Learning how to engage with another's point of view by intercultural, interdisciplinary and transdisciplinary collaborations

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Abstract

The paper argues that the different dimensions of collaboration - intercultural, interdisciplinary, and transdisciplinary - contribute to mutual understanding and empathy. Their intersection fosters self-reflection and reveals shortcomings, blind spots, and prejudices about other cultures, disciplines, and social groups. The course aimed to overcome technology-driven design practices that tend to (re)produce stereotypes or social exclusions - often unconsciously. To make students aware of such problems, we introduced them to Feminist Science and Technology Studies, which show how dimensions such as age, class, and gender affect socio-technological participation. Moreover, we introduced user-centered and participatory design methods (contextual interviews, scenario-based design, design forecasting) that the teams had to adapt to pandemic conditions to conduct participatory research and propose design scenarios. The empirical course evaluation by the students indicates that the pedagogical concept, which we conceptualized as an extended version of a 'Third Space', allowed for intercultural, interdisciplinary, and transdisciplinary learning experiences and improved collective student and team performance, transcending culturally- and disciplinary-specific situatedness.

In our analysis, we reflect on the power of the different forms of collaborations and their contribution to teaching future researchers, designers, and engineers how to engage with another's point of view. We consider this ability a prerequisite for acting responsibly in a globalized digital world. Results from the study are contextualized in current debates on internationalization and digitalization in the educational sciences and translated into recommendations for practitioners.

Practitioner Notes

1. In order to acquire global competencies - understood as the ability to work with people who define problems differently than oneself - students need opportunities for intercultural, interdisciplinary, and transdisciplinary collaborative learning.

2. Intercultural, interdisciplinary, and transdisciplinary collaborations in educational settings foster mutual understanding and empathy. All three dimensions of collaboration contribute to reflecting on and questioning seemingly self-evident facts by revealing shortcomings, blind spots, or prejudices about other cultures, disciplines and social groups. They uncover knowledge about one's own (disciplinary) culture and social belonging. Intersecting intercultural, interdisciplinary, and transdisciplinary collaborations reinforces these effects.

3. The authors observed that intercultural, interdisciplinary, and transdisciplinary collaborations provide effective learning experiences when students from different cultural and disciplinary backgrounds work together on projects with people affected by specific issues. In such research-oriented and project-based courses, teachers need to create a space in which students can find appropriate ways of collaborating (e.g., considering and integrating diverse time frames and capacities, mindsets, as well as individual working approaches and routines).

4. Intercultural, interdisciplinary, and transdisciplinary educational settings offer collaboration possibilities for people at various levels of study. Inexperienced students in

the early stages should be integrated into supportive teams that include students from later semesters. All students should be accompanied by experienced teachers offering theoretical and practical advice.

5. Digital technologies, platforms, and tools offer students opportunities for long-distance, intercultural collaborations and thus intercultural experiences without travelling. However, virtual-only university collaborations crossing continents are challenging with regard to structural and organizational differences in schedules, time zones, and performance evaluation that often require individual solutions. Consequently, teachers and students who aim to undertake such a rewarding endeavor have to spend extra time and work on experimenting with different media, tools, and teaching and learning practices to adjust those to the specific participants and contexts.

Introduction

Living in a globalised world involves crises, like the current Covid-19 pandemic, that transcend national boundaries and affect people worldwide. However, the effects of these crises are distributed unequally amongst regions and populations. Digitisation has been considered a pivotal solution to keeping public, professional, and private life, including global communication and trading, going in times of pandemic-mandated lockdowns and prohibited travel. Globalisation and digitisation are mutually dependent. There is a broad and long-lasting debate about digitisation in higher education going back to the 1990s. It goes hand in hand with discussions on its potential for university internationalisation (Robson and Wihlborg, 2019) which is often realised in the form of the geographical relocation of students or an "internationalisation at home" that aims at providing students with an internationally oriented learning experience domestically (Mittelmeier et al., 2021). Digital technologies offer new opportunities for an "internationalisation at a distance" (Mittelmeier et al., 2021) beyond an internationalisation abroad or at home and concepts such as "portal pedagogy" (Monk et al., 2015). They open new pathways for collaboration between institutions, students, and teachers worldwide and offer benefits such as time and location-independent teaching and learning and personalisation according to individual preferences and habits.

Countries like Australia, Canada, and South Africa that have a long tradition of open and distance education are better prepared for internationalisation and digitalisation than, e.g., Germany, which comes last in Europe concerning the digitalisation of higher education (Zawacki-Richter, 2021). Against this background, Peters and Petar (2018) draft a vision of a digital university that does not just use digital technology to speed up administrative, institutional, and knowledge production processes. Instead, freed from injustice, racism, and sexism, their university vision is based on "radical openness, creative labor and the co-production of symbolic goods" (Peters and Petar 2018, p. 337) that explore the complex ontological, epistemological, ethical, and identity issues arising from teaching, learning, and living in the digital age. However, digital participation opportunities are not equally available to and usable by everyone. These inequalities often relate to age, gender, race, education, or income and include the affordability and availability of technical devices, infrastructures, competencies, or social support. Consequently, there is an urgent need for answers to culturally, structurally, and locally-specific needs and demands. Therefore, today's researchers and practitioners are forced to observe and engage with another's point of view as a basis for developing solutions that consider cultural, geographical, and individual particularities.

The challenges of a globalised, digitalised world have consequences for the way we prepare students for studying and working. In their future jobs, they will have to deal with complex situations that cross cultural, disciplinary, and academic boundaries. Hence, they need university courses in which they learn how to study problems in context and define them together with other experts and affected stakeholders, including users. This practice requires intercultural, interdisciplinary and transdisciplinary exchange (Downey et al., 2006; Krebs, 2020). An interrelated challenge for educational settings is making students aware of the so-called 'I-methodology' (Akrich, 1992, 1995; Oudshoorn et al., 2004; van Oost, 2003). Students tend to use stereotypes and have unconscious biases that can conceal important details and information and ultimately lead to problem definitions that match their own preferences but fail to address the target group.

