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# Supporting research on gender and design amongst STEAM researchers in the souths: A case study of subsumption in design methods

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**Abstract:** This paper tells the story of a research program that subsumed the approaches of design, arts and social sciences to enhance gender aware and inclusive research amongst twenty academic teams of Science, Technology, Engineering, Arts and Mathematics located in the Souths. These are the findings of our empirical exploration to support the emergence of a transdisciplinary area of research and practice which we defined as Gendered Design. The key factors that proved crucial to overcome disciplinary boundaries and catalyse processes of empowerment are: theoretical and methodological openness, design-driven strategy and experimentation, as well as a holistic and affective approach to collaborations and relationships.

**Keywords:** gendered design; participatory design; STEAM; transdisciplinarity

## 1. Introduction

In this paper, we examine new paradigms of transdisciplinary design research. We do this by presenting, and reflecting on, a research program that supported twenty academic research teams of Science, Technology, Engineering, Arts and Mathematics (STEAM) doing research on gender and design, and located in the Souths. We use the word “Souths” as opposed to the generalized term Global South, to recognize the variety of alternative epistemological perspectives specific to the countries and cultures of the researchers that participated in the program (Santos & Meneses, 2013).

Initially envisioned by a local governmental funding agency, the program appealed to us as a challenge that stood at the “cutting edge of complexity” (Dorst, 2019, p. 124). It required designing and managing, across three continents, distinct projects which, if they shared those goals, had different disciplinary backgrounds, sectors of application and socio-cultural contexts.



We report here on the lessons learned, as this opportunity developed, about the methods and the role of design in transdisciplinary research. The paper introduces both the theoretical background and the changing and evolving nature of the program, officially called *Gendered Design in STEAM in LMICs* (GDS). It then reflects on how the program was crafted slowly and collaboratively, by observing, testing, and tweaking processes between regions, disciplines, scholars, and communities.

Drawing from the understanding that transdisciplinary research and knowledge both value contextual, and concrete approaches applied to real life situations (Freitas et al., 1994), we decided that the structure and style of the paper should integrate theory with a narrative that also describes and reflects our experiences, the pivoting steps that allowed the process to move forward. We start by presenting how the theoretical foundations of the program came together; we then describe how we operationalized main concepts; and we conclude with reflections on what we have learned about the nature of transdisciplinary work.

## **2. Theoretical foundations of the program**

Our journey started when the International Development Research Centre (IDRC), located in Ottawa, Canada, asked us to manage a research program that had the overarching goal of supporting more inclusive practices in STEM (not STEAM) among academics of Low- and Middle-Income Countries (LMICs), by promoting ‘gendered innovation’ as a new area of practice and research. Specifically, the program had to accomplish three goals. The first was to make gendered challenges that arise in the design of technologies more visible to researchers, designers, and innovators alike. This goal had been explored in the North, and doing work in this emerging field from the Souths could represent a unique contribution to knowledge. The second goal was to identify, make visible, expand, and enhance the global community of experts and innovators in gendered innovations. The identification of participating teams, and the method of work, would also represent a unique contribution. The third goal was to test how design methods of gendered innovations could support research on the topic among LMIC researchers. Our mandate was firstly to identify research teams whose activities we were going to fund, through a call for project. Secondly, to support each selected team in their research process. Thirdly, to foster interactions, knowledge exchange and peer support between the members of the emerging network.

The tasks ahead of us, as complex and challenging as they were, stood at the intersection of many recognized types of practices, formal and informal, known and unknown, academic and real life, all with a need for final and tangible outcomes. We tried to identify preconceived notions in order to avoid them, and to make space for transnational perspectives, as well as variations in knowledge (academic and ‘popular’), expertise and experience. With a few milestones and ideas for collective activities that could guide a collaborative and open-ended process, we thus embarked upon exploring possible meanings of the inclusion of gender considerations in design.

The following theoretical concepts have been crucial to the program: gendered design; participatory research and design; and research at the intersection between Science, Technology, Engineering, Arts, and Mathematics (STEAM).

