key for reaching the Sustainable Development Goals (SDGs) - a set of 17 interconnected global objectives aimed at ending poverty, protecting the planet, and ensuring prosperity for all, they are the core of the United Nations' Agenda 2030 for Sustainable Development. Research is expected not only to inform political processes around the SDGs but also generate knowledge that challenges existing strategies, create

solutions together with policymakers and societal actors ("whole-of-society approach"[1]) and implement them. Sustainable development connects a myriad of disciplines and policy fields, making it necessary to integrate knowledge from different domains when feeding expertise into political processes in order to address societal challenges in this field. Communication formats and advisory mechanisms that are in place in this realm can be considered as a trend setter in providing, testing and refining co-creative approaches of knowledge production (Ansell, Sørensen, and Torfing 2022; Keitsch and Vermeulen 2020). At the same time, a recent study (Smith et al. 2021) that used language processing and network analysis of UN reports and scientific literature revealed discrepancies between the policy discourse and scientific debates and shows that there is a divide between environmental goals and other SDGs, which indicates that research expertise is often not addressing the SDGs. Furthermore, there is a consensus within the UN that the SDGs will not be achieved by 2030, which presumes that current implementation mechanisms should be evaluated and revised (Singh et al. 2021).

After the Covid-19 pandemic, when the value of high quality expertise for decision-making became more evident than ever before many countries have been trying to improve their scientific policy advice mechanisms, and make them more efficient and crisis resilient. (Gluckman and Mendisu 2021; Michie et al. 2022; OECD 2020). There have been calls in academic circles for more transparency and collaboration between different disciplines and societal stakeholder groups. Typical obstacles that hinder effective development of expertise to address societal challenges include the traditional separation between science and policy communities, differing institutional cultures, complexity and awareness of existing scientific knowledge on an issue (Sienkiewicz and Mair 2020). Some countries started testing and developing digital resources in order to facilitate science-policy interactions. Two examples of such digital resources, are the "Areas of Research Interest (ARIs)"[2] that have been launched in the UK 2023 and Repod[3], a repository for policy documents, launched in 2024 in Germany. Following different approaches both tools aim to be a central meeting point for researchers and policymakers and offer a way to match their expectations, facilitate sharing, accessibility and reuse of scientific research.

These and other similar resources to some extent relate to the concept of "Open Science Research Infrastructures" (Okune et al. 2018; Schroeder 2007) that encompass tools, platforms, and systems that support the open sharing and collaborative development of

[1] Visit https://www.bccic.ca/wp-content/uploads/2019/06/International-Partnership.pdf for further Information.
[2] https://ari.org.uk
[3] https://repod.zbw.eu

scientific research. Currently, they relate mostly to communication within academia - between researchers and academic institutions; and in this paper, we explore the opportunities such infrastructures offer to improve communication between academia with non-academic actors, particularly science-policy communication around the SDGs. After a brief description of the German landscape on science-policy advice, we outline existing obstacles in knowledge co-creation and reflect on how digital infrastructures share some thoughts on how digital resources might be able to help overcome these.

Science-policy communication on the SDGs in Germany

Germany has a very diverse and complex landscape of science-policy advice for sustainable development; it is one of only few countries EU-wide that have included research representatives into their advisory councils on sustainable development, commissions and other participatory instruments (Niestroy et al. 2020). Part of this landscape is The Science Platform[4], which provides a central forum at national level for science to engage with the development and implementation of the German National Sustainable Development Strategy (German NSDS[5]): "The Science Platform Sustainability 2030 has been designed to support sustainability-focused disciplines and programs as well as inter- and transdisciplinary research and knowledge transfer. It will shed light on connections between specific Sustainable Development Goals (SDGs) and identify key fields of action."