This paper presents a research and teaching collaboration between the Technische Universität Braunschweig (TUBS), Germany, and the Indian Institute of Technology Bombay (IITB), India. We took the pandemic and accelerated digitalisation as an opportunity to create an online course where students with different disciplinary backgrounds collaborated virtually across both

universities. As university teachers and researchers with expertise in gender studies and design research, we used the situation at hand as an 'ideal' field of research and application to make the students reflect on how today's global crises affect local crises that need to be explored and solved from multiple perspectives. For this purpose, our course offered a virtual-only, research-oriented, project-based learning experience that brought teachers and students from different cultural and disciplinary backgrounds together with people affected by the current pandemic situation in different ways. We take this course as a case study to show an example of how to teach future researchers, designers, and engineers to deal with the various challenges of a globalised and digitalised world, and to use digital tools and technology to find solutions. We analyse the course with regard to different forms of collaboration, its theoretical, methodological, and intercultural framing and the heterogeneity of participants. In this respect, we ask:

- How did the setting of the course influence the collaborative relations (between teachers and students, within the student teams, between students and stakeholders) that enabled students to engage with another's point of view?
- How did the different forms of collaboration contribute to a critical consciousness that sensitised the students to socio-technological inequalities and their own cultural, disciplinary, and personal embeddedness that goes along with assumptions that may have biased their problem definitions and solutions?

The paper is structured as follows: The following section discusses 'situatedness' as an aspect of intercultural, interdisciplinary, transdisciplinary, and global competencies by drawing on Feminist Science and Technology Studies and Engineering Studies. Central concepts of Participatory Design such as 'Third Space' are introduced. In the next section, the objectives and structure of the course are described. The following section first introduces the collaborative setting that represents the course's core pedagogical concept. Then, we discuss a survey on the students' learning experiences conducted at the end of the course. The survey findings give us reason to claim that the entanglement of intercultural, interdisciplinary, and transdisciplinary collaborations complement each other and support students in engaging with another's point of view. In our conclusions, findings are summarised and contextualised, practically and theoretically.

The problem of 'situatedness' in a globalised world and the need for intercultural, interdisciplinary, and transdisciplinary competencies: A review of literature

Today's researchers, designers, and engineers working within a globalised digital world face problems and challenges that transcend national, disciplinary, and academic boundaries. Consequently, students need to be prepared for work under such destabilised (and destabilising) conditions. They have to learn how to collaborate with stakeholders from different domains and regions, including non-experts, to provide knowledge, technical solutions, and designs that address variable problem spaces, target groups, and markets. In addition to their disciplinary expertise, they have to acquire what Gary Downey and his colleagues describe as "global competency": the ability to "work effectively with people who define problems differently" (Downey et al., 2006, p. 107ff.). Accordingly, curricula and pedagogies "that foster global, international, and intercultural (GII) learning across academic disciplines" (Krebs, 2020) are required. That includes inter- and transdisciplinary competencies. Inter- and transdisciplinary approaches are seen as promising ways to deal with internationalisation in higher education and "to advance pluralistic, diversal, decolonial and social justice focused research" (Khoo et al., 2018, p. 182) that requires us to collectively "work with, and across, differences" (Khoo et al., 2018, p. 181), including non-academic actors and non-

formal perspectives. In fields of knowledge that transcend geographical, disciplinary, and academic boundaries, such as sustainable development studies, international inter- and transdisciplinary education programmes are already mandatory (Di Giulio and Defila 2017; Khoo et al., 2018).

Nevertheless, collaboration between people who think, and act differently seems always to be a challenge. Even established researchers do not necessarily know how to work in teams and projects with members from other disciplines, as Freeth and Caniglia (2020) show in their case study. They found out that such collaborations 'force' the researchers to leave their disciplinary comfort zones and expert status. Instead, they become learners who must accept discomfort and learn how to "collaborate while collaborating" (Freeth and Caniglia, 2020). Inter- and transdisciplinary education requires a shared point of view, including a shared problem framing, a joint research objective, and shared outputs (Di Giulio and Defila, 2017).

We focus on globalisation as a broader challenge for developing approaches to international learning. In this respect, we were inspired by Downey's et al. (2006) approach to global engineering education, which refuses the essentialist notion of culture as "shared beliefs deeply embedded inside people's bodies and lives" (Lucena and Downey, 1999, p. 4.230.5). Such an understanding of cultures as "membership groups that are discrete, distinct from another, and have boundaries that overlap roughly with the boundaries of countries" (Downey et al., 2006, p. 108) is widely spread. However, this definition tends to assume that beliefs and values are shared among all members of a particular society, e.g., Germans and Indians, and thus reproduces stereotypes.

Arturo Escobar (2018) emphasised instead that today we live in a "pluriverse." Taking the effects of global mobility and migration into account, Welsch (2017) developed the concept of transculturality, which shapes individuals who are raised and educated differently, and form connections across cultural influences. In line with this thinking, Knight (2004, in Krebs, 2020) emphasises that internationalisation is not only about the relationship between and among nations, cultures, or countries, but also about relating to the diversity of cultures within countries, communities, and institutions, and thus addresses aspects of internationalisation at home. Taking globalisation and internationalisation seriously also means critically reflecting on and abandoning Western and Eurocentric perspectives in favour of considering other academic and non-academic realities, e.g., Indigenous, African, or Southern (Escobar, 2018; Khoo et al., 2018; Lehtomäki et al., 2018).

