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RESEARCH PAPER

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Identifying Topics for Future-Oriented, Innovative Research on Digital Transformation

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ABSTRACT

The importance of an adaptive and participatory scientific research process outside of the proverbial ivory tower is increasing. This is especially true in research on digital transformation, where topics are investigated in the context of their multidimensional socio-technological interdependencies. It is key to understand how research on digital transformation responds to these complexities, to what extent citizens' needs are effectively integrated as areas of scientific exploration, and how up-to-date topics can be identified. In commercial industry endevours, for example, the participation and collaboration of different stakeholders are seen as fundamental parts of work processes in order to create and leverage inter- and transdisciplinary synergies. Scientific research also has a promising history of different participatory approaches. In this context, we suggest a concept for the adaptation and implementation of such approaches to enable participatory, agile, and co-creative academic research. Our example is a structured process based on the innovation framework "Double Diamond," which is implemented to identify relevant topics for research on digital transformation. This process – characterized by a continuous alternation between collecting and condensing findings – included five qualitative and quantitative studies. The results of these studies are presented

and discussed considering the specific needs and values of participatory approaches in research on digital transformation.

1 Introduction

The dynamics of the digital transformation, with disruptive technological upheavals and serious social consequences, represent a challenge for both science and research. Therefore, research in this field – referred to as digital transformation research (DTR) in this work (for a more detailed description of the field, see Schmitt, Kohne, et al., 2023) – should be adaptable and react flexibly to changing framework conditions to achieve socially significant results despite highly dynamic and unpredictable developments.

Focusing on the aspects of society and digitization as its areas of inquiry, DTR needs to not only aim to create relevant output and communicate it in a suitable way but also include stakeholders in the various process phases to develop research and findings in relation to the needs of a society in flux. Indeed, a close-knit participatory process may provide the option to better align future research activities with potential relevance to those affected by the output. However, an orientation towards the needs of societal stakeholders, which can ensure the impact, acceptance, and relevance of research, is often neglected or is limited to science communication at the end of a research process. In this context, we aim to examine how DTR can best respond to these challenges, how the needs of societal stakeholders can be integrated effectively in the early phases of a research process, and how relevant, up-to-date research topics can be identified.

Diverse approaches exist that rely on participation and collaboration with different stakeholders in various fields of academic research (e.g., participatory research, citizen science), and concepts such as design thinking, service design, and agile project management exist in the business context. Similar approaches are also often referred to in the practice of co-creation (Horvath & Carpenter, 2020; Ramaswamy & Ozcan, 2018), where participants are involved as partners in a process of value co-production (Dollinger et al., 2018) rather than simply being a source of information. These approaches usually aim to create shared values (Aarikka-Stenroos & Jaakkola, 2012), react efficiently to changing conditions in the environment (Spinuzzi, 2005), and co-create innovative, sustainable, and purposeful solutions to complex problems (e.g., Argyris & Schön, 1989; Cargo & Mercer, 2008; Cornwall & Jewkes, 1995).

Nonetheless, the engagement of various stakeholders typically pertains to decisions made at the science policy level. Indeed, it is uncommon for participation to extend to the actual decision-making process regarding research practice (Kleinman, 2000b). This phenomenon is possibly due to the necessity to create convergence within processes instead of always consulting experts and non-experts alike at all moments when working within high-complexity environments (Kahane, 2021). However, in the rare instances where laypersons are directly involved in research practices, they often challenge the established norms of scientific methods (Kleinman, 2000a).

Borrowing from those ideas and concepts, we describe an innovative approach to participatory, co-creative, and agile research to answer the above-mentioned questions. This approach is based on the innovation framework "Double Diamond" (British Design Council, 2005; Kochanowska et al., 2022), which was implemented to identify relevant topics for research on digital transformation at the Center for Advanced Internet Studies (CAIS). Using a process of structured change involving divergence and convergence – characterized by a continuous alternation between collecting and condensing findings – we conducted five qualitative and quantitative studies between September 2019 and February 2021. Before we describe and discuss each step of the process, the results, and the limitations, we discuss different participatory approaches used in research and practice and their role in the acceptance of the resulting products and the distribution of power.

2 Participation as a Condition for Acceptance and Distribution of Power

2.1 Participatory Approaches in Practice

In commercial industry, the participation and collaboration of various stakeholders are seen as fundamental parts of work processes in order to create and leverage inter- and transdisciplinary synergies. Indeed, these types of collaboration are inherent components of approaches used for innovating business development, such as *design thinking* (Brenner et al., 2017), *service design* (Stickdorn et al., 2017), and *agile project management frameworks* (for example Scrum; scrumguides.org, 2020; Turner, 2019). These approaches have at least three main concepts in common, which – incidentally – are reflective of the challenges facing DTR (Simon & Schmitt, 2023).

Firstly, in order to react flexibly to changing conditions to achieve sustainable solutions, iterative and incremental processes are of considerable importance (Darvishmotevali et al., 2020; Miceli et al., 2021). Secondly, these approaches aim to integrate diverse disciplinary perspectives to address the complexity of problems (e.g., societal problems). Thirdly, the approaches strive to co-create value with the potential users of a product (or a service), and the consideration of their needs is an integral part of the design process, resulting in better and more profitable business results (Aarikka-Stenroos & Jaakkola, 2012; Chatterjee et al., 2022), customer loyalty, and the acceptance of a product (Cossío-Silva et al., 2016).

Therefore, the role of the customer as an "important resource provider" (Saarijärvi, 2012, p. 383) – "whether being social, cultural or physical" (ibid.) – "has changed from isolated to connected, from unaware to informed, from passive to active" (Prahalad & Ramaswamy, 2004, p. 4). From the perspective of the customers, co-creation may be perceived as fun, empowering, and useful for knowledge transfer (Greer & Lei, 2012). In turn, for the organization this approach is particularly beneficial for acquiring a deeper knowledge of customers' practices and understandings; in this way, current societal trends can be considered in the early phases of product design.

However, despite these advantages, participatory approaches are costly in terms of time, financial resources, and identifying methods that enable stakeholder participation (Greer & Lei, 2012). The success of these approaches depends on mutual trust, the willingness and ability to provide and process necessary information – on the part of the company and the customer – as well as the willingness and ability of the company to deliver the promised product in a satisfactory form (Järvi et al., 2018). Furthermore, participatory approaches also give rise to new dependencies and avenues for exploitation, as the demand for unpaid contributions from consumers by companies grows. Some scholars even perceive practices involving co-creation as a means of molding and controlling consumers via marketing narratives (e.g., Cova et al., 2015). These practices have also been criticized due to the fact that *real* participation is rarely fully implemented. Often, the actual opportunities for participation are insufficient, or in the worst cases, there is just an illusion of participation employed as a legitimizing or placating tool (Jalonen et al., 2020).

