

## Transdisciplinary research and design – Editorial

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### Abstract

This editorial summarizes the background and findings of the First Mini-Conference on Transdisciplinary Research and Design (TRaD 2022) held in Oulu. We describe the aim and vision of the conference, the conference theme, the articles presented and published in the conference proceedings, and the history of the research groups organizing the conference. Furthermore, in the editorial we highlight the main findings in relation to the conference aim. We discuss the conceptualization of transdisciplinarity and directions for further research and collaboration on this topic.

### Keywords

Transdisciplinarity, transdisciplinary research, transdisciplinary design, transdisciplinary education, nexus analysis, human-computer interaction, human-centred design, HCI, design, STEAM, design-driven language education, diversity, participatory approach.

## 1. Introduction

The Mini-Conference on Transdisciplinary Research and Design (TRaD 2022) was organized on 14th February 2022 as an online event at the University of Oulu, Finland. This was an inaugural event gathering presenters and research presentations from a broad spectrum of disciplines: information systems, human-computer interaction, information technology, product development, environmental engineering, architecture, engineering, fashion design, language studies, and education.

The conference was arranged by the INTERACT Center for Transdisciplinary Research (<https://interact.oulu.fi/ctr>) in collaboration with EveLINE, a multidisciplinary research group at the University of Oulu (<https://nexusunioulu.wordpress.com/people/>). Over twenty years, the organizing groups have shared an interest in people's (inter)actions and agency in technology-rich everyday life, and transdisciplinary research.

The aim of the conference is to promote and advance the state of the art in transdisciplinary research. The conference vision is to bring together researchers from different academic fields to discuss and explore issues and questions related to experiences and understandings of transdisciplinary work in research, design, and education. We think TRaD 2022 was successful in accomplishing both the stated aim and vision with its contributions to the literature and the clarifications of transdisciplinarity during the live dialogue between participants. The conference included *five paper presentations* (which are highlighted and cited in this editorial), online discussions on the presented topics, and interactive annotations on the Padlet online tool. The participants included doctoral researchers, professors, senior researchers, lecturers, and practitioners from universities and companies in Finland, Germany, and the United Kingdom.

The conference started with an introductory talk by Professor Netta Iivari, head of the INTERACT Research Unit and the Center for Transdisciplinary Research. This was followed by a presentation by

Leena Kuure, Netta Iivari and Marianne Kinnula on transdisciplinary research conducted within EveLINE research group. The five paper presentations were grouped into two sessions. The first session started by a paper about transdisciplinary innovation and education through Science, Technology, Engineering, Arts and Mathematics (STEAM) (see **Durall et al., 2022**), and continued by a paper on mapping the divergent perspectives surrounding Finnish hydropower and its removal (see **Patro et al., 2022**). In the second session, the first paper considered transdisciplinarity in Human Computer Interaction (HCI) (see **Rajanen & Rajanen, 2022**), while the second paper discussed diversity in product teams presenting a discourses survey on the topic (see **Hekanaho, 2022**). The third paper addressed design-driven language teacher education as a transdisciplinary field (see **Kuure et al., 2022**).

The papers presented in the conference are included in this volume proceedings. Thus, the TRaD 2022 Proceedings comprise original short papers that have not been previously published elsewhere. The papers were selected for presentation in the conference through an open call for papers (see section 4). The papers were discussed by the participants during the conference sessions live in Zoom, through written annotations in Padlet, and in the final session by the conference organizers and participants. Conference organizers (i.e., the authors of this editorial) further reviewed the papers and provided written feedback and suggestions for the final versions.

## 2. History

The INTERACT Research Unit was established officially in 2015 as a research unit within the Faculty of Information Technology and Electrical Engineering (ITEE) of the University of Oulu, but it has a long history of operating as a research group inside the then Department of Information Processing Science (now the Degree programme of Information Processing Science). The INTERACT Research Unit provides research and education in human-centred design and digitalization. The research focuses on three strategic areas, namely, Politics of design, Digital transformation, and Usability and user experience. The research is positioned at the intersection of Information Systems (IS) and HCI. It involves a strong emphasis on Scandinavian values, and draws on qualitative, interpretive, critical, and participatory research methodologies. In recent years, the research has also started to pay attention to different kinds of societal issues, such as school bullying, through inclusive and empowering processes of design and making.