Aware of these theoretical efforts, we follow Lucena and Downey's (1999) concrete recommendation to

> help students make visible their own perspectives by demonstrating knowledge about many others. The idea is to help them see what they take as natural to be the product of historically and culturally specific processes. (p. 4.230.6)

Their concept of an "Engineering cultures" class challenged the students' perspectives with respect to culture (or nation) mainly by demonstrating differing national traditions of engineering cultures. In our course concept, we took the structural conditions of our teaching as an opportunity to question even more dimensions of taken-for-granted assumptions. In addition to geopolitically-framed perspectives, through creating an intercultural, interdisciplinary, and transdisciplinary learning space, we took into account assumptions resulting from disciplinary backgrounds or the power position of the academic researcher in relation to the affected stakeholder and users. We thus aimed to meet the requirements of global education:

> *Learning to engage understanding and ways of thinking about work that differs from our own would seem to be an obvious objective for any kind of employment in the globalising world.* (Downey et al., 2006, p. 108)

Based on this background, we conceptualised our course theoretically and methodologically as follows: we introduced the students to theories from Feminist Science and Technology Studies (FSTS) and methods from Participatory Design as tools to research, reflect on, and integrate the socio-structural particularities of a certain social group into technological research and development projects. By using these approaches in diverse German and Indian contexts, we aimed at interrogating assumptions.

Feminist Science and Technology Studies (FSTS) analyses the social conditions of knowledge and technology production. Using a power-critical lens that considers gender as a category of difference and inequality entangled with categories such as age, class, or ethnicity, FSTS scholars ask: who participates and who makes decisions, who benefits from the outcome and who is disadvantaged, ignored, or excluded? They offer engineers and designers tools to examine the larger context they are embedded in and make them reflect on the effects of their research and design activities. Empirical studies from this field provide evidence that science, technology, and society co-materialise, including the reproduction of existing power structures and gendered images of their production and application field (Benjamin, 2019; Cipolla et al., 2017; Ernst and Horwath, 2014; Ford and Wajcman, 2017; Subramaniam et al., 2017; Suchman, 2007). As a consequence, science and technology can neither be seen as objective nor as neutral spaces. They are what Haraway (1988) calls "situated", mirroring the power relations and social orders of a specific time and context, and thus partial. Without reflection, the outcomes of any practice run the risk of generating unconscious or unintended biases, discriminations, or exclusions. These phenomena have been criticised as effects of the so-called "I-methodology" (Akrich, 1992, 1995; Oudshoorn et al., 2004). This ironic term describes an unconscious approach, where researchers and designers consider themselves advocates of the researched (user) group. However, instead of informing themselves on the users' needs and demands, they follow their own preferences and interests. To avoid such misdirections, researchers, designers – and students - can reflect on their situatedness by becoming more aware of the epistemological and ontological assumptions of their knowledge and technology production processes. Such assumptions are influenced by the social, cultural, and political context, the disciplinary culture, including implicit and explicit theories, values, and applied methods, and the researchers' personal interests. Engaging with another's point of view facilitates this reflection process.

In our course, students had to work with researchers and students from other geopolitical backgrounds and disciplines. Moreover, we referred to Participatory Design, which provides methods and tools that explicitly enable communication and collaboration with stakeholders from different domains, including users who are affected by the technology being developed. Short narratives of everyday situations, sketches, or paper prototypes are used to define the problem space and visualise future solutions that can easily be discussed, modified, and expanded collectively, including users with less technical know-how. Participatory Design is an ethical practice that draws on narrative methods that contain value judgements negotiated by diverse stakeholders (Christiansen, 2014; Stahl, 2014; van der Velden and Mörtberg, 2014). In this respect, Robertson and Wagner (2013, p. 68) refer to concepts of "dialogic ethics" in reference to Levinas (1985) or "narrative ethics" referring to Hall (2002). Originating from the Scandinavian movement of "workplace democracy" in the 1970s, Participatory Design follows an emancipatory agenda that explicitly requires integrating users who are affected by the technology being designed, but are often marginalised or overseen (Ehn, 2008; Björgvinsson et al., 2010; Buchmüller et al., 2016). Users are

regarded and appreciated as experts on their own domains who shall become co-researchers and co-designers, collaborating with other experts in the process of defining and solving problems on equal terms. Costanza-Chock (2020) even insists that people "most affected by the outcome should lead design processes" (p. 85) and therefore "be involved throughout all stages of any tech project" (p. 98). That's why Participatory Design considers "community accountability" (p. 86ff.) a cornerstone of design justice. It also requires that people own the process and its results.

In our course, the combination of FSTS theories and participatory design methods led to intercultural, transdisciplinary collaborations with particularly disadvantaged and marginalised users in India and Germany. This combination promised to provide "performative effects" that allow for more socially fair knowledge and technology production (Sciannamblo et al., 2018).

Ideally, Participatory Design opens up a 'Third Space' that Muller and Druin (2012) define as space for mutual learning and equal negotiations between heterogeneous participants. These participants collaboratively identify problems, generate ideas, and consider alternatives to make joint decisions about beneficial solutions. In this respect, design is understood as a collective practice of exploring possible futures and solutions. In our course, we expanded the Third Space concept from such transdisciplinary engagements towards pedagogy. We offered a teaching and learning environment for mutual learning by collaboration between heterogeneous participants. It comprised collaborations between teachers and students from different countries and disciplines and amongst students working together in culturally- and disciplinarily-mixed teams, including collaborations with informants from affected social groups in Germany and India (Fig. 4). This heterogeneity opened up a Third Space that allowed for different situated actions – intercultural, interdisciplinary, and transdisciplinary – as a means to make the students aware of their (unconscious) assumptions and prejudices toward people who perceive, define, and solve problems differently. This concept took Haraway's notion of situated knowledge seriously since we created a space for engaging with another's point of view responsibly. It aimed at making the students globally and socially responsible "collective designers" (Ehn and Badham, 2002; Ehn et al., 2014).