### *2.1 Gendered innovations and design*

The initial task was to probe the potential of the notion of Gendered Innovation for STEM research in the Souths. According to those who coined the expression, Gendered Innovations can be understood as new or improved products and processes designed using sex and gender analysis, generating substantial benefits for society, and advancing gender equality (Schiebinger, 2008). Prominent authors in the field speak of two types of gendered innovations: 'gender responsive' and 'gender transformative'. Innovations of the 'responsive' kind integrate gender in their rationale, design, and methodology, and rigorously analyse gender inequalities to inform implementation, communication, and influence strategies. This type of innovation does not address structural dimensions of gender inequalities, which our program set to examine. By contrast, innovations of the 'transformative' kind are more in line with the concerns of our program; they examine and analyse gendered practices; they build a base of evidence to inform long-term practical changes in the power relations and norms, roles, and inequalities, where differentiated experiences based on gender occur.

Starting from these definitions, and borrowing from the field of Participatory Design (PD) and Critical Studies in Design, we implemented a conceptual change: from "Innovation" to "Design". Since the word innovation is often understood as something new, as in a business innovation, it was not well-suited to represent a program aimed at promoting traditional, and various types of knowledge. Design can be as much about the acknowledgement, maintenance or improvement of existing practices and products as it can be about invention (Cruickshank, n.d.; Kolko, 2008; Samples, May 25, 2020).

The expression Gendered Design thus seemed to fit our goals better: it refers to the practice of reflecting upon, and incorporating systematically, gendered considerations in all design exercises. With the help of De Laurentis (1987), Suchman (2002), and Bardzell (2010), we agreed to work with the 'transformative' understanding that the socio-cultural nature of gender issues, and the nature of power dynamics in general, require an engagement at the communal grass roots level, as well as a critical reflection on the politics of technology. In this regard, below we discuss how co-creation and participatory methods would become crucial to the practice of Gendered Design, as they allow for the engagement of local communities in a redistribution of power, when the time comes to make decisions related to technology (Simonsen & Robertson, 2013).

This initial understanding of Gendered Design did not necessarily need to be embraced by the research teams of STEM academics that we were going to support. We wanted them to explore, and come to terms with, what gender and design could mean in their different geographical, national, and economic contexts.

Feminist standpoint theory and the situated nature of knowledge (Haraway, 1988) reminded us to pay attention to who has the power to produce recognized knowledge. As women are too often underrepresented and/or overlooked in STEM and design fields, we recognized that women's voices are often silenced, invisible and lacking agency over knowledge production (e.g., Fricker, 2007) in STEM research, which led us to prioritize STEM projects either led by women or directly or indirectly benefitting women's lived experiences, perspectives, and histories.

The Call for Projects launched in 2019, asked applicants "to carefully consider and articulate how their proposed project falls within the category of 'Gendered Design' in respect of their unique LMIC context". We thus conveyed both our own working definition of 'Gendered Design' and the openness of the program to various interpretations of the notion of gender.

## *2.2 Participatory methods*

The second theoretical foundation is composed of the twin notions of Participatory Action Research (PAR) (FalsBorda, 2001; Thiollent, 1985) and Participatory Design (PD) (see for instance, Simonsen & Robertson, 2013). They allow for the critical reflection on the politics of technology and on the potential for redistribution of power mentioned above.

Participatory Design (PD) is an approach of diverse origins. One of the most well-known was formulated in Scandinavia in the 1970s as a direct response to changes in workplaces occasioned by the introduction of automated technologies (Simonsen & Robertson, 2013). Academics in design committed to democratic values reflected on the implications of new technologies on users' lives and on who had the decision-making power over them. As it evolved and transformed, PD has been embraced by practitioners from different fields and geographical areas. The field of application has expanded from the workplace to wider social contexts and matters - living labs, social innovation, and public engagement - through what have been defined as democratic design experiments (Light & Akama, 2012; Binder et al., 2015; Del Gaudio et al., 2018; Noronha et al., 2020). In parallel, a growing number of academics in the field of design have explored the implications on people's lives of what is designed and how it is designed, and have further asked how to make design processes more inclusive and democratic (Del Gaudio et al., 2018; Del Gaudio, forthcoming).

PAR is a form of PD that has seen wide application in social improvement projects, many of them located in the Souths, and implemented by Southern citizens. According to the methodology of PAR, the promotion of transformative processes is linked to a better understanding of local realities (FalsBorda, 2001). Bridging practice and theory, it places local populations at the center of the interpretation of the design context, definition of solutions and the production of knowledge (Thiollent, 1985).