The Center for Transdisciplinary Research (CeT) was established by the INTERACT Research Unit in 2018 based on strong, multidisciplinary research collaboration for more than twenty years within the EveLINE research group at the University of Oulu. Aiming to strengthen and make this collaboration more visible and institutionalized, CeT focuses specifically on promoting transdisciplinary research and design to address the emerging global challenges of the increasingly digital world that we live in and shape through our participatory processes. CeT addresses two strategic focus areas of the University of Oulu: 1) digital solutions in sensing and interaction, and 2) understanding humans in change. As the transdisciplinary approach often means cross-boundary collaboration, it is challenging in itself. Therefore, the transdisciplinary approach requires discussion among participants to understand and transcend these various challenges. The CeT members are engaged in a broad range of activities to advance transdisciplinary research and design, e.g., organizing events (workshops, conferences, seminars), developing novel approaches and understandings, publishing research articles, carrying out research projects, and networking locally, nationally, and internationally.

One of the important threads in the emergence of CeT is EveLINE – a research group that launched its collaboration at the beginning of the 2000s along with the strong wave of digitalization in Finland. The group initiated its work in a virtual university project established to promote research guidance on all levels of university education as a joint venture of participants from different faculties. The work involved workshops on theoretical and methodological issues, online sprints in study circles, and discussing participants' thesis manuscripts in different phases of the research. After the two-year funding period, the collaboration was integrated in the daily work of the participants in academia and became more directly oriented to research. An important source in this work was an international “discourse nexus summer school” organized in 2004 by professors Paul McIlvenny and Pirkko Raudaskoski at Aalborg University, with guest speakers and facilitators including Prof. Ron Scollon

(Georgetown University, USA). Nexus analysis involving a mediated theory of social action and a participatory research strategy (Scollon, 2001; Scollon & Scollon, 2004) explored at that event among other topics was something that became a central theoretical and methodological framework binding researchers from various disciplines together. EveLINE was established as a research group in 2008, around the theme of everyday life in technology-rich neo-communities which started appearing as a central focus for projects and events of different kinds.

### **3. CeT and EveLINE approaches to transdisciplinarity**

CeT and EveLINE approaches to transdisciplinarity heavily rely on nexus analysis, a research strategy and theoretical lens deriving inspiration from various disciplines and traditions, most notably linguistic and anthropological fields, including conversation analysis, critical discourse analysis, semiotics, multimodal discourse analysis, and ethnography, but also practice theories, and activity theory, among others (Scollon & de Saint-Georges, 2012). Nexus analysis, to start with, approaches phenomena in our everyday life as complex entanglements of social action and practices that evolve in situ but echo at the same time discourses across wider timescales – this suggests that examining nexus of practices requires a multiplicity of foci, methodologies, and theoretical perspectives – and therefore also expertise of different kinds combined for achieving a deeper and also holistic understanding of what is going on. Transdisciplinarity is required from single researchers, on one hand, to approach the complex phenomena they study with open eyes, acquiring more expertise and understanding from different fields. On the other hand, transdisciplinarity is needed by joining the expertise of researchers coming from different fields – and that, again, requires openness to detach themselves from their own familiar ways of doing research and entering progressive dialogue, exploring new approaches to understand the complex phenomena better and in new ways.

