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Schafft Wissen: Gemeinsames und geteiltes Wissen in Wissenschaft und Technik: Proceedings der 2. Tagung des Nachwuchsnetzwerks "INSIST", 07.-08. Oktober 2016, München

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Schafft Wissen: Gemeinsames und geteiltes Wissen in Wissenschaft und Technik

Proceedings der 2. Tagung des Nachwuchsnetzwerks „INSIST“, 07.-08. Oktober 2016, München

Herausgegeben von
Julia Engelschalt, Arne Maibaum,
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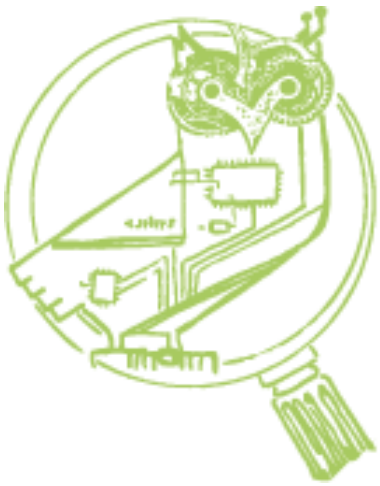

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Geleitwort

Initiiert an einem Bielefelder Küchentisch, blickt das Interdisciplinary Network for Studies Investigating Science and Technology (kurz: INSIST) auf eine mittlerweile fünfjährige Geschichte zurück. Der Anspruch der Beteiligten war von Anfang an, Nachwuchsforscher*innen, Studierenden und allen Interessierten, die sich für Fragen der Geschichte, Philosophie und Soziologie der Wissenschaft und Technik und angrenzende Felder interessieren, eine Plattform zum thematischen wie auch informellen Austausch zu bieten. INSIST versteht sich als *bottom-up* organisierter, offener Rahmen für das Ausprobieren und die gemeinsame Umsetzung neuer Ideen, als Interessenvertretung für Nachwuchsthemen und auch als Möglichkeit zum Knüpfen von Praxiskontakten.

Wie fruchtbar neben dieser Offenheit auch die Schaffung von Kontinuität sein kann, zeigt die Tatsache, dass aus der ersten INSIST-Nachwuchstagung, die 2014 in Berlin stattfand, inzwischen eine Konferenzreihe geworden ist. Am 7. und 8. Oktober 2016 fand in München die zweite Tagung mit dem Titel „Schafft Wissen: Gemeinsames und geteiltes Wissen in Wissenschaft und Technik“ statt – diesmal mit großzügiger Unterstützung des Munich Center for Technology in Society (MCTS) der Technischen Universität München.

Neben einer inspirierenden Keynote von Prof. Dr. Ulrike Felt (Universität Wien) bot diese Konferenz in zehn interdisziplinären Panels ein breites Spektrum an Themen und viel Raum für kritische Diskussionen. Alle Beiträge einte das gemeinsame Interesse an den vielfältigen Aushandlungsprozessen, denen wissenschaftliches wie technisches Wissen in verschiedensten Kontexten der Produktion und Kommunikation unterliegt. So ging es in den Vorträgen unter anderem um die Wechselbeziehung zwischen Wissen und Öffentlichkeit(en), Wissen und Politik, Wissen und Körper sowie Wissen und Digitalisierung. Daneben wurden Orte des Wissens, aber auch sozio-experimentelle Wissens(an)ordnungen und Fragen der Teilhabe an Wissen bzw. der partizipativen Wissensproduktion diskutiert. Darüber hinaus wurde die Nachwuchstagung durch eine Ausstellung mit Collagen von Laura Voss (MCTS) bereichert, die in ihrer Auseinandersetzung mit Innovation und der Produktion von Wissen und Technologie wissenschaftliches und künstlerisches Arbeiten in einen fruchtbaren Austausch bringt.

Zur INSIST-Tagungsreihe erscheint hiermit nun auch der zweite Band der Proceedings-Reihe. Ein Teil der Vorträge wurde von den Autor*innen zur Veröffentlichung ausgearbeitet und hat ein Peer-Review-Verfahren durchlaufen. Wir bedanken uns ganz herzlich bei allen Autor*innen, Reviewer*innen und Herausgeber*innen für ihre unermüdliche Arbeit – und freuen uns schon jetzt auf die dritte INSIST-Nachwuchstagung, die im Oktober 2018 in Karlsruhe stattfinden wird.

Julia Engelschalt & Franz Kather, Universität Bielefeld
Sprecher*innen von INSIST

Editorische Notiz

Die hier versammelten Beiträge der zweiten INSIST-Nachwuchstagung 2016 „Schafft Wissen: Gemeinsames und geteiltes Wissen in Wissenschaft und Technik“ reflektieren, wie auch die Proceedings zur ersten INSIST-Tagung, sowohl die Bandbreite an Themen, die aktuell in der Wissenschafts- und Technikforschung diskutiert werden, als auch die rege Beteiligung unterschiedlichster Fachrichtungen an diesen Diskussionen.