2.2 Participatory Approaches in Scientific Research

In the context of scientific research, there are also various attempts and methods to include important stakeholders as initiators and co-creators of research. Due to reasons of space, we highlight three different approaches used in research. For example, in design research, using collective creativity by combining the expertise of systems designers (researchers) and the situated expertise of the people whose work may be impacted by the development of new systems is usually referred to as *participatory design* (Sanders & Stappers, 2008). In this context, design workshops, in which participants collaboratively envision future practices and products, are a central resource for research (Robertson & Simonsen, 2012).

Additionally, in *participatory (action) research*, which draws from various disciplinary contexts (e.g., education, sociology, feminist studies; Hall, 1992; Stanton, 2014), involving the subjects of research in the process of inquiry into social contexts, in whic certain social phenomena occur, is a fundamental principle. Especially with marginalized groups, the knowledge and capabilities of the research subjects are literally moved "from [the] margins to [the] center" (Hall, 1992, p. 15) of knowledge production.

The idea underpinning *citizen science*, in turn, is to enable citizens to participate in evidence-based policy and decision-making (Silvertown, 2009). In contrast to other participatory approaches, citizen science tends to take place in a less controlled scientific environment, which should ideally give the responsibility for the research process to the citizen scientists (Haklay et al., 2021), which can be a challenge and opportunity at the same time. However, this approach fails at times, as often citizens are included only for data collection.

In all these formats, the needs, knowledge, and perspectives of non-expert agents – albeit in different roles – are involved in the scientific process. The participatory formats can be thought of as paradigms to influence and democratize knowledge production (Hall, 1992; Pelacho et al., 2021; Salomon, 2000). Consequently, in addition to research and teaching, the mission of science is, thereby, expanded to include a so-called *third mission* aimed at exchange and cooperation with society. Participatory approaches may create awareness and positive attitudes toward scientific research and its results (e.g., Kelemen-Finan et al., 2018; Price & Lee, 2013; Queiruga-Dios et al., 2020; Van Brussel & Huyse, 2019), empower citizens by giving them a voice, and ultimately lead to mutual learning processes between citizens and expert researchers (Bonney et al., 2016; Brown, 1985; Cornwall & Jewkes, 1995). However, for these mutual learning processes to occur, projects must continue long enough "to fully explore the mutual learning and to both reflect on and otherwise evaluate the process and its outcomes" (Robertson & Simonsen, 2012, p. 5). This demands that researchers distance themselves from a hege-

monic notion of scientific knowledge production and dissolve the hierarchy of the expert researchers compared with the respective non-expert stakeholders (see e.g., Hall, 1992).

In the following section, we explain how we learned from these approaches to counter the challenges of DTR.

2.3 The Need for Participation in DTR

DTR evolves just as much as processes of digital transformation keep developing and creating changes in circumstances, for example due to new technologies and platforms and their accompanying impact on individuals and social contexts. These developments also lead to rapid changes in new research questions, thus increasing the need for productive synergies through innovative inter- and transdisciplinary collaboration (Schmitt, Goldmann, et al., 2023; Simon & Schmitt, 2023).

However, the adaptability of scientific research – not only in DTR – may be inhibited by certain issues, such as the top-down development of research agendas, rather conservative project management approaches, and strategic compliance (Woiwode & Froese, 2020), especially for early career researchers, due to the current incentive structure of the academic system. At times, this conventional mindset at times is a limiting factor when addressing complex issues and may obstruct action on emerging trends, as well as the consideration of new questions in the first place. As a result, this mindset also hampers the relevance of research. In this context, relevance refers to research being helpful and effectual for a high number of the included disciplinary perspectives rather than producing abstract knowledge for its own sake (Crow, 2010). Indeed, this principle of relevance overlaps with the principles of co-creation as specified earlier.

Given the above issues in research, borrowing from the described participatory concepts seems necessary to respond to the initially stated challenges of DTR. An approach is sought that a) includes the concepts of iterative and incremental processes to enable continuous responsiveness to changing conditions, b) provides the possibility to adapt questions and methods to these very conditions, and c) involves various relevant stakeholders with diverse disciplinary perspectives as experts of their everyday life to tackle the complexity and versatility of problems. In the following section, we demonstrate how the needs of societal stakeholders can be integrated effectively into the early phases of a research process in DTR and, more specifically, how relevant, up-to-date research topics can be identified in a participatory, co-creative, and agile process.

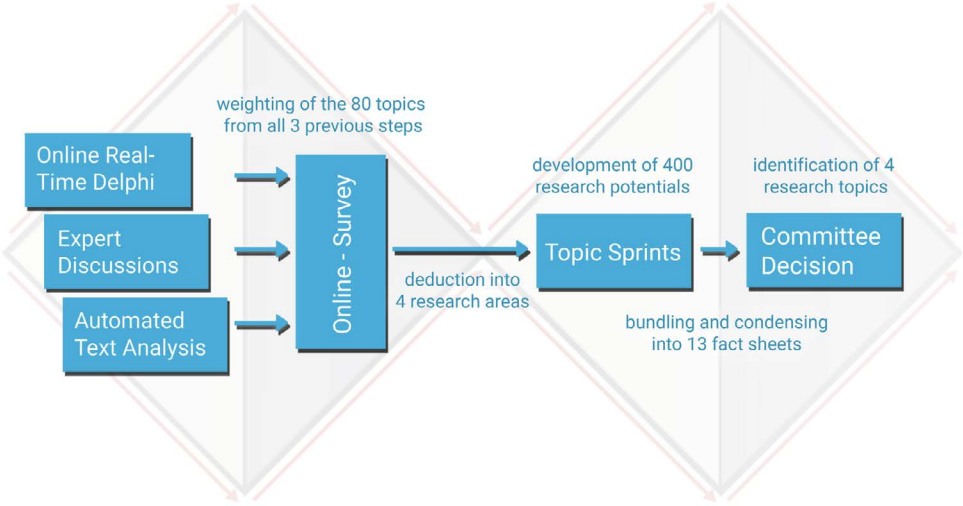
3 Identifying Topics in Digital Transformation: Research as a Participatory Process

We designed a structured process of sequenced methods that identify important research topics on digital transformation. The process is based on the innovation framework "Double Diamond" (British Design Council, 2005), which is characterized by a continuous alternation between collecting and condensing findings. The first diamond comprises two phases: *discover* and *define*. The discovery phase serves to "understand, rather than simply assume, what the problem is. It involves speaking to and spending time with people who are affected by the issues. […] The insight gathered […] can help you to define the challenge in a different way." (ibid.). The second diamond consists of the phases *develop* and *deliver*. The develop phase "encourages people to give different answers to the clearly defined problem, seeking inspiration from elsewhere and co-designing with a range of different people" (ibid.). Finally, in the delivery phase, different solutions are tested on a small scale. Solutions that do not work are rejected, and those that do are improved (ibid.).