In EveLINE we have carried out studies on transdisciplinary research, design, and education (e.g. Iivari, 2019; Iivari & Kuure, submitted; Keisanen & Kuure, 2011; Kinnula et al. submitted; Kuure et al., 2016, 2020; Molin-Juustila et al., 2015). These studies emphasize complexities associated with transdisciplinary work, within which various kinds of histories, experiences and expertise become articulated, advocated, and acted upon, and where participants bring with their historical bodies diverse epistemologies, methodologies, values, practices and assumptions to the joint endeavour. Different kinds of relationships, alliances, interaction orders become established, enacted, and negotiated among the participants, with divergent discourses circulating around and shaping the joint endeavour. The institutional contexts that intersect in the collaboration both limit and open possibilities for the work, and influence the participants, who search for their zones of identification within their own institutional contexts as well as in relation to others. We call for critical reflection on our (transdisciplinary) research, design, and education practices: we should be reflecting on what kind of researchers, designers, and educators we are and what kind of associated practices and values we carry with us, advocate, and allow to speak through us.

### **4. What is transdisciplinary research, design, and education?**

The idea of the *Mini-Conference on Transdisciplinary Research and Design (TRaD 2022)* was born from our wish to invite a broader community interested in the topic of transdisciplinarity to discuss and reflect on the topic with us. Our call for papers invited submissions based on *empirical studies or that provide theoretical and/or methodological discussion* on the conference theme. Papers which reflected on the *experiences* of doing transdisciplinary research were also welcome. In this first edition of the conference, we especially encouraged submissions addressing questions of the following kind:

- What is transdisciplinary research and/or design?
- What (novel) approaches are used?
- What challenges and/or good practices have been encountered?
- What notable results are there to learn from?

In addition to these topics, we also welcomed submissions that would discuss and explore research experiences and perspectives on any issues and questions relevant to advancing transdisciplinary research and design. Papers had to cite relevant published work and clearly indicate the importance of the submission to transdisciplinary research and design. Furthermore, the conference discussion also included reflections on transdisciplinary *education*, strengthening the transdisciplinarity of the University of Oulu, and brainstorming ways to collaboratively contribute to the state of the art on transdisciplinary research, design, and education.

In the following we summarize the results of the conference by shortly analysing the papers through the lenses of the call's questions.

#### **4.1. TRaD insights on what transdisciplinary research, design and education mean**

Transdisciplinarity seems to be a difficult concept to define. Different researchers view transdisciplinarity through their own experiences and many use the term without thinking of it deeply. It is easy to mix or interchange transdisciplinarity with multi-, inter- and cross-disciplinarity. A common view is that more than one discipline is involved, connected, and built upon, but how transdisciplinarity stands out from the other approaches and how it is performed are things that need to be clarified. In the following, we clarify the term based on the conference papers and discussions.

Mikko Rajanen and Dorina Rajanen in their paper “**Transdisciplinarity in HCI**” identify the origins of the term “transdisciplinary” back to Piaget in the 1970s (Nicolescu, 2005; Cole, 2019). The paper outlines and reflects upon the concepts of transdisciplinarity, HCI, and transdisciplinarity in HCI. Transdisciplinarity is different from multi-, cross-, and inter-disciplinarity in that it builds knowledge *beyond* the academic disciplines, *across* them, and *between* them (Nicolescu, 2014). Thus, transdisciplinarity is not confined within one or more disciplines but seeks to cover realities that are ontologically situated between the existing academic discourses, beyond them and across them. In the HCI field, transdisciplinarity is driven by the design-orientation of the field. The HCI field contributes with new designs to the socio-technical landscape and new realities are formed that need to be understood, integrated, and improved in all their complexities.

Epari Ritesh Patro, Outi Autti, Sahand Ghadimi, Jenni Hakovirta, Päivi Magga, Anu Soikkeli and Ali Torabi Haghighi in their paper “**Mapping the divergent perspectives surrounding Finnish hydropower and its removal**” view transdisciplinarity as offering sustainable solutions to problems that have multiple objectives of different nature that are defined by stakeholders with different backgrounds (e.g., “Dam removal is inherently transdisciplinary effort, multiple objectives are at stake and have to be addressed concurrently.”). The transdisciplinary approach proposed in the paper builds upon and extends environmental engineering and architecture approaches to “better understand some of the conflicting viewpoints evident in discipline-based approaches of narratives over the implications of the hydropower dams.”