One of its formats - The Dialogue between Scientific Councils[6] (further referred to as the Beirätedialog), was initiated by the German Science Platform in cooperation with SDSN Germany and is an overarching dialogue between science advisory councils to the ministries with the aim to produce advice for the Federal government. Usually these science advisory councils are permanent bodies that work bilaterally with their Ministries - e.g. the Council for Economic development[7] with the Ministry for Economic Affairs and Climate Action - they review government actions and advise decision-makers through reports, statements and recommendations. The Beirätedialog aims to create a space for cross-council and cross-ministry engagement on sustainability-related issues and conflicts, as well as on the role of advisory councils and scientific policy advice in implementing the German Sustainability Strategy (DNS). In 2023 one of the biannual meetings - "Shaping

[4] https://www.wpn2030.de

[5] https://www.bundesregierung.de/breg-en/issues/sustainability/germany-s-sustainable-development-strategy-354566

[6] https://www.wpn2030.de/beiraetedialog/

[7] https://www.bmwk.de/Redaktion/DE/Artikel/Ministerium/wissenschaftlicher-beirat.html

Transformation Together - Impulses from Scientific Policy advice"[8] was dedicated to discussing how science-policy interactions can be improved. The authors of the present paper took part in a four-year participant observation and were able to follow the activity of the platform from the beginning, multiple times its advisors voiced the need for a more holistic approach to science-policy advice, an improved overview of relevant advisory knowledge and more awareness about advisory procedures. We take up this call, and look for possible strategies to address it.

Background

In this section, we give a brief overview of the terms "co-creation" and "research infrastructure" as they are related to in the academic literature on transdisciplinarity, science-policy interactions and science communication.

Why co-creation?

Although co-creative knowledge production has been a matter of academic debate for decades, it is still in many academic works considered as a promising innovative setting to bridge the gap between policymaking and research (Metz, Boaz, and Robert 2019). As the term itself suggests, co-creative research practices aim to bridge the gap between research and policy cultures, addressing the complex nature of policy problems (Sienkiewicz 2020), and embody a paradigm shift in knowledge production and defining its societal impact, where researchers and policymakers work together throughout the whole research cycle: Defining research questions, agreeing on methods, adjusting them, and assessing implications for policy and practice (Hunter 2009; Mauser et al. 2013; Regeer and Bunders 2009; Lember 2018). In sustainability studies co-creation is considered to be part of transdisciplinary research (Lang et al. 2012), which is defined as a "reflexive research process that addresses societal problems by means of interdisciplinary collaboration as well as the collaboration between researchers and extra-scientific actors; its aim to enable mutual learning processes between science and society" (Jahn, Bergmann, and Keil 2012). Transdisciplinary or co-creative ways of research are considered to be key in addressing societal challenges, also the SDGs.

At the same time, up to now there is little clarity on the questions of how, by whom, and for what knowledge from scientific research is being used for the benefit of society. Impact studies often focus rather on what happens when knowledge has already been created and "put out there" (Nagy et al. 2020). Yet, according to co-creative logic of knowledge

[8] https://www.wpn2030.de/wp-content/uploads/2024/02/Beiraetedialog-2023-I-Bericht-RT-A.pdf

production, utilization of knowledge already happens while it is being developed, it can already impact societal spheres and even to a greater degree if it is co-created among academic and non-academic actors (Hoffmann, Klein, and Pohl 2019).

Infrastructures for research communication

An infrastructure is seen as a socio-technical system that provides a framework for communication and data processing between different communities of practice (Edwards 2003). It can support or even curate knowledge exchange processes and help to archive and maintain an overview of an ever-growing corpus of expertise. Contemporary communication in academia is largely shaped by open science infrastructures - systems, tools, services, and platforms that support the practice of open science, they facilitate the sharing, accessibility, and reuse of scientific research and data (Kitchin 2014; Vicente-Saez and Martinez-Fuentes 2018; Munafò et al. 2017). They are designed to promote transparency, collaboration, and the dissemination of scientific knowledge across various domains and disciplines. Such infrastructures have to large extent transformed research practices in the last decades by creating new opportunities for collaboration and information exchange. Key components include institutional and thematic repositories for publications, research data, and software as well as services for discovery, publishing, peer review, and analysis (Stojanovski 2022). These infrastructures are mostly discussed in regard to their potential to transform communication within academia, between researchers, but at the same time such infrastructures bear potential to engage diverse audiences, e.g. help bridging the gap between researchers and the general public (Laura 2021). Hanseth et al. (1996) and Larkin (2013) argue that infrastructures rely on a certain degree of standardization and compatibility if they are to function effectively.