This separation between the two diamonds helps overcome one crucial challenge that is often not addressed: making sure to tackle the right problem before properly solving it. Separating the problem space from the solution space helps to ensure focus and penetrate the core of the problem and challenge or question it without being affected by bias and unchecked assumptions, even in uncharted, uncertain terrain. In our case, each phase of the process was included in at least one qualitative or quantitative study conducted between September 2019 and February 2021 (see also Figure 1).

Indeed, we involved the whole spectrum of stakeholders (e.g., researchers, practitioners, laypersons) to ensure that the future research output would match actual societal needs. Key stakeholders were frequently engaged and repeatedly included in the different steps of the process to validate and improve on the intermediate results.

Figure 1: Overview of the process of identifying research topics[1]



For our process, participation exceeded the mere presence of stakeholders in the research process to generate exploitative gain. Indeed, participation is understood by us as the active involvement of stakeholders, with the aim of co-creating relevant research questions. The innovative aspect of this approach is involving stakeholders as experts of their daily lives in a society that is characterized by digital transformation in almost every aspect from the outset, even before the actual research project starts. We include not only those stakeholders with expertise, information, and resources, but also those who are affected by the outcomes of DTR and who can comment on the potential consequences.

Previously, Foucault (1998) highlighted these participatory approaches as ways to generate questions, through which new modes of thinking and experimental practice could arise. Indeed, this approach creates awareness of the necessity to decolonize the process of scientific knowledge co-production. Specifically, by enabling "normal" people to articulate their views and express their knowledge through describing and analyzing their own situations and challenges, researchers can step back from their often-perceived role as experts who impose their views on others. While Weszkalnys and Barry (2013) did not directly address research on digital transformation, their argument is relevant to it when they state that "[…] research has come explicitly to interrogate its own entanglement in the world that it analyses" (p. 196), recognizing that the issues and processes research studies are intricately connected to the various ways they are understood, valued, and encountered.

[1] An overview about the whole process can also be found in this video (in German): https://www.cais-research.de/forschung/inkubator/

This mode of thinking is something we were considerate of when setting up the structures for our topic-finding process. The following sections give an overview of the methodological approach of each phase and the respective results.

4 Discover: Three Components to Open Up and Discover the Field

To open the field and to obtain the first insights into potential research topics in DTR, we conducted a) an online real-time Delphi study with academic experts ($N=98$), b) an automated text analysis (e.g., calls for grant proposals, digital strategy papers, $N=471$), and c) six expert group discussions ($N=26$). Three studies with very different methodological approaches were selected to obtain the broadest possible overview of potential topics in DTR. This selection of studies follows the logic of the Double Diamond framework, where the first two phases of the diamond have the strongest emphasis on exploration in order to stress the distinction between understanding the so-called problem space in the first half of the process before moving into the solution space in the second half of the process (Gong, 2020; Kochanowska et al., 2022).

4.1 Online Real-Time Delphi

Method and Sample

The study is an adaptation of the Delphi method, involving at least two rounds of written interviews to collect expert knowledge and assessments on a specific issue, with participants having the opportunity to correct their statements during the process (Döring & Bortz, 2016). The aim of the various interview rounds is to gauge consensus and disagreement regarding judgments of a certain issue in order to yield well-founded predictions. In September 2019 and October 2019, 98 experts (postdoctoral researchers) on DTR from various research institutions in North Rhine-Westfalia ($n_{female}=18$, $n_{male}=53$, n.a.$=27$) participated in the study. Of these, 21 persons had a technical background, 28 had a background in the social or economic sciences, 6 had a background in the humanities or cultural sciences, and 8 had a background in medicine or the natural sciences.

A standardized online questionnaire was used to identify – among other things[2] – potentially relevant topics for future DTR. Potential research topics were assessed using an open-ended question ("What phenomena of digital

[2] The measures and results provided in the present paper were part of a more comprehensive study which also included questions regarding the importance attached to digital transformation and assessments of the future of DTR (i.e., theories, data, methods, interdisciplinary collaboration) (see also Schmitt et al., 2021).

transformation should research further be concerned with?") and a scenario task ("Imagine you could develop a research program on topics from the field of digitization. […] What overarching topic would you address in your research program? What individual projects would you work on in the program's projects?"). The answers were manually coded into categories.

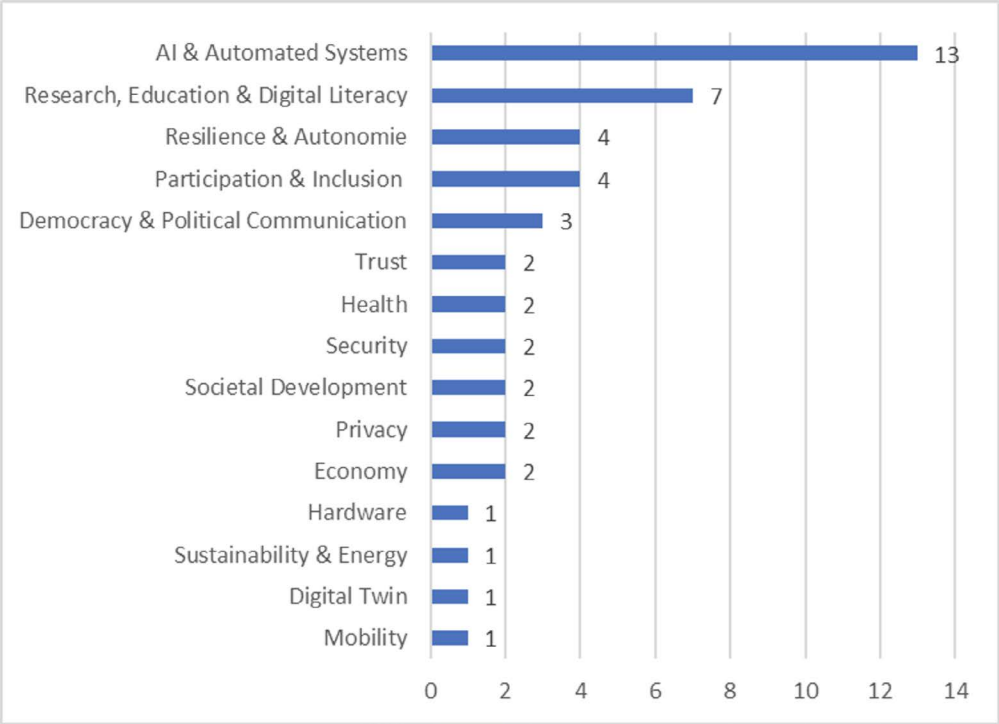
Results

The study provided an initial survey of research topics in DTR. Figure 2 gives an overview of the topics the participants mentioned. In particular, phenomena such as IT security and data protection ($n = 12$), as well as education and digital sovereignty ($n = 5$), were deemed especially important by the participants. This result confirms previous research indicating that these are areas where laypersons also perceive a need for action (acatech / Körber-Stiftung, 2019).