Case Study: A research and teaching collaboration between a German and an Indian University

The course we take here as a case study took place at the Technische Universität Braunschweig (TUBS), Germany and the IDC School of Design at the Indian Institute of Technology Bombay (IDC@IITB), India, from October 2020 to February 2021. It resulted from an intensive exchange around overlapping and complementary research interests during a visit of an IITB delegation at the TUBS in 2019. The idea of offering a joint online course was promoted by experiences with online-only teaching at both universities during the summer semester of 2020 because of social distancing and lockdown requirements due to the Covid-19 pandemic. The course was open to Indian industrial design students (BDes, MDes and PhD) as an add-on learning elective and to German students of all disciplines and degrees. Consequently, the course participants were diverse not only in their cultural origin but also in their disciplinary backgrounds and stages of education (Fig. 4, middle column).

The teaching team that consisted of the authors of this paper comprised a professor (PhD) of industrial design from the IDC school of design at IITB, India; a professor (PhD) for *Gender, Technology and Mobility* at TUBS, Germany; and her research assistant, a feminist design researcher (PhD) (Fig. 4, left column). The German researchers focused on FSTS and critical and participatory design approaches to support socially responsible research and development in

engineering. The Indian professor provided extensive competencies in design forecasting, user-centered design, and hands-on experience in collaborative industrial design projects. The teachers' distinct disciplinary backgrounds, experiences, and research interests helped create the right boundary conditions for successfully running this experimental course.

Objectives

The course aimed at teaching the students how to do research and design in a socially fair and democratic manner that counteracts or (in the best-case scenario) overcomes socio-technical inequalities in a globalised digital world. As an essential requirement, students should become aware of, appreciate, and finally integrate different affected stakeholders' perspectives into the research and development process. As teachers/mentors, we consider this ability an essential prerequisite to acting responsibly as future researchers, designers, and engineers in a globalised digital world.

To achieve that goal, we created a research-oriented, project-based teaching and learning space. We, the teachers, clustered the student participants, diverse with regard to their cultural origin, disciplinary background, and level of knowledge, into intercultural and interdisciplinary teams. Each team had to create their own research project that focused on the relationship between social inequalities and technology during Covid-19. Following FSTS perspectives, the teams had to identify social groups from both countries who were particularly affected by the pandemic and vulnerable or disadvantaged regarding technical accessibility or socio-technical participation due to pandemic-related measures.

The overall task of the students was to investigate the 'real' concerns of informants from the identified social groups using the methods of user-centered and participatory design research and propose corresponding design solutions for the future.

Course structure

The course was attended by ten students from distinct backgrounds, including Bachelors, Masters, and PhD researchers (Fig. 4). The small course size offered a very intimate atmosphere, suitable for intense exchanges between students and teachers. The web conference platform BigBlueButton was used for discussions and presentations, while the collaborative exchange of thoughts and ideas was supported by the visual platform Miro.[1]

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[1] URLs of the used digital platforms and tools: https://www.bigbluebutton.org; https://miro.com/de/

Figure 1: Personal stories about living as student in times of Covid-19 in India and Germany

Figure 2: Socio-political contextualization of Covid-19

In the following, we outline the five-step course structure.

Step 1: All course participants shared personal insights on how Covid-19 changed their daily lives, collected on a pinboard in Miro (Fig. 1). These personal stories were the basis for discovering the first similarities and differences of what it means to live as a student or university teacher under pandemic conditions in India and Germany. Personal experiences were framed and contextualised by political structures and decisions in both countries and their consequences for public life (Fig. 2).

Step 2: To sensitise the students to socio-technical inequalities, they were introduced to FSTS and Participatory Design theories and approaches.

Figure 3: Brainstorming about marginalised groups in times of Covid-19 in India and Germa*ny*
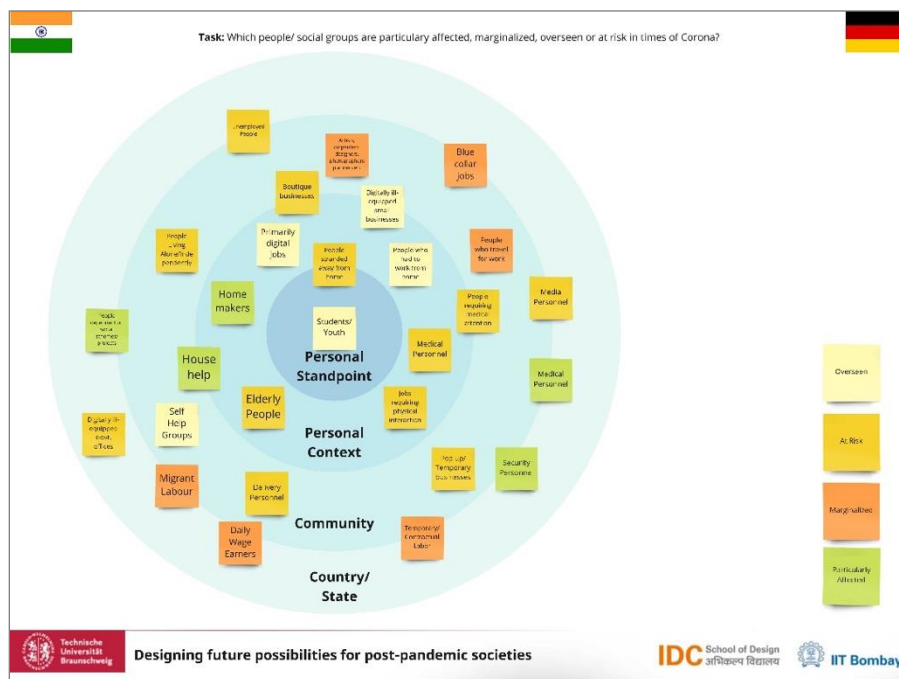
Step 3: The teachers clustered the student participants into three teams, whose members were mixed according to their cultural origin, disciplinary backgrounds, and level of knowledge. Each team created their own design research project, which focused on social groups who were identified as particularly disadvantaged in their socio-technological participation during pandemic times in India and Germany (Fig. 4). Team 1 focused on primary/elementary school teachers. In both countries, these had suffered from the lack of technical equipment, tools, and skills, albeit to different degrees. Additionally, online schooling is a particular challenge for teachers of very young pupils who are not yet able to read and write. Team 2 investigated working mothers who were challenged to reconcile private and professional duties at home through carrying out increased care duties for young children. The team paid particular attention to the distribution of home and care work between the women and their partners. Team 3 explored the situation of young adults with mental health

issues who suffered enormously from the effects of social isolation. That team found out that mental health problems increased or manifested under lockdown conditions in both countries.