Research interest and approach

With our paper, we aim to provide a deeper understanding of existing obstacles to knowledge co-creation and share first ideas on how digital infrastructure can contribute to addressing these and facilitate knowledge co-creation. We rely on the co-creation cycle that was proposed by Jacobi et al. (2016). It resonates with other similar approaches that describe transdisciplinary or co-creative research with a focus on sustainability as e.g. by Lang (2012) or others. This framework demonstrates how researchers engage with non-academic audiences throughout the whole inquiry process; showing that this is a dynamic and evolving, rather than one-time delivery of expertise. What is interesting for us, is that they describe the steps of a co-creative research cycle, define its outputs and demonstrate on which societal areas research can have an impact.

Jacobi et al. (2016) describe a research cycle that consists of five steps in which research and non-academic audiences are involved from the beginning: 1) joint definition of problem and contents of the project or initiative; 2) integration of natural and social sciences; 3) integration of non-academic actors in their knowledge; 4) social learning process and joint reflection on the goals; 5) collective action for implementation. Transdisciplinary research connects different epistemologies and co-creates at least three different forms of knowledge: ”1) *target knowledge* - normative knowledge (steps 1 and 4); 2) *systems knowledge* (in the form of empirical knowledge (knowledge represented in steps 2 and 3) *transformation knowledge* - on how a sustainability program can be addressed (4 and 5) [...]” (Jacobi et al. 2022, p.109).

Findings

Stakeholder participation, collaboration between experts with diverse backgrounds and interdisciplinarity are key enablers of policy impact (Wagner et al. 2023). Although many works emphasize on the necessity of collaborative approaches to tackle societal challenges in the realm of sustainable development, they also agree that the sole fact bringing together diverse stakeholders does not necessarily guarantee that solutions will be formulated collectively in a mutual negotiation process (Osborne, Radnor, and Strokosch 2016; Pimentel, Cho, and Bothello 2023).

Obstacles to co-creation

Co-creative knowledge production increases chances of producing advice that is tailored to the specific needs and contexts of the stakeholders, otherwise expertise might not be fully applicable to specific local or contextual issues; it encourages interdisciplinary collaboration, integrating insights from various fields to address societal challenges holistically. Adaptive, iterative and inclusive processes make it possible to continuously integrate feedback from stakeholders in order to refine and improve solutions (Sarkki et al. 2014; Dilling and Lemos 2011). Despite the increased understanding that advisory knowledge benefits if it is co-produced with its end users, linear models, in which policymaking is simply informed by scientific evidence, still persist in science-policy advice (Reichmann and Wieser 2022; Durant 2015; Böcher 2016). Based on our literature analysis and the experiences of the Beirätedialog, we identified two main obstacles: 1) Procedural inconsistencies and 2) Fragmentation of knowledge.

Procedural inconsistencies refer to the different logics and that motivate inquiries in research and policymaking and different workflows: what is relevant for researchers might not necessarily be interesting for policymakers, there is mismatch in time-frames as decisions

need to be fast, and discovery and rigorous quality assurance in academia takes time (Nyboer et al. 2021; Kirchhoff, Carmen Lemos, and Dessai 2013). Relating to Jacobi et al. research cycle, policymakers and societal actors could already engage beginning from the first step of the research cycle and help define the research question bringing in their priorities; by engaging in all other steps throughout the cycle they can help match expectations, aims and adapt solutions to the ever changing political context.

The second obstacle - Fragmentation of knowledge - basically refers to the presentation of expertise to audiences outside academia. Despite calls for more openness and collaboration, scientific knowledge production has remained quite closed and fragmented (Botlhale 2023; Mačiulienė 2022). A study by the SBU (2022) (Botlhale 2023) highlights that "strong super-specialization and fragmentation of science and policy, when evidence from different relevant areas does not come together as well as the lacking overview over existing state-of-the-art knowledge is an obstacle for efficient co-creation as well. Researchers and policymakers might find it difficult to navigate this complex landscape because of its diversity.

Infrastructures for co-creation

Freiling et al. (2021) define the use of open science infrastructures not only in terms of their capacity to enhance quality control, providing access to more knowledge and supporting objectivity as a central part of research, but also as ensuring the social duty of science, making sure expertise from research benefits societal actors to a maximum. In practice such infrastructures can play a crucial role in accumulating and sharing knowledge from diverse sources e.g. in a repository, and connect information across disciplines, policy fields, domains, institutions and this way provide a better overview of the state of knowledge and existing trends (Maynard, Funk, and Lepori 2017; Stojanovski 2022).