Figure 2: Word cloud visualizing the frequency of mentioned phenomena in the interviews

Regarding the scenario task, Figure 3 shows a rough categorization of the topics of potential research programs identified by the participants. The categories were quite broad in terms of content. Due to space limitations, we only provide some insights in the first four categories. Specifically, the category "AI & Automated Systems" includes research programs dealing with the ethical issues of AI, programs addressing the potential and limitations of AI in different contexts (e.g., hospitals, critical infrastructure), and proposals for programs on robotics and virtual environments. Some proposals pooled in the category "Research, Education & Digital Literacy" focus on digital literacy, as well as digital transformation in higher education. Proposals summarized under the label "Participation & Inclusion" primarily highlight the challenges of digital transformation for political and social participation. Finally, the cluster "Resilience & Autonomy" included proposals that focus on the individual and organizational management of digitization.

Figure 3: Categorization of potential research programs (numbers indicate the quantity of proposals)



The sample was small and selective, although this characteristic is quite common in Delphi studies (Döring & Bortz, 2016). Further, only individuals already holding a doctorate or the position of a professor were asked to participate. Therefore, it remains to be determined how people of lower career levels may respond to these questions.

4.2 Expert Discussions

The Delphi study served as the basis for the second component: expert discussions with researchers in DTR. Besides clarifying issues relating to organizing interdisciplinary research[3], we focused on identifying and discussing topics of future significance in DTR.

Method and Sample

Due to the COVID-19 pandemic, discussions were conducted online via the video-conferencing tool Zoom following the recommendations for online focus groups by Forrestal and colleagues (2015). The discussion groups (ad hoc groups) ($n = 3$ - 6 persons) were homogeneous in terms of the participants' academic career level (i.e., PhD students, postdocs[4], or professors). Two group

[3] Schmitt et al. (2021) present results regarding the organization of interdisciplinary research in research on digital transformation.

[4] By using the term "postdoc", we refer to individuals who have completed a PhD but who do not (yet) have a position as professor.

discussions were conducted per target group, giving six group discussions in total. For recruitment, relevant persons with different disciplinary perspectives from different German research institutions (e.g., universities, non-university research institutes) were directly approached.

The discussions were conducted between September 14, 2020, and October 1, 2020 ($n_{female} = 13$, $n_{male} = 13$). In addition to the oral exchange, text-based methods were used, as recommended by Baudendistel et al. (2015). Prior to the discussions, the participants received a link to a shared online whiteboard (Mural). Potentially relevant topics for DTR were collected in two ways: 1) the participants were asked to write down topics on Mural which, in their view, will be of importance in the next 5 – 10 years; (2) the participants were further asked to identify particularly relevant topics for DTR and to state which disciplines should be involved in researching these topics. In doing so, reference could be made to the written notes.

The discussions were recorded and transcribed by a professional service provider (for the transcription rules, see Dr. Claussen et al., 2020). The interviews were analyzed by means of a structuring qualitative content analysis, as proposed by Kuckarzt (2018), using MAXQDA 2020 (VERBI GmbH). The minimum coding unit was one sentence. The topics on the whiteboard were clustered by two researchers in close coordination (see Figure 4), and topics that could not be clearly assigned to a cluster were placed at the interfaces of the resulting “topic milieus.”