Step 4: All three teams went through the same process consisting of 1) research and analysis; 2) projection, ideation, and design; and 3) user testing. They were introduced to methods of participatory design research in weekly sessions. The teachers also provided material for enhanced learning. All research results were documented following a scenario-based design approach (Rosson and Carroll 2012). Instead of formalised requirements or abstract user need models, this approach offers a way to transfer research insight into stories or narrative texts that describe a technical system's current and desirable future application from the user's perspective. In participatory design contexts, these scenarios or stories are used as communication tools between designers and users to create a mutual understanding of the problem space and drive a discussion about possible futures and solutions.

Step 4.1: During the research and analysis phase, each team conducted contextual interviews with informants from their selected social group in India and Germany to gather insights on their current situation and difficulties. Instead of visiting and observing the interviewees within their familiar environment, the teams had to consider social distancing requirements and adapt their research methods accordingly. Their analyses were accompanied by desktop research into media reports and surveys. Based on these insights, the teams created problem scenarios that had to be discussed with and confirmed by the informants. We used scenario-based design as a storytelling method that allows users to transcend cultural, disciplinary, and academic boundaries. However, sharing personal stories is a very intimate task. Consequently, ethical questions were raised, especially when working with stakeholders who were particularly vulnerable (such as the people with mental health issues that team 3 worked with and focused on). Using and designing digital technology that addresses privacy issues and involves the risk of data control and surveillance was also discussed. In this respect, as already pointed out by Downey et al. (2006), problem framing represents a crucial step because of its serious implications for the resulting solutions. Following FSTS perspectives, for instance, Costanza-Chock's (2020) arguments for design justice, problem scenarios have to consider relations of power and domination between stakeholders or domains and corresponding inequalities. Finally, scenarios provide opportunities for perspective change and intercultural learning by making different views and life situations easily accessible and comprehensible to others.

Step 4.2: In the phase of projection, ideation, and design, the teams had to think about what could or should be in future. For this purpose, they had to create future scenarios that considered social, political, economic, and technological trends or developments and illustrated how the informants they had involved in the design in India and Germany might be affected by them. A list of intended design values in the form of parameters offered by design forecasting (Malhotra, 2016) supported the scenario creation. These parameters had to be reflected on and prioritised by the teams and offered a systematic way to concretise design solutions in domains like humans, technology, and the environment. Supported by this method of design forecasting and considering future trends, the teams had to create target scenarios describing a solution for a problem they had identified during their research and analysis phase. This solution provided the basis for designing a lo-fi prototype.

Step 4.3: Based on the target scenarios and prototypes, the teams conducted feedback sessions with the informants to check whether they had understood their life circumstances and current problems. The teams finished their design research projects by integrating results from the feedback session in the analysis and design proposals.

Step 5: At the end of the course, the students were asked about their learning experiences. For this purpose, the teachers conducted an online survey that asked the students to think about the different forms of collaboration in the course and evaluate their lessons. In addition, we discussed the results in a concluding online session bringing everybody together.

## Reflections through different collaborative actions

This section follows our course structure concerning the students' learning experiences in order to evaluate how the goal of expanding the students' cultural, disciplinary, and personal situatedness as a way to overcome the so-called I-methodology was achieved. First, we describe and visualise the collaborative setting of the course. Then, we explain how we conducted a survey to gather feedback about the students' learning experiences. The last part provides an analysis of how the different forms of collaboration affected learning.

The collaborative setting of the course

The learning experiences the course enabled derived from the heterogeneous composition of the participants and the organisational structure. Both elements provided an educational framework that enabled situated reflection through different collaborative actions. Figure 4 visualises the collaborative setting of the course that comprised intercultural, interdisciplinary, and transdisciplinary virtual-only collaborations between participants who were diverse in their cultural origin, disciplinary backgrounds, level of disciplinary knowledge, personal expertise, and experiences.

The graphic below (Fig. 4) shows that all collaborations were framed by the intercultural context, resulting from the variable origins of the participants and the investigated groups from India and Germany. Within the intercultural frame, interdisciplinary interactions took place amongst teachers with different and extensive experiences in user-centered, participatory design research and gender studies, between teachers and students, and amongst students with varying levels of knowledge in industrial design and from different engineering domains. The transdisciplinary collaborations were enacted by the theoretical and methodological framework of the course that encouraged the students to apply FSTS perspectives, and user-centered and participatory design methods. Given that six out of ten participants were industrial design students studying at least on a master's degree level or even doing their PhD, most were familiar with standard design approaches like observational studies or usability testing. FSTS and participatory design research, however, were new for most of the students. Combining these approaches asked the student teams to collaborate with informants from particularly affected social groups in both countries during the research and analysis phase and to request their feedback on the developed prototypes. The various collaborations were enacted through the organisational structure of the course. The teachers and students met online once a week on the virtual conference platform BigBlueButton and these weekly sessions were used for exchange. The student teams shared their results, progress, and problems through oral reports or presentations. The teachers, in turn, offered recommendations and provided theoretical or methodological inputs according to the tasks that had to be accomplished by the teams during the following week. After each session, the teachers reflected on the teams' progress and difficulties while the teams continued working on their projects in a self-organised manner.