These two approaches informed our early decisions and actions. Two of us had expertise and experience with PAR and PD (Hallgrímsson, 2018; Del Gaudio et al., 2016), and were committed to making such ways of linking design and research inherent features of the program. In this way, the research program provided a unique and new opportunity to allow

these approaches to be adopted between and amongst scientist, engineers, designers, and local stakeholders in the context of gendered design with a focus on the Souths.

### ***2.3 The addition of the “A” in STEAM***

The funding agency (IDRC) had observed the presence of humanists and social scientists in teams of STEM researchers that had a more gender-aware practice (Saint-Denis, 2020). The research office at Carleton University also had identified a practical case of this synergy at work in the former research projects of one of the authors (CUDRG, n.d.). From working with one of the other authors (Hallgrimsson, see *Made in Africa Mobility Lab*, n.d.), the funding agency had witnessed and identified the power of design to be a “natural bridge builder between technology and humanity” (Dorst, 2019, p. 119).

As we took on the challenge of supporting STEM researchers to be more socially focused, we adjusted our terminology from STEM to STEAM. To fully affirm the relevance of this approach for the desired socio-technical transformation, we included the arts and social sciences as full partners in the program. The naming was suggested by our regional expert for the African region, Emmanuel Mutungi, who brought the notion back from similar initiatives in which his colleagues had been involved. In the context of this study, STEAM refers to the integration of concepts, methods, and perspectives from the Creative Arts (visual arts, performing arts and literary arts and design) and the Liberal Arts (social sciences and humanities) in STEM research. We were thus set to work in a transdisciplinary fashion (Held, 2016).

## **3. Practicing transdisciplinary research**

A transformative approach driven by design methodologies led to the making of a core team with a broad representation of faculties from within and outside of our own university.

This meant discovering, across our large and common institution, scholars, graduate students and administrators already versed in transnational and interdisciplinary work. To the initial group made up of one design scholar researching prototyping in the Souths and one social historian of development and solidarity, we added a third academic who just joined our institution, a design scholar with experience of work with PAR and PD in the Souths (Del Gaudio, 2018). Subsequently, we looked for Regional Experts (Figure 1; Figure 2) among Southern colleagues, expert in gender and design, participatory design and local knowledge, respectively located in the three large regions of the projects – Latin America, Asia, and Africa.

Each funded project was also going to be supported by Sector Experts (Figure 1; Figure 2), whose respective experience fit broadly thematic sectors discussed below. Additionally, one Gender Expert (Figure 1; Figure 2), joined the group, an anthropologist specialist in the study of technologies in the Souths (Mire, 2012). Coming from several disciplinary and regional traditions, these Regional and Sector experts would identify networks of researchers

suitable for the upcoming Call for Projects, help select the local research teams, and support them thereafter.

A substantial portion of resources went to the funding of graduate research assistants in our and our partners' institutions. This was consistent with the transformative approach of the program: we wanted to engage and train a new generation of transdisciplinary researchers. Some research assistants were going to support the Sector Experts, while others the Regional Experts as well as our own work of coordination. We also established an operational unit in our own institution, staffed by a full-time Research Coordinator.

Given the complexity of the project and language and disciplinary barriers, visual infographics would become an efficient tool of communication amongst members of the project. From the beginning, the following chart (Figure 1) clarified to all parties, including the participants that answered the Call for Projects, the goals, team membership, funding available, activities and timeline.

It should be noted that we did not wish for this structure to become an inflexible plan. Instead, it was offered as the starting point for an organized "inception" event, held in May, 2019. This event aimed at gathering interest in our institutional community, our institution's STEAM scholars and graduate students, by introducing the Regional and Gender Experts as well as the representatives of the funding agency; and by inviting participants to explore ways of working. Embracing one of the theoretical foundations of the program, Participatory Design workshops were held to allow participants to bring their respective disciplinary knowledge to the design of activities that would best serve the program over the subsequent two years.

This event represented a critical moment in reframing the program. Our collective understanding shifted away from statements of "what the program should be" towards questions of "what the program could be" and a more responsive "let's work together, listen to each member of the program, see how things unfold, and adapt" approach.