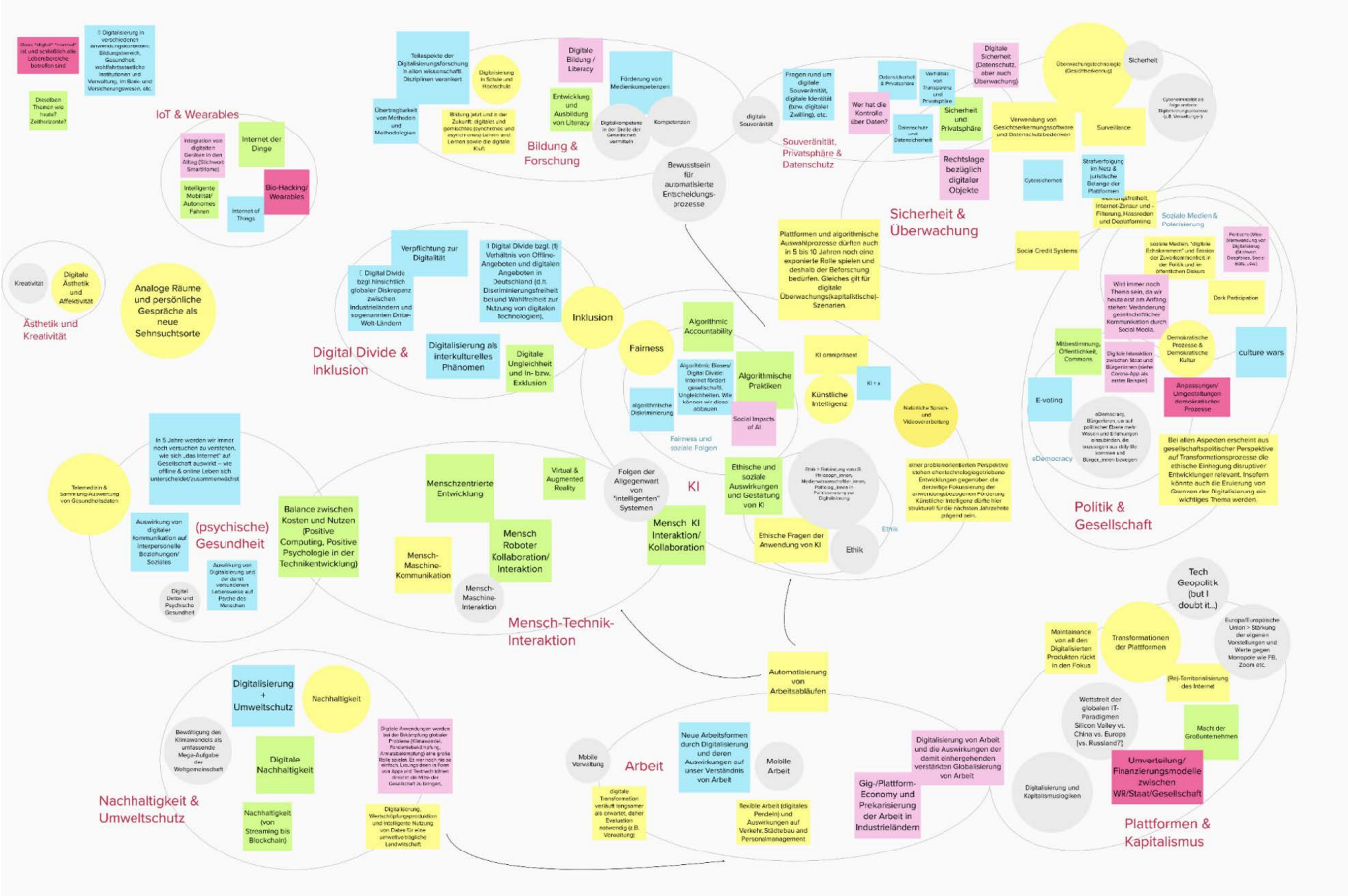
Results

The spectrum of potentially important topics identified for DTR was broad. Topics relating to digital inequality, inclusion, and participation were mentioned particularly frequently. In this context, the participants mainly focused on how different groups of people can and want to use digital offerings, but also on how digital technologies can promote inequalities. Furthermore, the participants reflected on the digital transformation of work and work processes and how this can affect people’s well-being and productivity – a topic focus that can presumably be explained by the timing of the group discussions in September 2020, which was almost half a year after the outbreak of the COVID-19 pandemic.

Furthermore, the participants identified questions for DTR in the context of human-technology interaction and the human-friendly design of digital technologies as central. Particularly, relating to the various questions of digital equality and inequality, inclusion, and participation, as well as the increased demands on technical skills or competencies in dealing with information or one’s own data, the question of how people can be supported to competently manage these demands (digital and media literacy) was also repeatedly raised. Similarly, questions that can be assigned to the topics of surveillance, IT

security, and data protection, as well as questions that can be assigned to the area of social and political processes, were of considerable importance for the researchers surveyed.

Figure 4: Topic milieus based on the participants' notes on the whiteboard



Limitations

Most of the interviewed researchers had a background in social sciences, whereas researchers from technical and natural disciplines were underrepresented. While this balance of backgrounds may impact on the diversity of perspectives relating to DRT, it also reflects the current development of the field, which is mainly shaped by researchers in social sciences. Another limitation of this work is that the group discussions were conducted online. Although online formats can be used in pandemics to follow necessary social distancing regulations and overcome geographically long distances between participants, they also have various challenges (Sander & Schulz, 2015); for example, the opportunities for a lively and in-depth discussion are limited.

4.3 Automated Text Analysis

Anticipating social developments and reacting to them in an appropriate way are key tasks for political and social actors. However, it is also key to examine the following issues: which topics are addressed by the political domain in the first place; how funding bodies (e.g., the German Research Foundation [DFG] and the Federal Ministry of Education and Research [BMBF]) act in this field; and which topics with a focus on the digital transformation are addressed by other institutions. To address these questions, we conducted an automated text analysis of key documents.

Method and Sample

The automated text analysis of 471 documents included important texts, including the digitalization strategies of federal states, calls for research projects, and self-descriptions of existing research contexts with a digital focus such larger research projects at universities (see Table 1).

Table 1: Overview of the numbers of different document types

Overview of the Numbers of Different Document Types

Calls for research projects (BMBF, since 2015)[5]	Calls for research projects (DFG, since 2015)	SFB[6]	Calls for research projects and grant descriptions (foundations[7])	Self-descriptions of existing research contexts	Digitalization strategies
283	95	13	28	29	23

Data collection took place between August 20, 2020, and September 7, 2020. Drawing on the *bag-of-words approach*, we gained an exploratory insight into the basic structures and topics of the texts. For further analysis, a document feature matrix (DFM) was created using the R package Quanteda (version 2.0.1).

5 Calls for research projects from the DFG and BMBF were surveyed back to 2015. In the selection process, it was important that the calls dealt with topics related to digital transformation. This means that the calls for proposals had to contain at least one of the following terms: digital*, informatics, robotics, internet, web, network, online, computing, machine learning, virtual, cyber*, intelligent, smart, or model (for an overview about the field of DTR and central research topics up to now, see Schmitt, Kohne, & Breuer, 2023). In addition, a rough examination of the content of the respective calls for proposals was also carried out by the responsible researcher.

6 Collaborative Research Centers of the DFG. Only those dealing with DTR topics were considered.

7 Foundations were identified via the lists of a) the largest foundations under private law, b) foundations under public law, and c) political foundations on the website of the Association of German Foundations. A foundation was considered relevant if it generally promotes or supports research projects and deals with topics related to digital transformation.

Results

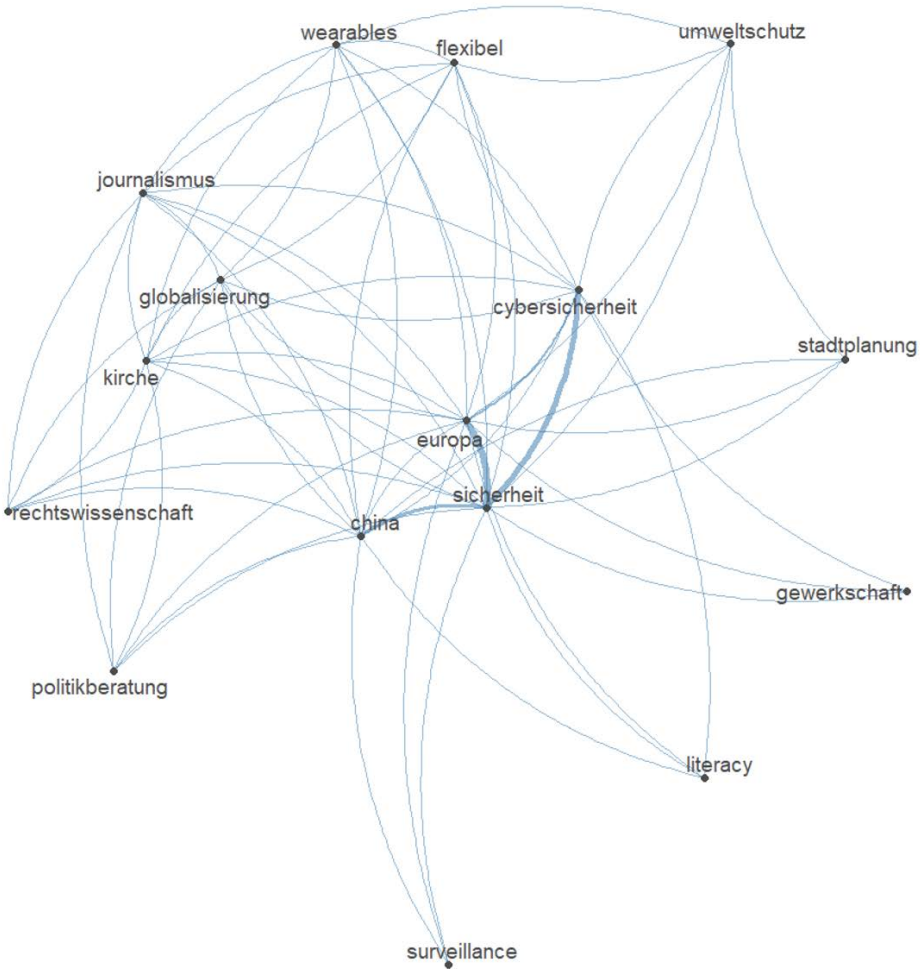
Due to the selection of sources, words related to “digital*” were naturally dominant in the samples. The focus of the texts on business-related, practice-oriented vocabulary indicates that the discussions were strongly related to the application of digital technologies (see Table 2).