Eva Durall, Claudia Carter and Kathryn Burns in their paper “**Transdisciplinary education and innovation through STEAM**” define transdisciplinarity by the following three main characteristics: Research addresses a realistic setting, deals with complex problems, and works across, between, and beyond disciplinary boundaries. Accordingly, transdisciplinarity breaks down disciplinary barriers “through reaching out to external knowledge (such as policy making and practice knowledge, or local and indigenous knowledge).”

Leena Kuure, Tiina Keisanen and Riikka Tumelius, discussing “**Design-driven language teacher education as a transdisciplinary field**”, define transdisciplinarity as transcending traditional disciplinary boundaries. In the humanities involving technology-development for language education, transdisciplinarity often refers to envisioning and applying alternative ways of thinking, learning, and teaching. Furthermore, quoting Colpaert's (2018) definition, they characterize transdisciplinarity as the “ontological specification of knowledge constructs on a higher, boundary-transcending level of abstraction” (p. 485).

Finally, Minna Hekanaho in her paper “**Diversity in product teams – A discourses survey**” views transdisciplinarity as “uncovering knowledge that might otherwise fall between disciplines”, a feature also identified in the other papers.

In summary, based on the proceedings of the conference, we can conclude the following about the nature and character of transdisciplinarity:

1. *Transdisciplinarity is an approach that is evolving as the result of new challenges in society and of the need to address these challenges.* For example, in HCI new designs and interactions with the increasingly digitalized environment require new approaches and thinking outside the boundaries of the disciplines that have traditionally built the theoretical and methodological foundation of the field. Similarly, researchers and practitioners in the fields of environmental engineering, design, language studies, educational sciences, and product development, encounter new challenges, conflicting views, complexities, and broad implications of their work that require new and transdisciplinary approaches.
2. *Transdisciplinarity builds knowledge beyond one or more academic disciplines, across them, and between them.* Thus, transdisciplinarity is not confined within one or more disciplines but seeks to cover realities that lie ontologically between existing academic discourses, beyond them and across them.
3. *Transdisciplinarity reaches external sources of knowledge outside of academic disciplines* (e.g., indigenous communities, alternative sources, arts, shared understandings). This relationship is bidirectional; transdisciplinarity benefits from and contributes to knowledge outside the academic domain. This means that researchers reach out beyond the academia when engaging in transdisciplinary research, but also that transdisciplinary research has the capacity to enable researchers to reach other areas of life (e.g., in comparison to inter- and multi-disciplinarity or just any field-specific research). Furthermore, by reaching out to other sources of knowledge, such as indigenous communities, the arts, alternative sources and shared understandings, we highlight the importance of participatory approaches to engage research participants ('outside of academic disciplines') to act as co-researchers and actively participate in creating new knowledge instead of being only objects of research.
4. *Transdisciplinarity defines and explores new theoretical and empirical constructs at higher levels of abstraction* (e.g., society, community, cultures, values) *and transcends existing disciplinary discourses* (for example, with innovative theoretical, empirical, technical, or methodological constructs).

## 4.2. TRaD insights on (novel) transdisciplinary approaches used

The five TRaD 2022 papers identify and discuss various approaches of how transdisciplinary work is carried out. These can be specific to their analysed context and level of analysis (i.e., HCI, environmental engineering and its social impact, language education, product development, higher education in science and arts) but can also be explored in other contexts in the future.

In the HCI context, Rajanen and Rajanen identify two approaches on transdisciplinarity: one that builds on *a theoretical, epistemological and axiomatic perspective of science*, and another that is operationalized at individual level, the so-called *polymath approach*. In the first approach, HCI is viewed as "having different layers of reality within the socio-technical context" whose dynamics can be observed and researched by crossing discipline boundaries. The polymath approach is related to education and, specifically in HCI higher education, aims at providing HCI students with "a wide variety of skills, experiences and expertise to create a holistic understanding" of the HCI practice and the socio-technical landscape and requirements.