Um – bei allem Wunsch nach Interdisziplinarität – der disziplinären Verortung der einzelnen Autor*innen gerecht zu werden, haben wir uns entschieden, die Zitierweise, die bibliographischen Angaben und fachspezifischen Gepflogenheiten im Textsatz weitgehend beizubehalten und lediglich im Layout zu vereinheitlichen.

Die Reihenfolge der hier zusammengestellten Artikel reflektiert weder die zeitliche Abfolge der Vorträge im Verlauf der INSIST-Tagung, noch soll durch die gewählte Anordnung eine qualitative Wertung vorgenommen werden. Vielmehr möchten wir auf diese Weise die Vielfalt und Unterschiedlichkeit der größtenteils in deutscher und erstmals auch teils in englischer Sprache eingereichten Texte unterstreichen.

Eine künstlerische Rahmung für den Band bilden ausgewählte Collagen von Laura Voss, die während der Tagung in München ausgestellt wurden. Entsprechend beginnt der Band mit einer Erläuterung dieser Arbeiten unter dem Titel „Technologie und Collagekunst“ (*Voss*). Im weiteren Verlauf des Bandes markieren die Collagen eine lose thematische Gruppierung der Textbeiträge in fünf Schwerpunkte: Popularisierung von Wissen im historischen Kontext (*Odenwald, Bauer*); Wissen in Experimentalanordnungen (*Funk, Borbach*); Wissensgemeinschaften (*Gaentzsch, Fritz, Seitz*); Wissen und Organisationen (*Coban, Deisner & Grieser, Kressin*); und schließlich Technik und Narration (*Rothenhäusler, Meinecke & Voss*).

Wir möchten uns an dieser Stelle bei allen Autor*innen für ihre Einreichungen bedanken. Alle Beiträge haben ein anonymes Peer-Review-Verfahren durchlaufen. Daher gebührt unser Dank auch den Mitgliedern des Review-Teams für ihre konstruktiven Anmerkungen und Verbesserungsvorschläge. Für die Möglichkeit der Online-Publikation im Social Science Open Access Repository (SSOAR) danken wir außerdem dem GESIS Leibniz-Institut für Sozialforschung.

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(De-)Constructing Participation in Transdisciplinary Sustainability Research: A Critical Review of Key Concepts[1]

Livia Fritz

Keywords: participation, co-production, transdisciplinary research, sustainability science

1. Introduction

> «But now that global environmental change is threatening the Earth's carrying capacity, more scientists must take on a new role involving engagement with end-users of science. Scientists need to collaborate directly with people and business to ensure shared understanding of the new realities shaping our world, and help translate knowledge into action for sustainable development.»
> (Wilson, 2012 Executive Director of the International Council of Science)

Over the past four decades, debates have intensified questioning the capacity of 'traditional' disciplinary research to tackle the complex problems posed by societal developments. As exemplified by the introductory statement by Steven Wilson in the run-up to the Rio +20 summit, the re-conceptualisation of models of science-society relations is considered indispensable in order to respond to the «grand challenges» of our times: climate change, environmental degradation, rising inequalities within and across societies, to name but a few (European Commission, 2011). Particularly in the area of (un)sustainable development, the malfunctioning feedback between science and political action has become manifest. Along with this realisation came pledges for opening up the research process by including societal actors beyond the traditional scientific sphere, heralding the power of discursive, participatory processes in fostering innovation and societal learning. Observably, the call for rethinking contemporary cultures of knowledge production has moved high on the international policy agenda (e.g. Rio Agenda 21[2]) and partly has found its way into science funding policies, e.g. the "Science

1. This contribution is based on my PhD Proposal accepted at the Doctoral School of Architecture and the Sciences of the City, ETH Lausanne.
2. In particular Chapters 35.5. and 35.7. allude to the need for linking scientific and traditional, indigenous knowledge (http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=52&ArticleID=85&l=en).

with and for Society" programme of the Horizon 2020 of the European Commission, and international initiatives such as Future Earth. Throughout Europe, national research funding bodies have introduced funding schemes which call for the integration of different actor groups into research processes, e.g. FONA (DE), proVISION (AUT), Swiss priority programme Environment (CH, 1992-2000) and MISTRA Innovation (SE). These developments in science policy and practices have led some authors to speak of a 'participatory turn' (Bäckstrand, 2003; Chilvers and Kearnes, 2015, p. 13; Jasanoff, 2003) and 'participatory *re*turn', respectively (Wynne, 2007, p. 100).