Table 2: The 10 most frequent features across all the documents

Feature	Number
Unternehmen (companies)	3380
Digitalisierung (digitization/digital transformation)	3058
Forschung (research)	2566
Digitale (digital)	2564
Entwicklung (development)	2487
Rahmen (framework)	2367
Digitalen (digital [pl])	2295
Research	2210
Wirtschaft (economy)	1938
Vorhaben (proposition)	1566

To analyze the overlap between topics identified in the real-time Delphi study the expert discussions, and the automated text analysis, we built a co-occurrence network. The nodes in the network represent those words in the documents that were also mentioned in both previous studies. The results suggested a focus on the topic of IT and cybersecurity. There were also overlaps regarding the topics of digital literacy, surveillance, and environmental protection, for example.

Figure 5: Co-occurrence network



Limitations

Since the text corpus in its current form is very small and heterogeneous, the methods used were not able to produce sufficiently precise results. Nevertheless, the results do give us valuable indications of the focal points emphasized by different social and political actors regarding key issues in DTR. Expanding the data collected and sharpening the analytical tools would help improve the process of identifying topics in text documents, although since this method was aligned with the methods used in the other two studies mentioned, it fits the overall methodological structure for identifying key topics in DTR.”

4.4 Interim Conclusion

At the end of the first phase of our structured process, topics and key questions in DTR were identified in two studies with DTR scientists and based on an automated text analysis of important documents in the field. In the subsequent sections, the findings are weighted and condensed. This weighting was conducted from the perspectives of different stakeholders. Additionally, from the results, 80 topics were derived in a process involving close coordination between two researchers to ensure intersubjective comprehensibility.

5 Define: Condensing Using an Online Survey with Different Stakeholders

Using an online survey, the identified topics in DTR were assessed in terms of their importance; specifically, the responses indicated which topics are important across society.

5.1 Method and Sample

The derived topics were weighted through a quantitative online survey with four groups of stakeholders: 1) people who are part of [institution] to include an internal perspective; 2) external experts on DTR who know the [institution]; 3) practitioners related to digital transformation issues[8]; and 4) citizens (see Table 3 for sample descriptions). The participants belonging to samples 1 to 3 were approached directly for recruitment to the study. For sample 4, a population-representative (in terms of gender and age) online panel was acquired via a service provider.

During the survey, the participants were asked to indicate on a scale of 1 to 7 (1 = *not* at all important, 7 = *very important*) the extent to which they believe that the topics should be researched. In addition, the participants were asked to indicate on a scale of 1 to 100 how highly they rated their competency regarding topics related to digital transformation. The practitioners' fields of occupation were surveyed using a standardized questionnaire (Ortmanns & Schneider, 2019). Many of the practitioners had a professional background related to education ($n = 15$), 12 had a background in economy and administration, and 8 persons had a background in the service industry (e.g., marketing).

[8] Practitioners are persons who work in places that are not considered research institutions in the narrow sense.

Table 3: Overview of Age, gender, and competency regarding digital transformation in the sample

	Experts			
	Internal (n=13)	External (n=44)	Practitioners (n=55)	Citizens (n=485)
Age (years)	Range: 22 to 65 M_{age}=35.31 (13.04)	Range: 21 to 64 M_{age}=37.57 (10.81)	Range: 25 to 74 M_{age}=40.56 (12.49)	Range: 18 to 84 M_{age}=47.84 (16.18)
Gender	m=7, f=6	m=22, f=21, other=1	m=32, f=22, other=1	m=272, f=212, other=1
Competency	M=72.8 (21.94)	M=80.79 (15.94)	M=72.67 (21.48)	M=55.26 (25.28)

Note: Standard deviations are displayed in parentheses.

5.2 Results

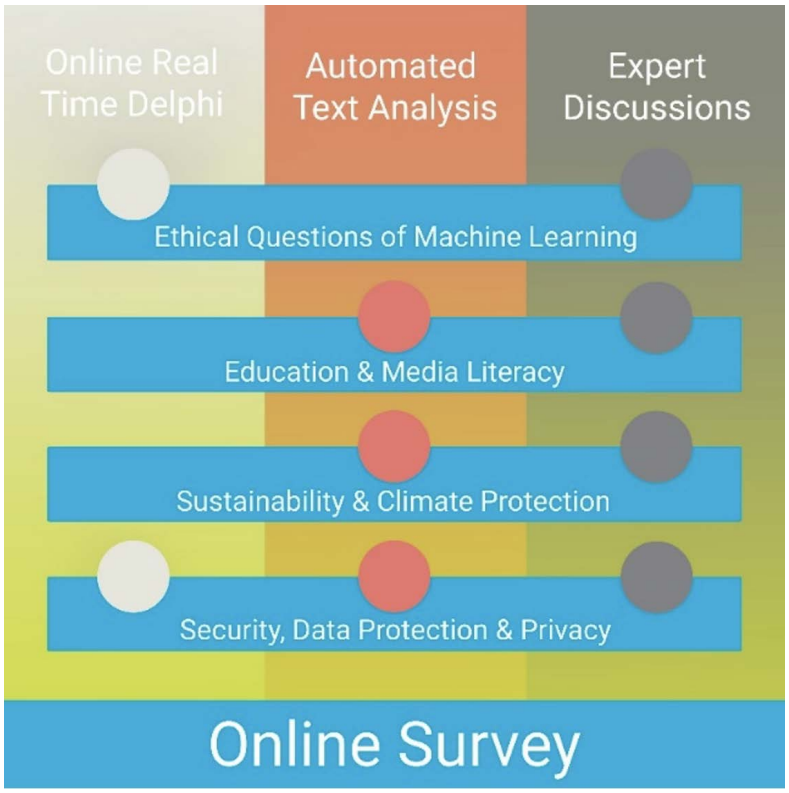
The survey's diverse sample provided a good illustration of the perceived importance of the identified topics in DTR. Overall, all the topics were rated as being relatively important, as indicated by the fact that none of the topics had a mean score below four on the question focusing on whether the participants thought that topic should be researched. Additionally, the differences in the mean value scores between the topics for this question were only minor. Indeed, there was a high level of agreement regarding the importance of the topics, as well as minor differences. For example, experts tended to prioritize abstract topics (e.g., transparency of algorithms), while citizens prioritized everyday topics (e.g., education and digitalization, IT security). The practitioners' answers show a clear link to their work context, as they perceived education and digitalization to be the most important topics. There was also agreement regarding the topics that were not perceived as relevant (e.g., "digital twin," "history and development of artificial intelligence systems").