When discussing hydropower rehabilitation and removal, Patro et al. identify both qualitative and quantitative approaches to gain understanding of the multiple views and objectives of the different stakeholders involved. *Participatory approaches* to involve local stakeholders in the specification of the local knowledge and requirements as well as *quantitative evaluation of multi-faceted decisions* are among the solutions explored by the research team.

Durall et al. parallel transdisciplinary education and innovation with STEAM approaches and discuss different strategies used in twelve cases where STEAM was implemented. Among the strategies used, they identify *framing* to allow participants to employ creative thinking, collaboration, and

participatory practices; *exploration* of new concepts and methods; *addressing real-world challenges*; and searching for and developing *innovations*.

In a language teacher education context, Kuure et al. address transdisciplinarity through the concept and practice of design-driven education. *Design-driven education* started as a project- or problem-based approach to language teacher education and was the result of collaboration with information technology and language technology companies, and university units in engineering, human-computer interaction and participatory design. Design-driven education implies that the learning process uses a design process model that includes stages starting from “problem-formulation, background research, ideation, concept generation and prototype preparation to experimentation with schools or other contexts for language learning”.

In product development, Minna Hekanaho addresses the transdisciplinarity of development teams through *the concept of diversity*. Thus, the paper identifies a practical way to approach transdisciplinarity by including people with diverse backgrounds in a project. The paper critically analyses selected cases by utilizing a discourse lens to identify how diversity is recognized and utilized – or not.

### **4.3. TRaD insights on challenges and/or good practices encountered**

All papers have identified challenges in addressing transdisciplinary research, design, and education such as complexity of the issues, conflicting views of different stakeholders, difficulty of collaboration between different stakeholders and practitioners, and urgency of acting and exploring solutions. Complexity is seen across the papers in the interleaved social, economic, technical, and ecological variables, actions, and impacts.

Good or promising practices have been identified in terms of *methods of analysis* (nexus analysis in the paper by Kuure et al.; discourse analysis and double expert role in the Hekanaho paper; multi-facet decision making in the Patro et al. paper), *participatory approaches* (Kuure et al.; Patro et al.; and Durall et al.), *education* (multidisciplinary HCI education in the paper by Rajanen and Rajanen; design-driven education in Kuure et al.; STEAM education, arts and design thinking in Durall et al.). *Design* is also seen in many papers as a cornerstone towards achieving the goals in transdisciplinary projects (see Rajanen & Rajanen; Kuure et al.; Durall et al.). In the other two papers, design is part of the development and engineering processes (see Patro et al.; Hekanaho).

### **4.4. TRaD insights on notable results to learn from**

All five papers indicate promising results and developments in transdisciplinary research, design and education. The role of the arts; participatory, user-centric and design thinking approaches; reaching out to the general public; aim towards sustainable solutions; critical discourse-oriented lens; understanding and specification of conflicting views; and advancing education are among the observed or predicted results highlighted by the TRaD 2022 papers.

### **4.5. TRaD collaborative reflection**

During the conference, the participants engaged in collaborative reflection on transdisciplinarity during the different presentations and particularly in the last session entailing a concluding discussion on core topics. The participants jointly ended up in highlighting the following aspects regarding transdisciplinarity:

- sensitivity towards complexity is essential,
- curiosity on how others think is required,
- a common vocabulary would be valuable,
- awareness raising within different disciplines is needed, and
- questions relating to identity and where one belongs become central.

There are different discourses circulating the use of the term transdisciplinarity, and the participants highlighted how we should critically reflect on what kinds of understandings we are imposing or advancing in our own work. This includes reflecting on the societal and academic circumstances of our work. For example, the relationship to democracy may need closer consideration: does transdisciplinarity aim at more democratic practices and structures? Are transdisciplinary practices inherently promoting more democratic practices? In terms of working in the academia, it was pointed out how it would be important to gain an overall understanding of how academia works: of the diversity of viewpoints, methodologies, epistemologies, statuses in the academic world, of journal policies, writing genres, funding bodies and schemes. This requires one to build a transdisciplinary *professional vision* (see e.g., Goodwin, 1994). For example, for the participants of the conference, digital technology plays an important role as a topic and as a research instrument, and therefore can be seen as part of the professional practice in transdisciplinary projects and education.