Figure 4: The collaborative setting of the course showing the heterogeneity of participants, different occasions and forms of collaborations
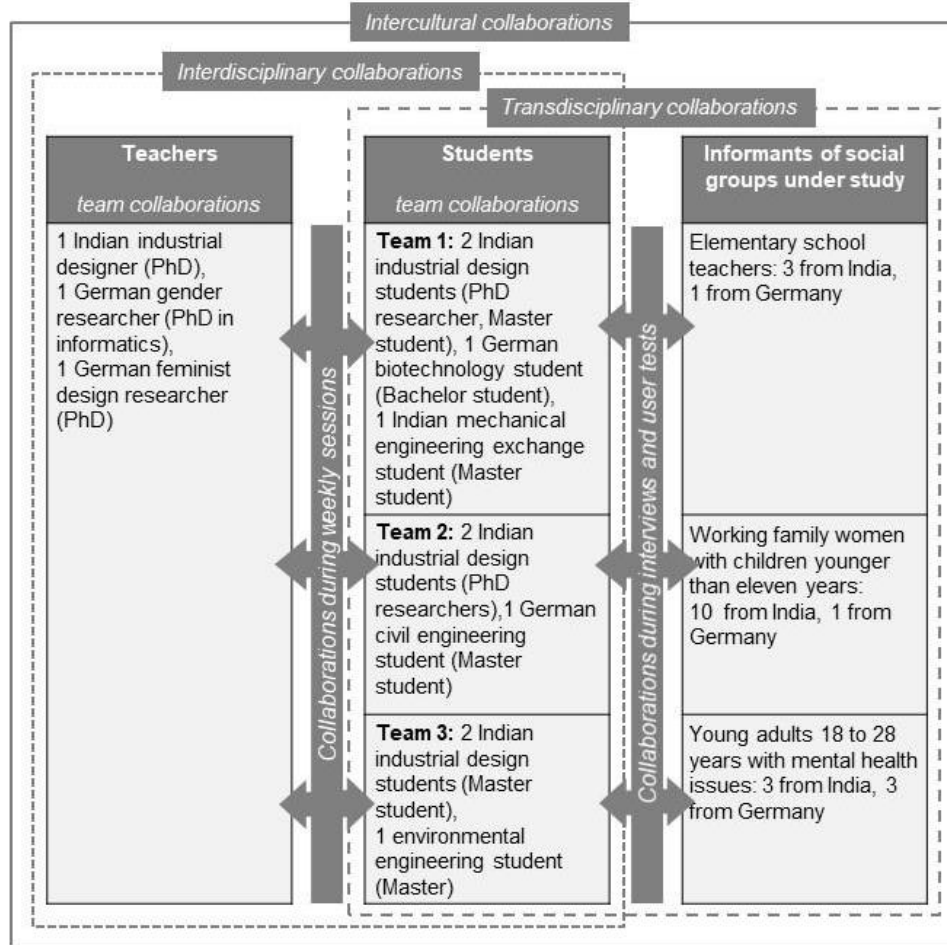
Method: Evaluating students' learning experiences from intercultural, interdisciplinary, and transdisciplinary collaborations – conducting an online survey

To evaluate learning effects on the students, we developed a questionnaire asking students about their learning experiences from these collaborations. For this purpose, we used an online survey created on a Google form filled out by each of the ten course participants. The survey was structured into three main parts. The first part asked about general information on the students, such as their major subjects, target qualification, and current study affiliation. The second part contained eight questions on the learning outcomes. We applied a mixture of predefined answers, Likert scales, and open questions to help the students qualitatively define, quantitatively evaluate, and describe their learning experiences in their own words. The first question asked the students to rate their learnings from each of the theories and approaches taught in the course on a five-item scale (from 1=no idea, not applicable to 5=great, understood it fully and can confidently apply in future studies). Next, they

were asked to rate their overall intercultural learning experience using a five-item scale (1= low, 5=great) again.

The following questions were formulated in a way that encouraged the students to engage in small thought experiments. They were asked to rate and openly speculate on their own learning experiences by imagining how it would have been if they had carried out the same tasks alone, or the course was monocultural, monodisciplinary, and without interaction with the informants. The final question offered a predefined list of different learning aspects: group activities/peer learning, learning through projects, cross-disciplinary study, cross-cultural study, and participatory design/user interaction. The students had to rate those according to their importance to their personal learning experience (1=not relevant to 5=most relevant). The third part of the questionnaire asked for feedback on the pedagogical quality of the course, using similar five-item scales to rate the offered content from 'poor' (1) to 'awesome' (5), the applied teaching methods from 'yawning' (1) to 'stimulating' (5), and the increase in understanding on the subject matter from 'not a bit' (1) to 'improved a lot' (5). These ratings were followed by open questions about the students' favourite things about the course, their challenges, and suggestions for improvements.

The survey results provided evidence that the way we formulated the questions and the combination of ratings with open answers helped the students deeply reflect on their experiences and ultimately provided very personal insights and perspectives. The survey, therefore, turned out to be a suitable approach to accessing the students' learning experiences that provided a fruitful basis for further discussions in the final session with all course participants.

Findings: Survey results

This section represents the findings and discusses how the different forms of collaboration taught the students to engage with another's point of view and ultimately enhanced their ability to act responsibly in a globalised digital world.