Theoretically, these debates are captured in notions such as (i) 'post-normal science', arguing that when "facts are uncertain, values in dispute, stakes high and decisions urgent" extended forms of knowledge production are needed (Funtowicz and Ravetz, 1993); (ii) 'mode 2 knowledge production', which – in contrast to the classical 'mode 1' knowledge production – stresses that non-academic rationales are increasingly framing the production and validation of knowledge (Gibbons et al., 1994); and (iii) the 'triple-helix model', which assesses science-university-industry relations (Leydesdorff and Etzkowitz, 1998). Ideas on what this opening-up process looks like, and what it should look like, are diverse and range from citizen conferences to transdisciplinary research (TDR).

Within sustainability research, transdisciplinarity (TD), aiming at integrative forms of knowledge production, has emerged as a key notion. First used some 40 years ago by Erich Jantsch, a physicist and early complexity researcher, at an OECD conference, the notion has gained prominence in particular in the context of environmental and sustainability-related topics (Jahn, 2008). The rise in popularity, especially after the Rio summit (1992) and the official birth of sustainability science around the year 2000 (Kates et al., 2000), was accompanied by various conceptualisations of TD. Broadly speaking, two branches can be identified: sociological, actor-orientated approaches on the one hand, and philosophy of science approaches on the other (e.g Mittelstraß, 1989). In this article, actor-orientated approaches will be of primary interest. In these approaches, most authors (e.g. Hadorn et al., 2008; Scholz et al., 2006) agree on three minimum criteria according to which TDR: (1) departs from *lifeworld* problems and creates solution-orientated knowledge; (2) integrates different scientific disciplines, i.e. is interdisciplinary; and (3) includes non-scientific actors and their expertise in the production of societally relevant knowledge and steers a process of mutual learning. It is this third element of TD knowledge production, and the *participatory claim* attached to it, which is at the centre of interest of this article.

Despite the widespread call for and high expectations attached to opening up research processes by involving societal actors, fairly little is known about what constitutes different meanings and practices of participation in knowledge production. The literature on participation is widely dispersed, and more recent approaches to participation in TD sustainability research hardly rely on theoretical and practical reflections on participation developed in more established fields. In light of this discrepancy, this article follows Irwin's (2006, p. 310) proposition

to make the new "constellations the object of research itself": it asks how participation in knowledge production is constructed and problematised in different scholarly fields, and which understandings of participation underpin such forms of knowledge production. The aim of this article is to (i) bring into conversation three largely disparate scholarly debates on participation in research, (ii) critically examine widely held conceptualisations of participation and (iii) draw tentative contours of an empirical-analytical perspective on participation in TD sustainability research. This shall provide some ideas on how a shift in analytical perspectives on participation might address important gaps in the current understanding of participatory knowledge production.

The article is organised as follows: part 1 provides a review of participation in three different bodies of literature and identifies underpinning models of participation. Building on this state of research, the shortcomings of widely recited models and associated empirical perspectives on participation are critically discussed in part 2. Part 3 outlines the tentative contours of a multidimensional perspective on participatory knowledge production in TD sustainability research before concluding with a summary of general insights and suggestions for further research.

2. Tracing the meanings of participation: a review of key discourses

Questions of participation have been a matter of interest in various academic fields and public debates for decades. Broadly speaking, the literature on participation falls into two categories: literature on participation in decision-making and literature on participation in research and knowledge production. In the following depiction of the state of research, emphasis is put on this second strand of literature on participation – participation in knowledge production, research, and neighbouring fields. The focus is on TD literature as a core discourse on participation in knowledge production in sustainability research. Two related key discourses are addressed: firstly, participation in development research literature, because it enriches our understanding of the development and change component of TD sustainability research and provides valuable examples of critical reflections on participation. Secondly, participation in science and technology studies (STS), because this body of literature allows for a deeper understanding of the science and knowledge production components and provides useful insights into the entanglements of science and society and the conceptualisation of expertise. In the following, these three widely disparate scholarly debates on participation are briefly reviewed and brought into conversation.

2.1 Participation in TD sustainability research

Literature on TD is ample, but scattered over various thematic fields, spanning from medicine and public health (Choi and Pak, 2006) to architecture and urban planning (Tress et al., 2005). Hadorn et al. (2008: 27) describe TD as a 'fuzzy and contested field' which is formed by various lines of thinking and heterogeneous

conceptions of science and expertise. This heterogeneity is reflected in the co-existence of a variety of terminologies. While there is strong agreement on participation as a key element of TD sustainability research, a myriad of terms are used to designate those participating in knowledge production, including notions such as future users (Defila and Di Giulio, 2015), stakeholders (Polk and Knutsson, 2008), practice actors, lay people, and civil society actors. Attempts to assemble the heterogeneous writing can be found in comprehensive volumes by Hadorn et al. (2008) and (2012) and in Fam et al. (2016).