Strong of this shared and enriched sense of direction, we finalized the Call for Projects. To welcome as many disciplinary contributions and approaches to knowledge production as possible, the Call included a choice of two streams: one for case studies and/or narratives of past/ongoing experiences of Gendered Design; the other for developing Gendered Design prototypes informed by case-studies. At the same time, we limited proposals to six specific thematic sectors of STEM: transport/mobility; renewable energy; manufacturing; housing, built environment and public space; infrastructure; and accessibility. The sectors reflected the expertise of the colleagues who joined the project, the mission of the funding agency (which excluded the better researched domains of health and agriculture), and the expertise and knowledge of the initial team.

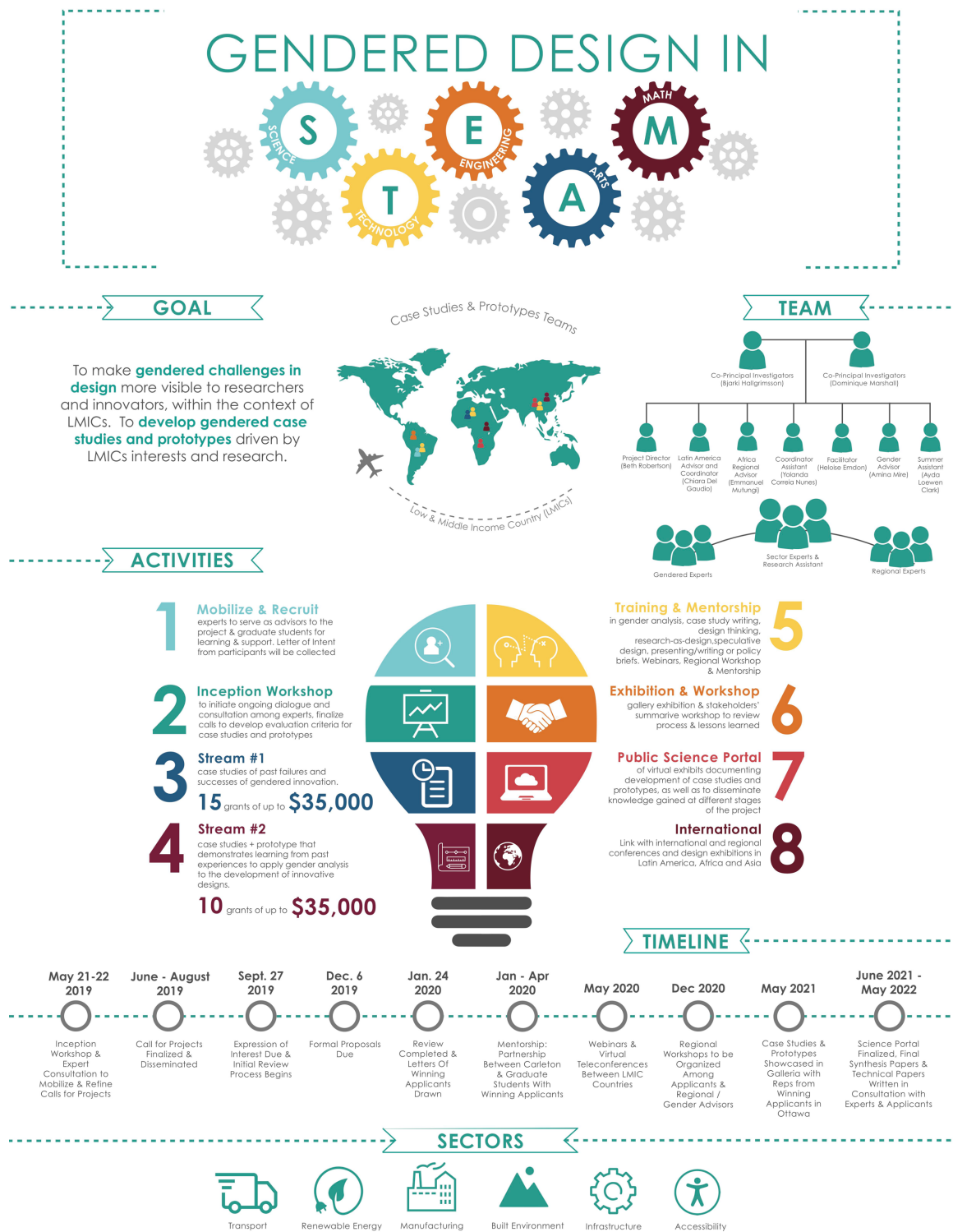


Figure 1. Poster representing the GDS program in its initial stage (May 2019).