The 10 most important topics for each group were ranked and compared. The means and standard deviations of the importance scores for the top 10 topics for each group can be found in the online appendix.[9] Based on this analysis, four overarching topic areas emerged that had great importance across the groups surveyed: 1) ethical questions of machine learning (AI, algorithms, etc.); 2) sustainability and climate protection associated with digital technologies; 3) security, data protection, and privacy; and 4) education and media literacy.[10] Figure 6 provides an overview of these four topics and further reflects intersections with the central topics identified in the three previous studies.

[9] Online Appendix: https://osf.io/jqg7y/?view_only=14bc22f08bb84e938600281b97044d22

[10] Please note, that these overarching topics often include more than one topic from the survey.

Figure 6: Overview of the important topics identified in the survey and links to previous studies



5.3 Limitations

There are limitations to this survey work regarding the samples. Overall, the four samples are very different in terms of size, which has consequences for the weighting of issues witwwhin the groups. The sample “citizens” was roughly representative in terms of age and gender, but the participants were part of an online panel, meaning a certain inclination towards digital media can be assumed. The group of practitioners was quite diverse in terms of its composition by field of activity, but individuals from the education sector predominated.

There are also possible limitations regarding the items in the survey. Indeed, the participants were presented with a very large number of topics to be assessed. Although the 80 items were distributed over three questionnaire pages and displayed randomly on each page to reduce possible sequencing and fatigue effects, potential overall fatigue effects on the third page cannot be ruled out. Furthermore, the wording of the topics identified in the previous studies was largely retained. Due to this, some item formulations were quite detailed and used technical terms, thus possibly causing difficulties regarding readability and comprehensibility. Only in some cases were participants given a simplified presentation or extra explanations.

6 Develop: Digital Topic Sprints as a Co-Creative Opening of the Process

Following the idea of the phase *develop* within the Double Diamond, we conducted so-called topic sprints to put the four topics up for discussion once again and to identify possible research topics in these areas. These topic sprints involved compressed, co-creative workshop formats for interdisciplinary collaboration, during which deliberately heterogeneous groups explored the overlaps between the four topics (see Section 3.2) and any overarching topics.

6.1 Method and Sample

Between February 15, 2021, and February 22, 2021, 41 different societal stakeholders engaged in seven 90-minute interdisciplinary online workshops. The stakeholders stemmed from diverse backgrounds, such as theater, research, education, law, and administration. These individuals were directly approached by researchers of CAIS for recruitment. With these intentionally heterogeneous groups, the overlaps of the above four topic areas and any issues relevant to multiple topics were examined, and research questions and project ideas were collected and discussed.

The topic sprints were moderated by one trained researcher, who documented the discussions on digital Post-Its in Mural. Additionally, a second person assisted with documentation. Brainwriting took place online in a shared document in the word processor Cryptpad, which allowed all written comments to be recorded, tracked, and reflected. With this specific workshop structure and carefully selected collaboration methods (e.g., individual brainwriting sessions followed by group discussions), we were also able to gather insights from the more introverted participants without creating uncomfortable team dynamics within the group.

6.2 Results

A collection of approximately 400 different potential ideas for future DTR, ranging from ideas for the interdisciplinary composition of research teams to detailed research questions, resulted from the topic sprints. Two trained researchers used an inductive process to group the results of the topic sprints into thematic milieus. Through this process, they ensured that the ideas and approaches formulated by the participants were always related to the four overarching topic areas, while also mapping possible overlaps with several topic areas. Moreover, any redundancies were removed at this stage.

One central insight from this study was that DTR must incorporate technological aspects. In particular, the overarching and recurring issues were participation, involvement, media literacy, and questions about the design and impact of digital education. Concerning the field of sustainability and environmental protection, the participants were particularly interested in the sustainable design of digital technologies and the promotion of environmental protection through digital technologies. Regarding the use of artificial intelligence in various areas of application (e.g., education, environmental protection), the participants discussed in detail the effectiveness and dangers of such technologies.

7 Deliver: Condensing into 13 Fact Sheets and Four Research Programs

The successful execution of the topic sprints resulted in a total of 400 potential research avenues being provided and built on by the participants. The suggestions from the topic sprints were then systematized and condensed into 13 fact sheets on different areas of research on digital transformation (e.g., environmental protection and AI, digital literacy, design, and digital technologies) in a collaborative process between two trained researchers. Each fact sheet contained a guiding question as well as reflections on central research questions, possible living labs, as well as a list of potential research collaborators and thoughts on interdisciplinary approaches.

At this point, it is important to highlight that the fact sheets serve as an early prototype of research programs that reflect the current discourse and needs of society. They represent a tangible deliverable that can create visible, accountable common ground to reduce the likelihood of the topics – intentionally or not – being strategically distorted by top-down decision-makers. The fact sheets are not always clear-cut in terms of their thematic classification, but they do set certain priorities in terms of the importance of different research topics. These prototypes formed the basis for deciding on the four research programs of CAIS, alongside yet another set of co-creative workshops with the institute's steering committees, directors, and advisory board, and, thus, resulted in the preliminary end of the process of determining topics for the first CAIS research programs.

Regarding the workshops, the format corresponded to the topic sprints. Specifically, the first step involved the addition of detailed approaches to open up the field, and these approaches were then summarized and condensed once again. In these workshops, the prototypes were evaluated in a voting session (5 minutes, with each person being given four votes) and discussed to determine which of the 13 topics were considered most important. Finally, the four topics for the research programs at CAIS were selected: AI and education technologies, digital democratic innovations, trustworthy AI, as well as sustainability in relation to digital transformation.