Within sustainability research, several interconnected strands of research on TD can be identified, each of which looks at participation from different angles. Firstly, a considerable body of literature elaborates on different ideal-types of TDR, i.e. it addresses the question of what TDR ought to be and how processes should be governed (Bergmann et al., 2012; Jahn, 2008; Scholz and Steiner, 2015). Lang et al. (2012), for instance, set up principles for guiding TDR from problem-framing to implementation. In their reading, an ideal-typical TD process consists of problem-framing, knowledge co-production and the re-integration of knowledge. Throughout these phases, participation appears as input from practice and science framing the problem to be researched, as a co-creation of knowledge by practice and scientific actors, and as a re-integration of knowledge into both societal and scientific practice (Lang et al., 2012, p. 28). Participation is hence ideal-typically thought of as a symmetrical process throughout all three research phases.

A second strand of literature reports on real-type TDR and associated participation practices. A vast number of articles focus on procedural aspects at the level of single projects or of a small set of case studies, i.e. they adopt a micro-level perspective (Steelman et al., 2015; Tötzer et al., 2011; Vilsmaier et al., 2015). Most of the case study analyses include a description of participation as one element of the process and capture the narrative of the researchers involved. A few authors (e.g. Binder et al., 2015; Di Giulio et al., 2016) explicitly include the reflections of non-scientific actors participating in TDR projects. In a quantitative review of this literature, Brandt et al. (2016) identify 'practitioners' engagement' as one of five key challenges in TD sustainability research. While practitioners were involved in most projects in their sample, only few projects gave decision-making authority to practitioners (Brandt et al., 2013, p. 6). Unlike in ideal-typical TDR, Wuelser and Pohl (2016) find that participation in the problem-framing phase is low in ten projects they studied. Following Di Giulio and Defila (2016, p. 201) this is not necessarily perceived as problematic and matches the preferences expressed by non-scientific participants interviewed, who welcome a traditional division of labour between scientific and non-scientific actors in this early project phase.

The third branch of literature is interested in setting up methods of evaluating TDR and its real-world impacts, and aims at the formation of quality criteria so as to enhance the legitimacy of participatory knowledge production in academic discourse and beyond. In these endeavours of assessing outputs and

impacts beyond academic impact metrics, participation in TD sustainability research is viewed as one element on the pathway to impact (Blackstock et al., 2007; Walter et al., 2007; Wiek et al., 2014; Wolf et al., 2013). TD, and with it the participation of heterogeneous actors in research, is seen as a means for achieving desired societal changes towards sustainability. In Walter et al.'s (2007) ex-post evaluation of the impact of TDR, for instance, participation appears as one potential influencing factor, albeit without further specification or operationalisation of the concept. A more elaborate conceptualisation of participation in impact-focused studies is Wiek et al.'s (2014, p. 124) differentiation between nature and quality of participation in TDR.

2.2 Participation in science and technology studies

Literature from the field of STS provides ample reflections on science-society boundaries, and the participation of heterogeneous actors in social spaces of science and technology has become a key concern (Abels, 2006). Scholarly interest ranges from participation in science-policy making and agenda-setting to participation in social appraisals of technology and risk assessments. Over the past four decades, industrialised societies have lived through numerous public controversies of emerging techno-scientific programmes, including nuclear power (Nowotny, 1976) and the nuclear catastrophes of Three Mile Island and Chernobyl, GMO techniques (Hansen, 2010), nanotechnology or shale gas extraction (Goldstein et al., 2016). Such controversies and political attempts to reduce public scepticism towards science and technology by allowing for 'public engagement' or 'public participation' in the governance of science and technology have attracted scholarly attention. STS contributions have shown that the opening-up of technology and risk assessment has been conceived, among other things, as a means to (re-)establish public trust in science or to foster acceptance for new technologies, and has widely echoed a 'deficit model', according to which the 'public' is imagined to have knowledge gaps that need to be filled by *better* science communication (Hansen 2010). Who belongs to those 'publics', which are included in social appraisals of technology and risks, and how they are constructed in relation to 'expertise' is subject of ongoing debate (Fineberg and Stern, 1996; Joss, 2002).

At a conceptual level, participation in technology assessment, just like TD approaches, challenges the well-established perception of a clear-cut boundary and division of labour between society and science as well as the idea that science holds a monopoly over the production of valid, trustworthy knowledge that should 'speak truth to power' (Hoppe, 1999). STS authors address participation as a form of boundary transgression and largely rely on Jasanoff's (2004) idiom of co-production. Along with that, public participation in science(-based policy making) triggered a series of debates on how to demarcate different forms of knowledge and expertise (Beck, 1992; Demeritt, 2015; Jasanoff, 2003). In a widely cited (though not uncontested) article, Collins and Evans (2002, p. 249) aim at dissolving the boundary between certified (scientific) and non-certified

(non-scientific) actors, and introduce the term 'experience-based experts' to designate those public actors who have special expertise in virtue of experience.