One aspect of our work in the academia is the education of future (transdisciplinary) professionals. Participants reflected on what it takes to learn to become transdisciplinary: how to learn to notice what is relevant and to become a professional while at the same time become and be aware of the broader frameworks, and of the work being done across disciplines?

It was also discussed how academics engaging in transdisciplinary research may face struggles in how their work is evaluated, as it is not necessarily easy to publish transdisciplinary research, or to gain funding for it. Therefore, it was concluded that there is a need for structures, people, publication channels, courses and education that offer examples and support for transdisciplinary work. To advance transdisciplinary practices, more information and research is also needed on how to facilitate transdisciplinary research, design, and education, and what the required skills are. Concerted efforts in identifying the strengths, opportunities, weaknesses, and threats in transdisciplinary work was suggested as one way forward.

## 5. Conclusion

This first Mini-Conference on Transdisciplinary Research and Design (TRaD 2022) was organized online to promote and advance the state of the art in transdisciplinary research; to bring together researchers from different academic fields to discuss and explore issues and questions related to experiences and understandings of transdisciplinary work in research, design, and education. We consider TRaD 2022 successful with the five paper presentations supplemented by introductory talks and group online discussions.

The long multidisciplinary research history behind the event provides us better insights into the needs and justifications for transdisciplinary approach as well as to the shared values and interest among the initiators. The connection to increasing and life-changing digitalization of our every-day life is highly emphasized. The multidisciplinary nexus analysis has been successfully used for transdisciplinary research. From a theoretical and methodological perspective, it seems to be a promising strategy for future in the context of exploring complex, transdisciplinary and highly discursive phenomena.

The call for papers for the mini-conference invited authors to share their empirical work and experiences on transdisciplinary research and design. During the actual conference, transdisciplinary education emerged as a focal topic as well. The papers made great efforts towards understanding and defining the concept of transdisciplinarity. All seem to point towards the same direction that issues and topics in relation to transdisciplinarity typically fall between or cross different types of disciplinary as well as professional boundaries. The nature and character of transdisciplinarity was considered as something that evolves as a result of new challenges in society and of the need to address these challenges; builds knowledge beyond, across, and between academic disciplines; and reaches out to non-academic sources and communities while searching for new theoretical and empirical constructs at a higher level of abstraction.

In addition to the conceptual discussion, some practical issues of shared interest were considered in the papers. In the transdisciplinary work reported in the papers and conducted within a variety of different contexts, various approaches have been identified. First, a theoretical, epistemological, and axiomatic perspective of science crossing disciplinary boundaries can be used when observing and

studying the dynamics of different layers of reality within a socio-technical context of interest. Second, in the polymath approach a variety of skills, experiences, and expertise are taken into use when building a holistic understanding of the phenomenon in interest. Third, participatory approaches with several stakeholders and people with diverse backgrounds as well as quantitative evaluation of multi-faced decisions have been used. In the participatory approach, different strategies have been followed like framing, exploration, innovation, and addressing real-world challenges. Finally, the design-driven education approach has been used where the stage-based design process model has been used for a multidisciplinary process of language learning with new technologies.

We wish to thank the authors for their insightful contributions to the discussion on what transdisciplinary research is. The authors and their papers represent a range of different fields, thus promoting discussion between and across disciplines, which was the objective of the mini-conference. The short papers take on different perspectives on the topic of transdisciplinary research, offering various interpretations and shedding light on the complexities involved. We wish to thank all the participants at the mini-conference for joining us in exploring the nature of doing transdisciplinary research and finding new avenues to go further.

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