Twenty research teams, ten in each stream, received funding. The Stakeholders' Chart presented in Figure 2 shows the twenty projects selected from approximately one hundred applications. The infographic illustrates early organizational decisions: a core team, surrounded by an extended team of Sector, Gender and Regional Experts and, ultimately, the twenty projects. The Chart illustrates the interdisciplinary, geographical, and thematic complexity of this creative and committed network of researchers. For us, the program provided unique opportunities for learning about the very nature of transdisciplinary work.

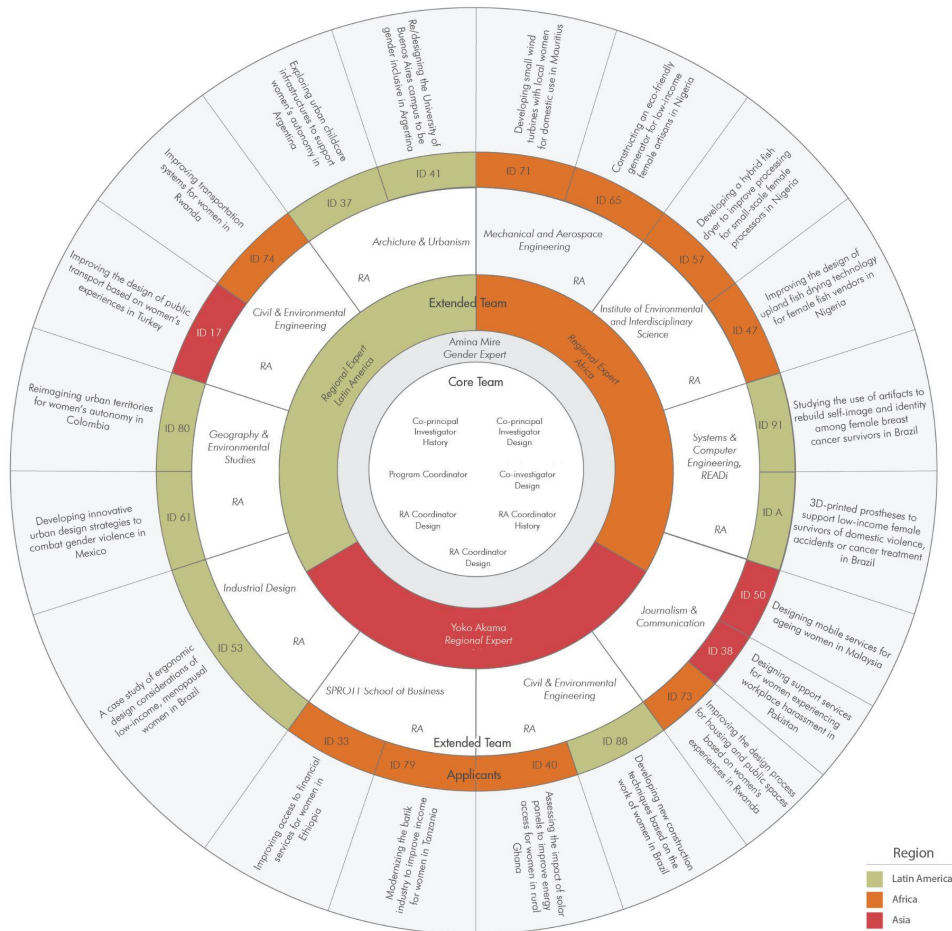


Figure 2. Infographic representing the stakeholders of the program, their role and relationship (September 2020).

Initially, we envisioned a set of regional workshops in the Souths. Material and epistemological difficulties associated with this formula emerged, as well as the associated need for change. Firstly, the funding would limit the overall number of participants. Secondly regional workshops, conceived to acknowledge and enrich localised traditions, were not sufficient to allow for meaningful cross-pollination between continents, such as supporting exchanges between projects in the same sector located in different regions. Furthermore, considering that Gendered Design, as we conceived it, would only be possible through the

convergence of diverse expertise - disciplinary, regional and others, we set to imagine a program able to support the emergence of a “collective form of intelligence” (Lévy, 2014). This would recognize the fact that each project team, as well as each expert, had some of the required knowledge.