TDR and the participation of non-scientific actors in research projects has also attracted the attention of STS scholars, representing the most direct overlap with literature on TD sustainability research. Building on ideas of 'mode 2' (Gibbons et al., 1994), in an analysis of TDR projects Felt et al. (2016) challenge ideal-typical imaginaries of participation and ask to which extent participation constitutes a practice of boundary transgression. They assess (dis)entanglements between practice and scientific realms and find different models of how researchers and practice actors (re)define science-society relations. i) Linear translation model: scientific and societal arenas remain largely separated. Researchers are powerful actors in shaping what is to be regarded as a societal problem and knowledge is then translated to society. (ii) Delimited neutral arena model: temporal zones of encounters are established between the research and the problem-related area. Participating societal actors are regarded as gatekeepers who hold some specific, experimental knowledge or have access to data. (iii) Temporary shared epistemic arena model: the research arena is functionally delimited but partly overlaps with the problem-related arena with regard to producing, reflecting, and integrating knowledge. Participating societal actors appear as knowledgeable agents (Felt et al., 2016).

In *Remaking Participation,* Chilvers and Kearnes (2015) gather diverse facets of STS scholarship on participation and propose to rethink public engagements with science and environmental issues as diverse, emergent and in the making. The authors were motivated by "[...] the almost breathless celebration of the transformative potential of participation followed quickly by arguments for more participation" (Chilvers and Kearnes, 2015, p. 14). What they identify as missing in the dominant discourse – and this goes in line with the argument presented in this article - is a sustained attempt to not take participation for granted, but to understand how participation is constructed and in the making. Despite the fact that several of the here mentioned topics discussed in STS are relevant for thinking about participation in TDR, with a few notable exceptions cross-referencing between the two fields is rare.

2.3 Participation in development research

Within development studies – an interdisciplinary field interested, among other things, in societal changes in the Global South and closely associated with real-world actions – there has for decades been a tradition of participation in research and research-based development practices. Not least as a reaction to the sobering results of decades of development co-operation matched with the emergence of post-colonial thought (e.g. Said, 1978), the call for the inclusion of local/indigenous knowledge has entered development research long before it was labelled 'transdisciplinary'. Practices of Rapid Rural Appraisal (RRA) and, in particular, Participatory Rural Appraisal (PRA) emerged from the 1970s onwards. While the former developed tools for better grasping local knowledge (Chambers, 1994,

1974), the latter more radically aimed at reversing roles and shifting the perspectives from outsiders to insiders and stressed the importance of local actors as holders of valid contextualised knowledge (Brutschin and Wiesmann, 2003).

Influenced by the writings of Lewin (1946) and relying on the work of Freire's *Pedagogy of the Oppressed* (1970) and Boff's early liberation theory (1979), proponents of participatory methods and Participatory Action Research (PAR) questioned the dominant top-down practices that characterised much of development planning, research, and thinking. Participation has been seen as a means to ownership and empowerment of individuals and communities and, in turn, as a prerequisite for lasting change (Whyte, 1991). In the meantime, this initially radical critique of development practices and research has been mainstreamed in international development and incorporated into projects and programmes of governments and international organisations (Parfitt, 2004).

With this widespread adoption of participatory approaches in development practice, concerns grew that participation was not the panacea many claimed it to be (Christens and Speer, 2006). Critical perspectives on the concept and practice of participation and participatory development are provided, most prominently, by Kothari and Cooke (2001), Hickey and Mohan (2004) and Cornwall and Coelho (2007). Broadly speaking, different criticisms can be grouped into two branches: i) an internal critique of techniques and methods which aims at improving practices of participation; ii) a more fundamental critique which stresses power effects of participatory discourses (Williams, 2004, p. 559).

In addition to this rich experience with participation practices under different headings, development literature provides practical examples of and critical reflections on TDR (Habermann et al., 2013; Witjes et al., 2012). With the exception of few authors (e.g. Wiesmann et al., 2011), sustainability research scholars rarely refer to experience with participatory approaches in development research and vice versa. Yet, the goals, dynamics and normative aspirations might be comparable and could render an integration of these respective research bodies fruitful. Relying on experiences with participation within development research gives valuable input for improving our understanding of participation in knowledge production for societal change.

2.4 Of ladders and flows: deconstructing 'models' of participation across fields

The rough literature overview given above indicates the various discourses on participation in science and (societal) development and suggests that participation has been brought forward in reaction to different kinds of problems. Put simply, TD sustainability research identifies mismatches between what we know and what we do; development research, on the other hand, observes a lack of ownership and empowerment and, with regard to technology assessment, STS literature problematises a decreasing public trust in science and technology. The common answer to those and other problems is seen in the participation of various actors in the respective process.