Overall rating of the learning experience

The intercultural learning experience was rated high by all ten students. Cross-cultural studies and project-based learning were most emphasised, rated most important by six participants and very important by four. These were closely followed by group activities and peer learning, which were considered most important by five and very important by four participants, and cross-disciplinary studies, which were evaluated as very important by eight participants. These findings suggest that project-based intercultural, interdisciplinary, and transdisciplinary learning experiences complement one another. One student described the overall experience as follows: *"The framework was perfect with lectures, an accompanying project, very good teamwork in the group and the interaction with the users."* The students appreciated the gradual introduction of theories and methods and the project-specific and personal recommendations from the teachers.

Intercultural learning experience

The intercultural nature of the course was a strong motivation for the participating students. For some, it was the first time coming in contact with people from the corresponding country (Germany or India) – a fortunate opportunity enabled by the online format. The students enjoyed the general intercultural exchange and engaged actively in discussions about the pandemic from different cultural perspectives. They profited from the *"quite good discussions not just for the tasks, but also*

cultural, language based, geographical, socio-political." The intercultural comparisons made them *"look and think outside the box."* They revealed similarities and differences between countries that contributed to a better understanding of the structural conditions resulting from each participant's personal situation, culture, and political system. *"The intercultural exchange and comparison helped and led to a kind of macro-view on the particular situation",* as expressed by one student. Another student discovered structural differences they were unaware of before: *"I was not sure of the social security benefits of teachers in Germany and those were a good point of inspiration."* Differentiating between structural and personal aspects might also be necessary for deciding what can be influenced, changed, and even improved by design. In this case, the scenario method was emphasised as a helpful means to facilitate cultural comparisons based on stories instead of abstract information.

The intercultural collaboration increased understanding and empathy with the foreign culture and enhanced awareness of the students' own culture by questioning previously taken-for-granted aspects. In some cases, it also led to an intercultural exchange of ideas and solutions: *"We got to know which country dealt better with a similar situation."*

Comparing working alone against working collaboratively

The students were asked to think about their hypothetical learning experience had they been working on the same tasks alone. Almost all believed that the course would have been less exciting and motivating. Additionally, the findings would have had an exclusively Indian or German focus, depending on the student's background. They speculated that they might have accomplished the tasks faster but felt they would have missed out on the motivating team dynamics and the different perspectives. One student added that "*the way I would choose the target users and define the scope of the problem would be very different and narrower than what we ended up doing as a group."*

Comparing working with people from one discipline against working with people from other disciplines

The participants regarded design as a diverse field that depends on inter- and multidisciplinary inputs. As a consequence, they considered the various perspectives and approaches offered by interdisciplinary inputs and collaborations very rewarding. They argued that this diversity expanded their knowledge base and practical skills, enriched their discussions, and contributed to a better understanding of the problem to be solved. As one student stated: *"different personal backgrounds often mean different approaches toward problem solving. People from just one discipline would probably have similar methods."* Consequently, *"a monodisciplinary approach would have narrowed down the possibilities and thinking"*, another student pointed out. Agreeing with that sentiment, one student assumed that *"there would be probably less breadth and more depth, but the output would not be as holistic as it turned out to be in a multidisciplinary setting."*

Comparing learning experiences through 'interaction with real users' against 'no interaction with real users'

Accomplishing the overall goal of the course would be considered hardly achievable without the information provided by the informants of the investigated user groups:

(…) without actual users and their stories, our solution had lesser chance of being appropriate and actually helpful. Some very unique insights were a result of those interviews and they informed us to ideate in the right direction.

Interacting with target social groups helped us understand the extent to which we end up assuming and speculating when we work in isolation. If we had not interacted with targeted social group, probably we would have missed a lot of nuances and subtle differences and would have ended up with a shallow, prescriptive solution which might not have addressed the core issues.

Another student stated, however, that this information increased the complexity, which made finding a solution harder. Still, they said: *"Pretty hard to imagine this course without interacting with the participants."* Doing participatory user research virtually due to lockdown and social distancing was even more challenging as the following quote illustrates:

Major challenges were conducting user studies and testing through digital format. Though the team managed to go through with it, I missed the inputs of an observational study or shadowing exercise where I could see the small actions of the users which they might've skipped while narrating their experiences.

The collaboration with people from another country increased empathy for the culture as a whole and the social groups or "subculture" under research, as the following quote illustrates: *"(...) Without the constant interactions our group would not have understood the plight of teachers neither have been able to convey their struggles."* Elizabeth Sanders (2002, p. 4), a participatory design researcher from the U.S., considers empathy for users a constitutive basis for design resulting from emotional understanding and complementing rational understanding. In some cases, the intercultural interactions challenged the students' assumptions created by affinity and prior dispositions, as reflected in this quote:

It was especially important in my case since I was also a part of the user group that our team had selected and my prejudice would have been very high if I did not interact with others like me who had gone through the same problem with different experiences and different solutions.

Overall likes and learnings from intercultural, interdisciplinary, and intercultural collaboration

Most students emphasised their enjoyment of the rich communication within teams and during the weekly sessions with all participants, including the teachers. This interaction even helped, as one student explicitly stated, to overcome social isolation during the pandemic: *"The course indirectly helped as a communication tool which I missed during the lockdown. I am happy to get to know more people, both from India and Germany."* Although the intercultural and interdisciplinary collaboration posed some challenges, it was a motivating driver the students found inspiring and rewarding beyond accomplishing their tasks. They mainly appreciated these exchanges for their own learning experiences and personal growth. These encounters provided mutual inspiration, new methods and skills, and expanded the teams' competencies that frequently complemented one another:

Also seeing the different approaches that everyone would like to take for the project was really interesting.