8 General Discussion

Through this project, we suggest an innovative approach to tackle the challenges of DTR (for a more detailed overview of the challenges, see Simon & Schmitt, 2023). Scientific approaches to the participation of non-scientific persons (e.g., participatory design, citizen science, participatory research), as well as approaches from commercial industry (e.g., design thinking, service design, agile project management frameworks) to involve customers in product design, proved to be very fruitful as groundwork for identifying key issues and topics in DTR.

Structuring the phases of this work in line with the Double Diamond helped us to ensure that the entire process of identifying research topics was participatory and co-creative, cycled between phases of convergent and divergent thinking, as well as being iterative and incremental. The first three components of the research (the real-time Delphi study, expert discussions, and automated text analysis) enabled experts to gain a wide understanding of the topic area. The survey with different stakeholders (experts and non-experts) made it possible to perform an initial condensing of the results; subsequently, the topic sprints, involving open discussions with people from diverse backgrounds and resources, widened the scope of the process (see also Saarijärvi, 2012); finally, the results were systematized and summarized in fact sheets. These fact sheets underpinned the final step in the process, which involved the various CAIS committees weighting the results further and developing them, leading to the determination of the four overarching research topics of the CAIS research programs.

We intentionally included the public – who are affected by the digital transformation in various domains of their lives – to actively participate in this inclusive process of scientific agenda-setting (Delvenne & Macq, 2020; Hall, 1992). However, the aim of the inclusion of the many external stakeholders was not simply to collect their data in order to then tailor a product to them without having them actively participate in the process. Instead, the approach was designed in such a way that those involved could help shape the process of finding a topic and co-create within it. Inviting citizens to engage with scientific matters, in our case in the identification of research topics, which is a process usually reserved for scientific experts (i.e., researchers), as well as for citizens to do so in an explicitly innovative fashion, pushes the boundaries of traditional ways of scientific knowledge production and power distribution. This process brings us closer to the ideal of responsible research and innovation, “from science in society to science for society, with society” (Owen et al., 2012, p. 751).

Our approach further has the potential to foster a sense of reflexivity among the participating researchers. Relating to ideas from science and technology studies, it is key to remain critical and aware of creating biases and framings when picking parameters, questions, topics, and instruments of scientific research (see e.g., Delvenne & Macq, 2020; Fisher et al., 2006; Owen et al., 2012); indeed, involving a variety of people and methods in this process allows researchers to avoid the incorrect assumption that their research undertakings are completely objective and natural when in fact they may be biased and exclusionary.

Furthermore, this type of co-creative participation in research may address several challenges scientific research encounters. For example, this inclusion of a variety of individuals can generate an understanding among those individuals of why and how science works and where it needs input. While this may not suffice to fully achieve science literacy among the involved stakeholders, it may reduce potential skepticism toward scientific research, as well as foster people's readiness to engage in scientific research (e.g., Martin, 2017; Sandhaus et al., 2019).

Participatory research is based on the idea of active citizenship and the principles of efficient production by harnessing the complementary and interchangeable skills of various stakeholders. However, although it generates fresh ideas, knowledge, and positive attitudes toward science, it also causes novel challenges. As an illustration, although the idea of participatory research is to include all citizens, as well as those of minority groups, in participatory research, there is often a rather uneven distribution of participants from various groups. Indeed, due to some individuals being more active and interested, with those of higher social status often exerting dominance in participation, the voices of others may be unrecognized (Jalonen et al., 2020; Pateman et al., 2021).

Indeed, in our study, apart from the open-access survey, this observation held true for the topic sprints, as the participants were mainly recruited via the professional and social networks of the participating researchers. Moreover, only individuals who felt able to participate in an online workshop using tools such as Zoom and Mural took part in the topic sprints. In this context, it can also be assumed that the participants already possessed good digital competence and had an interest in digital tools and issues. In the subsequent rounds of the topic identification process, the emphasis should, thus, be on involving target audiences that represent other segments of the population more prominently. Specifically, the currently ongoing follow-up project to the above-described topic-finding process has been designed to allow representatives of often overlooked groups, such as migrant communities and senior citizens, to contribute their perspectives on DTR with less of a barrier to participation.

Such a complex topic-finding process further requires manifold resources (e.g., time, money, facilitation) to make sure it represents the intended close-knit participatory setting (regarding costs and opportunities; see also Greer & Lei, 2012; for facilitation, see Schmitt, Goldmann, et al., 2023, and Simon & Schmitt, 2023). Moreover, additional work for the research team is necessary to organize the process in an iterative and incremental setting such as this. However, despite the additional work, this setting may significantly reduce the risks of missing relevant points (and having wasted resources). Indeed, this setting further increases the options to readjust the topics on the way, thus supporting research to meet the challenge of the ever-changing and flexible environmental conditions surrounding DTR. The advantages of this iterative and incremental setting underline the importance of including ideas of agile project management in scientific research. An interdisciplinary research team is also helpful for the implementation of such a complex, multi-method design.

9 Outlook

The process discussed in this work has been designed to identify research topics in DTR for CAIS. In 2021, the CAIS started its first two research programs, and the third will start at the beginning of 2024. Each of these 5-year programs focuses on one of the four research topics that resulted from the process. The fourth topic will follow soon as part of a research program at CAIS.

Each of the four research programs is interdisciplinary in nature, meaning that researchers of different disciplinary backgrounds collaboratively work on the research questions. Through the integration of different laboratories, the programs also have a transdisciplinary component. However, starting and conducting the process took about 1.5 years, which is quite a long time for identifying research topics in a fast-developing field. Additionally, the time period during which this research was conducted was unusual, as this work mostly took place during the COVID-19 pandemic. Consequently, all the studies were conducted virtually. Moreover, it can be assumed that results were probably shaped by the challenges of the pandemic-related distancing measures (e.g., home-schooling). However, the identified topics have proven to be extremely relevant. For example, with “AI and Education Technologies,” we have identified a topic that is being widely discussed, and not solely because of homeschooling and ChatGPT.

Making the scientific agenda setting more inclusive ensures relevance at the very beginning of implementing research topics as future research programs and creates a basis for reflexivity among all the involved parties. These advantages of inclusive agenda-setting support productive inquiry into the complexities and interdependencies of DTR. Moreover, the systematic collection, sorting, and condensing of the topics discussed serve as a starting point for the co-creative, long-term monitoring of future research questions, which should help to map changes in the population's perspectives on topics related to digital transformation and their relevance over the years. This understanding, in turn, should contributes to the formulation of topics for future research programs to ensure innovative and responsive research on digital transformation.

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