Accordingly, participation is a polyvalent term, occurs in different shapes, is associated with multiple ends, and has come to mean different things to different people. Combined with a variety of nouns, the term 'participatory' has been loaded with diverse social, political and methodological meaning. Broadly speaking, the manifold ways of making sense of participation can be contextualised in two historically parallel developments: growing public engagement in environmental decision-making in the global North, and action-orientated approaches to community participation of marginalised groups in the Global South (Lawrence, 2006, p. 282). Yet, are there any common grounds when we speak of participation TD sustainability research, development studies, and STS?

Across the three fields, several authors take up and further develop a particular vision of participation which goes back to the *Ladder of Participation* by Arnstein (1969). Her ladder is probably the most popular typology upon which many of today's conceptualisations of participation in various fields are built (Huxley, 2013, p. 1533). Relying on her experiences as a community worker in the US of the 1960s, Arnstein (1969) categorises eight uses of the term participation and arranges them in a ladder pattern, with each rung corresponding to the extent of citizen power: manipulation and therapy (non-participation); informing, consultation, placation (tokenism); partnerships, delegated power, and citizen control (citizen power). While numerous scholars have renamed the rungs of the ladder for their purposes, Arnstein's model instilled a particular vision of participatory progress, whereby climbing up the ladder is accompanied by a redistribution of power from the power-holding bodies to the to-be-empowered citizens (Chilvers and Kearnes 2015: xvi). This implies a realist understanding of power as a commodity which can be held by actors and exerted by one actor over another (Hayward, 2000).

In the literature on TD sustainability research, the underpinning model of participation is hardly ever elucidated. Among those authors who make their understanding of participation explicit, different approaches exist. For instance, Stauffacher et al. (2008) conceive participation, in reference to Arnstein, as intensities of involvement of non-scientific actors throughout a project cycle. With the help of this functional-dynamic model, they analyse (and propose to design) the intensities of involvement in a TD case study along the axes of information, consultation, cooperation, collaboration, and empowerment. Conceptualisations of participation specifically for the context of knowledge production have been provided by Defila et al. (2006, p. 216) as well as by Boeckmann (2005). With slight variations, they describe participation as a continuum ranging from non-scientific actors being the object of research/being informed to being a partner on equal footing/actively shaping the process. Both establish an indirectly proportional link between the number of people involved and the intensity of their involvement. In a similar vein, adaptations of the Arnstein typology can be found in the field of development studies. These include Pretty's typology (1995, p. 1252), which speaks to the user of participatory approaches and conceptualises motivations as an important factor in shaping interventions, and White's (1996)

typology of interests, which aims at unfolding conflicting ideas about how participation is being used throughout a process. Burgess and Chilvers (2006, p. 719) show that in the literature on participation in governance of science and appraisal of technology, too, three to four-stage classifications of participatory processes based on Arnstein's ladder have become widely used.

Stirling (2008, p. 268) argues that one common feature of participation and its analysis lies in the importance of intentionality attached to it. Analytical attention has been focused on the motivation underlying participation practices. Most prominently, Fiorino distinguishes between three imperatives underwriting participatory practices: normative (participation as an end in and of itself), substantial (participation aimed at achieving better ends), and instrumental (participation aimed at securing particular interests/ends) (Fiorino, 1989), each of which result in different forms of participation. While the first is process-orientated, the latter two focus on outcomes (Stirling, 2008, p. 269).

Alternatively to models based on degrees of involvement, Rowe and Fewer (2005) focus on the *nature of involvement*. They identify three forms of public engagement according to the flow of information: public communication (one-way communication), public consultation (one-way communication in the opposite direction), and public participation (two-way communication). In the field of STS, further suggestions on how to capture participation reflecting the 'acceptability' or 'trust' problem in the public include: Nelkin and Pollak's (1979) distinction between participation as advisory, as public consultation, and as information; or Chilvers' (2007) division into non-interactive, interactive, and active forms of participation.

Field / *Axes of comparison*	**Sustainability research**	**STS**	**Development research**
Important literature sub-fields on participation	actor-orientated branches of TDR	participatory technology and risk assessment, public engagement	participatory rural appraisal, participatory action research
Main "problem" to be addressed by participation	complexity of *lifeworld* problems; gap between knowing about unsustainable practices and acting accordingly	lack of trust in science and new technologies	lack of ownership and marginalisation
Actors / "invited publics"	'practice actors' (often institutionalised actors such as municipalities, companies, NGOs)	the 'public'	concerned individuals, communities
Exemplary typologies of participation referred to	functional-dynamic model by Stauffacher et al. (2008); continuum of participation by Defila et al. (2006) and Boeckmann (2005)	participation as flow of information by Rowe and Fewer (2005)	Pretty's typology (1995); White's (1996) typology of interests
Exemplary contribution to other fields	guidance in process design and choice of methods for involvement of non-scientific actors	reflexivity, 'construction' of expertise	critical analyses of power in and through participation processes

Table: Schematic comparison based on scoping literature review.