> *What I learned most was how to define problems and try to find directly related solutions, which was not very easy.*

Additionally, they liked working on projects they were interested in that addressed contemporary issues: *"I was free to deal longer with a topic that interested me personally."* Another student emphasised, *"the up-to-dateness of the course as well as the intercultural part. Most fascinating, I guess, was to talk about the pandemic with the Indian colleagues and exchange the point of view of it."*

The challenges of virtual, intercultural and interdisciplinary teamwork

Working together virtually across cultures, countries, time zones, and institutions was challenging due to bad internet connectivity or different personal schedules and responsibilities. It was also a physical effort, as the following quote vividly describes:

> *Finding the right time that everyone was free. Our meetings and interactions would many times be in the night, sometimes extending from 11 pm to 4 am IST. This at times became challenging.*

One student complained about the restrictions of virtual user studies that detach both researchers and users from context:

> *Major challenges were of conducting user studies and testing through digital format. Though the team managed to go through with it, I missed the inputs of an observational study or shadowing exercise where I could see the small actions of the users which they might've skipped while narrating their experiences.*

Another challenge resulted from communication amongst non-native English speakers. In the beginning, as one team reported, they were struggling with different accents and usage of the English language, which was also shaped by discipline-specific terms. Over time, however, they developed a mutual sensitivity for personal ways of speaking. Another team considered the imbalance of knowledge that resulted from group members who were already working on their PhD in design and others who had no idea about design a significant challenge. It was solved, however, by working closely together. Finally, all teams dealt with intercultural and interdisciplinary circumstances and learned *"how to effectively work in a multidisciplinary and multicultural team spread over multiple locations"* as a student summarised.

The overall findings give support to the claim that the entanglement of intercultural, interdisciplinary, and transdisciplinary collaboration effectively encourages learning experiences that contribute to overcoming what was initially described and criticised as I-methodology:

> *The course helped me understand how to minimise the effects of my assumptions and biases while working on identifying problems and generating probable solutions for a structurally marginalized target group.*

Conclusions

This paper discussed an intercultural, interdisciplinary, and transdisciplinary learning experience offered by a university course organised by the three authors who teach at IIT Bombay, India, and

TU Braunschweig, Germany. Students working in diverse teams from both universities developed design proposals from an analysis guided by Feminist Science and Technology Studies, Participatory Design, Design Forecasting, and other methods in a project-based, research-oriented educational setting. The design task was situated in the Covid-19 pandemic by researching social groups that were particularly affected by the pandemic and its societal effects. Student feedback was very positive on all aspects of the collaboration even noting that whilst such collaboration might 'slow down' the progress of a project, the ethical and nuanced nature of such collaborations provide deeper, richer and more satisfying learning projects and experiences.

Our evaluation indicates that the course achieved its main objectives. Students learned how to deal responsibly with multiple perspectives in a globalised digital world. Concerning their research and design task, they learned to reflect and contextualise their personal embeddedness and situatedness. Hence, they were able to overcome what was initially criticised as 'I-methodology'. Moreover, the students learned how to deal with and even appreciate people who define and solve problems differently – a capability that Downey et al. (2006) termed a global competency. In various collaborations, they showed engagement with another's point of view. The students developed empathy as an additional effect of engaging with others alongside the emotional understanding that complements a mere rational understanding which traditionally forms a constitutive basis for design.

This project's research ethics and orientation are in line with feminist approaches and participatory methods in design. Thus, the success of the course in achieving its objectives can, in part, be considered a result of the theoretical approaches, namely FSTS and PD, which we had chosen and taught as course content. Through a close interconnection between theoretical input and practical application, these approaches created a sensitivity to social inequalities and the particular disadvantages and marginalisation of the chosen social groups in the teams' focus. According to the evaluation, however, it was mainly the students' organisation in intercultural and interdisciplinary teams and the weekly sessions with the teachers as mentors that enabled students' learning experiences. These educational settings generated authentic collaborations that could make students and teachers aware of taken-for-granted assumptions as a prerequisite to engaging with another's point of view. Moreover, our study shows that the effects of intercultural, interdisciplinary, and transdisciplinary collaboration reinforce one another.

In order to conceptualise the collaborative setting (Fig. 4) that represented the core of our pedagogical concept, we extended the concept of Third Space (Muller and Druin, 2012) through intercultural, interdisciplinary, and transdisciplinary collaborative actions between heterogeneous participants. Our study findings indicate that the extended version of this concept has the power to support rethinking approaches to international learning in higher education. Such spaces promise to offer experiences that increase sensitivity to others, enhance everyone's ability to engage with different perspectives and approaches, and support international competencies that researchers from several domains need to act responsibly and ethically in a globalised digital world.

In the context of the debate on internationalisation and digitalisation, our study provides an example of how to realise courses for the category of "internationalisation at a distance" that Mittelmeier et al. (2021) introduced as a third category between "internationalisation abroad" and "internationalisation at home". This model opens up intercultural teaching and learning opportunities without forcing students to relocate. Nevertheless, structural differences at the university level challenge the implementation of such courses, such as imbalances in credit structures, academic calendars, and other procedural nuances. Therefore, we would like to conclude with a few practical recommendations for university teachers who aim to set up similar initiatives.

Recommendations

Drawing on our collaborative setting (Fig. 4), we recommend a research-oriented and project-based course, which involves students from different cultural and disciplinary backgrounds and other diverse stakeholders. In our experience, intercultural, interdisciplinary, and transdisciplinary collaborations foster the negotiation of diversity at various levels. In such spaces, inexperienced students in their early stages of study should be integrated into supportive teams that include students from higher semesters. All students should be accompanied by experienced teachers, who give theoretical and practical advice.

To tackle multiple challenges at various level and power imbalances between the participants, teachers need to create a space that offers time and resources to make both teachers and students find suitable ways of collaborating. Within these collaborations, diverse time frames, capacities, mindsets, individual working routines, and preferences for (digital) technologies, platforms, and tools must be considered. Instead of providing a recipe for successful intercultural, interdisciplinary, and transdisciplinary collaboration, we consider experimenting with teaching and learning practices and discovering the innate strengths of various tools to adjust them to the specific participants, situations, and contexts a necessary and rewarding endeavour.

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