Through design-driven strategies and processes (Freire et al., 2017; Verganti, 2009), we re-conceived the program to be a physical and virtual Hub for Gendered Design research and practice: a platform for transdisciplinary exploration. We hoped that a Hub configuration (Figure 3) could generate new opportunities, connections, knowledge, and seeds for future activities on Gendered Design.

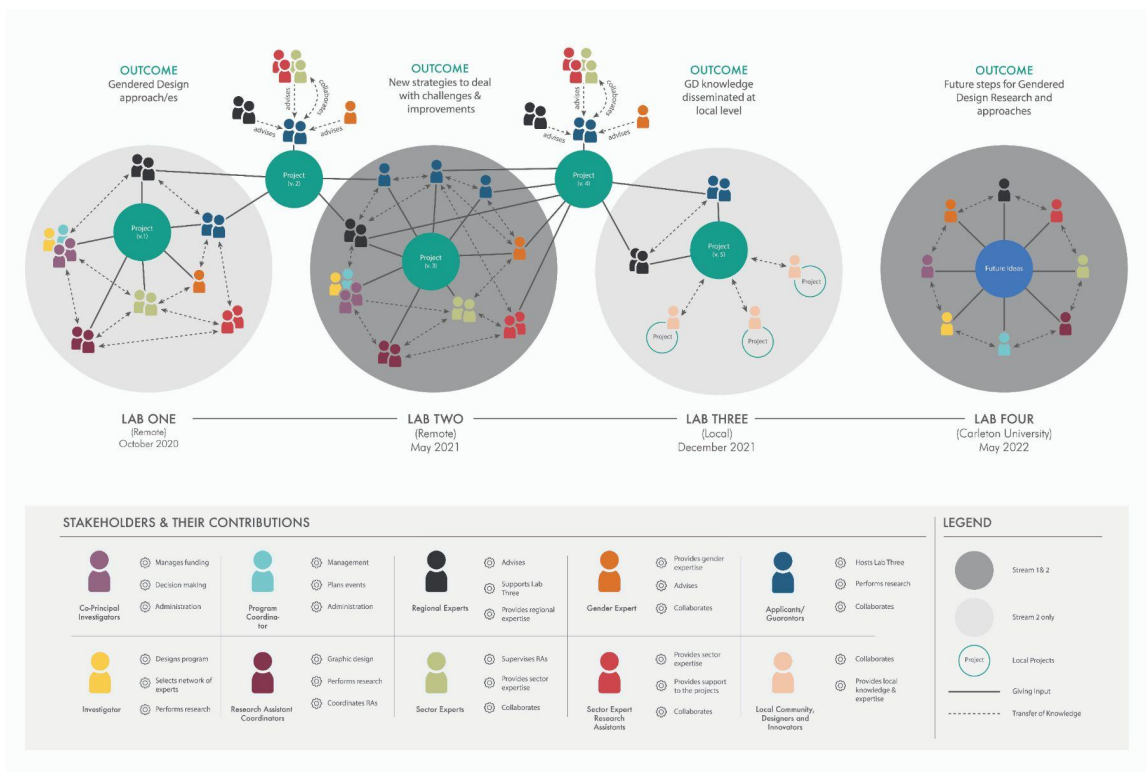


Figure 3. Infographic representing the Hub structure and dynamic (February 2020).

The Hub consisted of activities and outcomes common to all participants:

- a series of three program-wide Labs, virtual events that would focus on collective knowledge and network building (Figure 3);
- a seminar Master Course on Gendered Design;
- conversations on digital platforms (Slack and Instagram) to support knowledge exchange and network building throughout the program between the experts and the project teams, and between the teams themselves;
- a digital repository (open online library) with resources from the program;

- a bi-monthly Bulletin (Figure 4) for internal communication, focused on describing each project and including articles on workshop experiences, theoretical underpinnings about empowerment and prototyping;
- a final printed publication involving the research teams as co-authors;
- a final virtual portal/exhibit.