3. Critical reflections

In the previous part, the current state of research on participation in TD sustainability research were briefly discussed and key works in the bordering fields of development studies and STS were taken into account. Upon that basis, I described common notions and typologies of participation. In the following, I engage in a critical discussion of these conceptualisations of participation and their implications for empirical analyses of participation, particularly in TD sustainability research.

3.1 The predominance of ideal-typical imaginaries of participation

In the field of TD sustainability research, ideal-typical imaginaries of participation in knowledge production prevail while a critical perspective is widely lacking. The term participation has become a buzzword, or, as Renn labels it, a 'dazzling term' (Renn 2005 quoted in Scholz, 2011, p. 388), which is mainly positively connoted, associated with democratic values, empowerment, public trust, and a higher probability of inducing societal change. Linked to this, many approaches to participation implicitly adopt normative models that assume a 'correspondence theory' of an external 'public', which is imagined to be in a natural state and waiting to be mobilised by participatory methods (Chilvers and Kearnes 2015). The notion of participation per se, however, does not say much about *who* is entitled to participate in which ventures, and in which ways. Participation in knowledge production as such neither tackles questions of representation, nor does it ensure the quality of the findings (or even superior quality, as compared to non-participatory processes). Weingart (1997, p. 611) speaks of a "[...] romanticized appeal of the higher rationality of lay knowledge". Many accounts of participation echo Habermasian ideals of discursive democracy (Cornwall and Coelho, 2007, p. 79) and are normatively guided by principles of ideal speech situations as laid down in Habermas' *Theory of Communicative Action* (1981). In this regard, analytical approaches privilege consensus-orientated over conflict-sensitive perspectives on participation. Yet, participatory sustainability research is embedded in wider societal struggles for defining what sustainability is, and how it can be achieved. While sustainable development is considered a 'vision shared by all' and participation in TDR is expected to contribute to fleshing out this vision, transformation is not merely a question of the right management principles, but as such a deeply political endeavour that might be contested (Brand 2016). Which changes are perceived as desirable and feasible is the result of negotiation processes that reflect societal power relations as much as perceptions of society-nature relations. When it comes to concrete ways of framing and solving sustainability problems, different societal actors express varying and sometimes even incommensurable values and perspectives (Polk and Knutsson, 2008; Popa et al., 2015). Here it is assumed that this plurality of values and perspectives is traceable in sustainability-orientated research, and that it has an impact on the participation process. This entails moving beyond conceiving participation in TD sustainability research as a mere managerial-organisational challenge and

towards conceptualising it as an intrinsically political act (Cornwall, 2008, p. 281). While critical perspectives, for instance, on power within and through participation have gained considerable attention in development studies (Cooke and Kothari, 2001), they have only recently begun to emerge in fields more closely associated with public involvement in science and environmental risk, including sustainability research and STS (Chilvers and Kearnes, 2015). As of now, within the body of literature more narrowly focused on TD sustainability research, critical approaches are marginal, illustrating the potential benefits of bringing these different research fields into conversation.

3.2 Output-orientated (self-)reflections prevail over process-orientated empirical analyses

In reaction to the rather poor empirical basis upon which the high expectations towards TD approaches for sustainable development are grounded (Felt et al., 2012), many current contributions focus on the outputs, impact, and outcomes of TD sustainability research, and tend to regard participation as an input. Participation is frequently portrayed as a means to achieve a certain end (societal change), rather than as a dynamic social process in its own right, with various interpretations and uncertainties. Literature on TD sustainability research hardly addresses the ways in which, for instance, worldviews of the respective actors, the availability of resources, or the perceptions of expertise shape participation. Accordingly, little is known about causes hampering participation and co-production of knowledge, and insights into how different contexts affect participation and, in turn, the societal impact of a project are rare. Methodologically, most of the empirical literature on TDR is based on an in-depth analysis of individual projects, while more aggregated and comparative analyses are scant (Zscheischler and Rogga, 2015). Most of these (self-)reflections are partial in the sense that they speak from the standpoints of the scientific actors, while the perspectives of non-academic participants are seldom adopted.