Sticking to the described research cycle, we believe that by accumulating policy relevant research outputs in one central point of access, infrastructures can facilitate a major part of the co-creation process by: Supporting the integration of natural and social sciences (step 2) by providing an overview over existing knowledge from both areas on a particular topic (e.g. looking at what medical and educational researchers recommend during a pandemic) or stimulating the integration of non-academic actors in their knowledge (step 3) as well as social learning processes and joint reflection on the goals (step 4) by creating a direct link between researchers and policy makers. Furthermore, research repositories do not only accumulate data and research but also attempt to structure it across institutions and disciplines, they often employ dynamically extensible data models to accommodate diverse data types and metadata schemes; such metadata structures are essential for providing

context and enable data discovery if they align with the ontological characteristics of different research areas (Corradi et al. 2012; Stojanovski 2022). Relating to existing classification of policy relevant forms of knowledge proposed by Jacobi et al. (2016) research infrastructures could support science-policy co-creation by distinguishing between different knowledge types that policy documents from research contain.

Discussion and conclusion

Based on the above mentioned understanding of obstacles that hinder co-creation of knowledge production, we believe that research infrastructures can help to improve such communication processes. With their functionalities, they can be used not only to facilitate expertise and data exchange within academia, but also as a resource to bridge the gap between academic researchers and policymakers. In this respect, we bear in mind that an infrastructure is a socio-technical system, suggesting that functionality cannot be secured by providing the technicalities alone and address both obstacles - Procedural inconsistencies and Knowledge fragmentation. We identify three "building blocks" which could help establish a holistic system for co-creation by providing: 1) a central access point to knowledge outputs; 2) a common language (classification of outputs); 2) skillbuilding for knowledge sharing and knowledge usage.

Firstly, by providing a central point of access - such as a databank, or repository - to policy relevant research outputs (technical dimension). According to a recent estimate there are more than a thousand research entities in Germany (among them universities, research institutes, advisory institutes) that potentially produce policy-related research outputs for national, federal and local authorities (Kühnel 2022). Those are often referred to as "grey literature"[9], and comprise policy briefs, reports, recommendations written by researchers for the use in political decision-making (Antonopoulou et al. 2021; Lawrence 2017; Stephenson and Hennink 2002). To our knowledge, there is no comprehensive overview of research institutions that produce advice on the politics of sustainable development, but as an area that combines many political and scientific domains, among them economic, ecologic, social and cultural areas of expertise and action, we can state a major part of research advisory organizations can produce relevant knowledge. This makes it extremely difficult to keep an overview over the existing expertise and relate to it. Policymakers do struggle to access publications disseminated through academic channels, research tends to bridge this gap and produce in many cases "policy-ready" research that meets policymakers specific

[9] https://libguides.exeter.ac.uk/c.php?g=670055&p=4756572

requirements, effectively communicate findings, engage in traditional academic activities, and position themselves in political contexts (Brown 2011).

Secondly, providing a common language could help navigating through the diverse knowledge outputs (social aspect). Among the broad plethora of policy-relevant knowledge outputs, advisory institutions in Germany have the right to define themselves how they understand these terms. Many of these outputs contain the types of knowledge that according to Jacobi et al. is useful for science-policy communication: target-, system, or transformative knowledge. We believe that creating a central space that would make advisory knowledge can make science-policy interactions more efficient and transparent. Archiving alone is not sufficient as a strategy, what could be of use is uniform - standardized - definition of these types of knowledge with a description of the underlying expertise that was used can contribute to providing more awareness on the state-of-art knowledge. It can help navigate through it - e.g. policymakers would have the possibility to easily distinguish between “normative” outputs that include recommendations and “objective” findings. We believe that introducing a so-called lingua franca for science-policy interactions can help overcome the obstacle that we refer to as “fragmentation of knowledge”.

Finally, the technical infrastructure cannot do the writing of policy related documents, just as policymakers do not necessarily have a deep understanding of academic practices that would allow them to assess the quality of underlying expertise or how to interpret and understand uncertainties. This is why both sides need to have a certain skill set (social aspect) - for researchers on how to share their expertise with non-academic audiences, and policymakers on how to use it. By engaging in co-creation, researchers expose themselves to critics of a different kind–the broader public together with policymakers; used to inner-academic discussions, they might not be prepared for public negotiation logics, or public criticisms that come with a political debate. This requires for them skills not only how to formulate and share their findings through a research infrastructure, but also how to build a certain resilience and way of handling a political debate.

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