The Labs, core to the Hub configuration, were imagined as places and moments of collective exploration, knowledge building and advancement of Gendered Design. They would happen online, using digital tools such as “Zoom” meetings and “Miro” whiteboard tools (Miro.com). With the arrival of the COVID-19 pandemic, the teams had to redesign their respective projects in ways that would accommodate the stringent sanitary restrictions on travel and physical encounters, while preserving the intent of the original applications. The third issue of the Bulletin (May 2021) documented the remarkable ingenuity seven teams deployed to accomplish this transition. Meanwhile, the virtual Labs allowed the possibilities for peer exchange and support between projects to continue without interruptions.

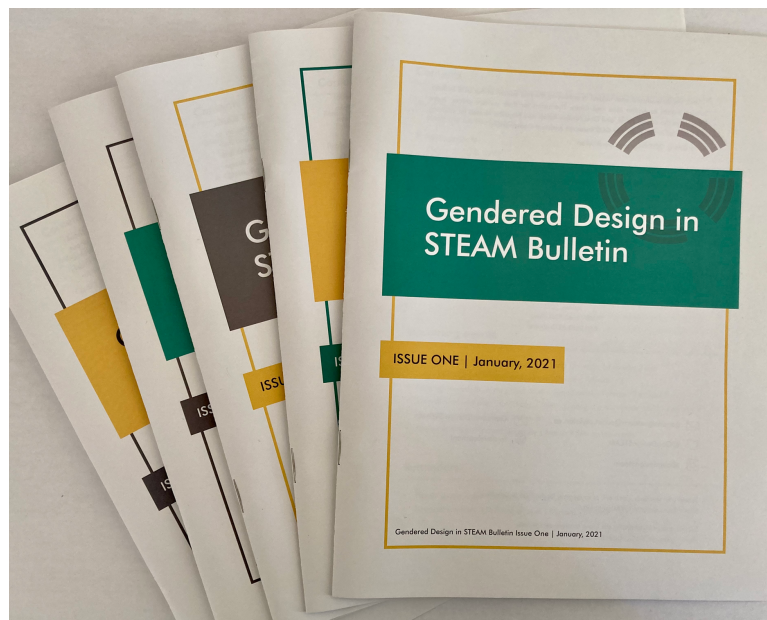


Figure 4. Issue 1 to 5 of the Bi-monthly Bulletin.

#### 4. Methods of design in transdisciplinary research

To summarize, the program embodies what Held (2016) defines as a transdisciplinary approach to research. It started with a problem - in this case bringing questions of gender to the fore of the scientific work of Southern researchers. From there, it identified those affected - in this case, the members of team in our institution and beyond, the teams of the twenty projects, and their own communities. Along the line, it was informed by continuous explorations and redefinition of the problem and of ways to address it without predetermined notions.

Retrospectively, we can reflect that this has been possible through the adoption of three separate and connected approaches: the iterative and abductive approach inherent to design; a strategic design approach able to deal with complexity; and an open and open-ended approach to design.

Embracing the program goals through abductive reasoning and iterations afforded by the prototyping approach found in the design process, required and enabled us to frame and reframe the program according to feedback and changing situations. Inherently, it also produced knowledge that would enable (yet) new possible and promising ways of working and outcomes. Putting our diverse knowledge to work iteratively in this way, allowed to build capacity at all levels.

To design ways of working and of promoting research in Gendered Design in STEAM in the Souths in such a collaborative transcultural process, we developed strategies. A new approach based on strategies emerged, and began to acquire relevance, during the 'inception' event. In that moment, we understood that flexibility had to be at the core of the program. Using a strategy rather than a plan, resulted in a flexible process capable of embracing complexity, in the face of changing and unstable situations (Morin, 2011). Accordingly, strategies for completion easily evolved with the participants' needs and feedback, external challenges (i.e., COVID-19), and project team members' insights from their respective fields. We designed ad-hoc activities, processes and tools, through which each participant's contribution could be heard regularly in order to fuel a continuous update of the program methodology. All this was embodied and reflected in the design and constitution of the Hub. This work "... constantly widened, re-adjusted and corrected during the process", is emblematic of transdisciplinary methods (Held, 2016, p. 189).

The openness of the approach and its open-ended nature enabled the program to support and follow transformations in knowledge production. Early in the formative 'inception' event, our partners appreciated design activities because they ensured an open-ended approach. We noted a general shift in mindset: the participants moved away from disciplinary, positivist and pragmatic approaches towards an approach that is open to interference and change, and that defines the method through intervention in the field (Deleuze & Guatarri, 2007).