3.3 Linearity and one-dimensionality

Several of the models of participation reviewed originate in the field of (urban, community) planning and were primarily designed with an interest in processes of decision-making and governance, quests for empowerment, or the planning of interventions. They are not based on experiences with participation in knowledge production and the inclusion of different epistemes in research processes. The short, non-exhaustive, review of typologies of participation referred to in the three bodies of literature suggests that linear, one-dimensional models and typologies of participation dominate. Their linearity is manifest in the implicit 'the more participation, the better' logic emblematically illustrated by the metaphor of ladders. They are one-dimensional in the sense that participation appears as a function of the degree of transfer of power which is intentionally handed over by the power-holding actors. In so doing, they rely on a classical understanding of power as 'power over', e.g. the 'powerful' transferring (or not) some of their power

to the initially 'powerless'; more relational and discursive forms of power are widely neglected. A post-structuralist approach would, for instance, suggest to understand power as various effects stemming from both intentional and unintentional practices and discourses of participation (Cook et al., 2013).

The ways in which participation is conceptualised arguably has repercussions on the empirical perspective applied to understanding participation practices. While the predominant typologies described provide a valuable starting point for thinking about types and degrees of participation in research and knowledge production, they fall short in explaining why participation plays out differently in different contexts. By and large, descriptive accounts are privileged which focus on the 'what' of participation, while the 'how' and 'why' of different forms of participation are under-researched. Beyond motivations and intentions, there is little systematic knowledge of the factors that form participation processes in TD sustainability research.

4. Contours of an alternative perspective: constructing spaces of participation

In this article, the ways in which participation is addressed in three scholarly fields were reviewed, and widely held conceptualisations of participation were critically reflected with regard to their repercussions on empirical approaches to participation practices. The comparative discussion of the fragmented literature on participation in TD sustainability research, development studies, and STS has shown that the notion of participation is loaded with various meanings and is mostly normatively connoted. While attempts of categorising and assessing participation along ladder patterns are abundant, the question of why different intensities occur largely remains unanswered. Different forms of participation appear as a result of the intentions and goals of those setting up the process; empirical perspectives are predominantly focused on the outputs rather than the processes of participation, and are guided by ideals of deliberative democracy. I therefore want to conclude this article with some thoughts on how the 'what' of participation (expressed in intensities) could be complemented with research on why these different shapes of participation materialise. Shifting perspectives away from the imaginaries of ladders might bring to the fore different kinds of questions for empirical enquiries into participation practices.

In the following, a tentative analytical perspective is outlined which is sensitive to the role of various factors shaping participation in TD sustainability research. Moving beyond linear, one-dimensional representations of participation, I here propose to conceive of participation as a *relational space* characterised by the duality of agency and structure (Löw, 2013). Following this idea, in participation processes the actors involved enter a social space which they actively create, but which is also co-constituted by the surrounding social structures and norms. Literature in the three fields reviewed here provides some spatial analogies, not directly focused on participation, but on related aspects of science-society

relations. With their concept of 'mode 2', Nowotny et al. (2001), for instance, suggest that the epistemological boundaries between the fields of science and society at least partially dissolve. At the intersection of the realms of science and other societal fields, a new common space emerges which they call the *agora*. In reference to the Greek "political arena and the market place", they describe the interface as "a public space in which 'science meets the public', and in which 'the public speaks back to science'" (Nowotny et al., 2001, p. 247). Other scholars rely on symbolisms of space as an analytical perspective on social processes. For instance, Felt et al.'s (2009) *epistemic living spaces* and Cornwall's (2004) *spaces for transformation* provide ideas on how to conceptualise participatory practices as a space.

Transferring elements of those concepts to the case of participation suggests that such spaces are shaped by miscellaneous factors, related both to their embeddedness in the respective societal fields as well as to the actors involved. Conceiving participation as a relational space allows us to understand different shapes and intensities not merely as a function of the intentions of the 'architects of participation' (Felt et al., 2012, p. 6). It also draws attention to the forces of the wider scientific and practice fields within which individual engagement situations are embedded, and hence urges us to take into account the power relations inscribed, the ascription of roles, expertise, and identities amongst those who participate. An analytical approach focusing on spaces of participation might guide an empirical analysis of the dimensions that constitute practices of participation and shape their fabrication. The resulting multidimensional approach directs analytical attention to factors on different scales, from institutional and structural ones to factors at the level of individual actors or collectives, and suggests that we look at their inter-relations. In so doing, it complements existing perspectives on both the 'what' of participation and on the outputs of participation, and helps us to move beyond the sole focus on the engagement situation by taking into account its embeddedness in the wider political economy of knowledge production.

While the literature in the three fields introduced above suggests that several elements are involved in the making of participation, these need to be systematically brought together. In addition, empirical research is needed to elucidate the way in which the actors involved conceive of participation, and what they perceive as participation-related factors. Future research should aim at widening the empirical basis on the factors constituting spaces of participation, move beyond single case study approaches and self-reflections, and take into account the perspectives and standpoints of both scientific and non-scientific actors in the making of collaborative knowledge production projects in the field of sustainability.

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