This way of thinking, aligned with the iterative process of design and to its responsiveness, seems appropriate for a transdisciplinary endeavour. Working in unison, on all levels of the program and always with peers, allowed us to have conversations, to listen and to change. And if the lack of certainty was unsettling at the beginning to our extended team and to the participants, on several occasions, they pointed out the relevance of that approach.

Recently, we held open ended and extended oral history interviews with the twenty principal investigators of the program. These interviewees appreciated an approach that invited them to go beyond usual logics of efficiency unable to confront the complexity of the world (Freire et al., 2017). In their eyes, more than halfway through, the program seemed to

be achieving the initial ambition of empowerment in the Souths and in gendered communities.

Finally, for the interviews we used the methodology of life stories (High, 2009) whose participatory features are very similar to those of PD. This kind of reflection, possible through the inclusion of art and social science in STEM teams, made visible the kind of shared language that has been constructed in parallel with the constitution of separate academic disciplines as discussed by Held (2016). These live stories, one of the knowledge outcomes of the program, will be soon deposited and made available in a public repository.

## **5. Final considerations: On designers, gender, and southern knowledges**

The extent and the locations of the program provided the kind of opportunities, sought by Kimbell (2015, p.299), to explore, through “different kinds of practices that have developed within various institutional arrangements”, ways to employ design within transdisciplinary work and to push its potential. Her project of “critical rethinking of design”, aimed at more situated and embodied practices that do not privilege the designer as the main world-making actor, includes the very kind of systematic collection of design practices with which we experimented to imagine meaningful collaborations between projects. Regarding designers and their role, the program designers (the core team) acted more like a compass than an overseer, for the researchers, their projects, their communities, and their respective ways of working.

Regarding design, we tried to see how “a particular kind of knowledge practice can be shared across all design fields” (Kimbell, 2015, p. 299). In this case design methods were used to foster transdisciplinary work and more inclusive work in STEAM. Such exploration was necessary to gauge the usefulness and existence of the notion of “gendered design”.

In this process, we noticed that the theme of gender, which finds its “origins in activist practice”, represents “an area of study that [embodies] several societal problems”, in ways that one discipline alone cannot grasp (Lykke & Last, 2018, p. 228, 231). In many ways, the theme of gender acted as a water-tracing dye: it allowed twenty teams widely dispersed across the Souths to follow intricate flows of ideas and practices between universities and various regional and institutional communities. Experimentation in Gendered Design by teams of STEAM researchers led to work with communities either nearby, or in places close to individual researchers - their families, and their life histories, beyond the boundaries of their disciplinary training (Elder & Potskin, 2018). The goal of capturing and interweaving gendered knowledge through networks and actions, many of them informal in nature, many of them interpersonal rather than individual, calls for reflections outside of regular academic discussions. Colleagues in the arts and social sciences, who enjoyed trusted relations with nearby communities and offered methods of engagement with them, facilitated conversations and exchanges beyond academia. Design methods facilitated this process of subsumption: the exchanges between the sciences and the arts and social sciences.

Finally, the program provided the opportunities to go beyond Northern attitudes towards the Souths and to explore possibilities outside of the usual cycle of ill-informed ambitions and defeatism. The theme of gender lent itself especially well to such academic endeavour, by opening researchers' work to "other power relations", often hidden in North-South relations (Thomas, 2020; Marshall, 2021, pp. 217-218). The same is true for questions of "Indigenous and Traditional Knowledge" (Mutungi, 2018). A transcultural approach is key in this type of transdisciplinary work. In our case, we brought to the program transcultural habits of work (Freitas et al., 1994) forged in our respective, former, and current North-South research partnerships (Shivakoti & Milner, 2021). Within a notoriously unequal research world, such approaches endeavour to support and enhance Southern and Indigenous academic voices, approaches, and cultures, build local knowledge, increase the visibility of local communities studied by these scholars, and promote the dissemination of Southern research results. We now have reason to believe that when the results of the twenty projects of the GDS program return to their communities, a strong body of common knowledge will support more gender inclusive attitudes and institutions in the world of Science, Technology, Engineering and Mathematics.

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