An emerging role for design methods in transdisciplinary practice

G. Mauricio Mejía[1], Cassini Nazir[2], Roger F. Malina[3], Alex García Topete[4], Felipe C. Londoño[5], Andrés F. Roldán[6], Priscila L. Farias[7], João Silveira[8].

[1 5 6] Universidad de Caldas, [2 3 4 8] University of Texas, Dallas, [7] Universidade de São Paulo, [8] Universidade Federal do Rio de Janeiro

[1] mauricio.mejiaramirez@ucaldas.edu.co, [2] cassini@utdallas.edu, [3] rmalina@alum.mit.edu, [4] alex.garciatopete@outlook.com, [5] felipecl@ucaldas.edu.co, [6] roldaman@gmail.com, [7] prifarias@usp.br, [8] silveiraufrj@gmail.com

Abstract

This paper is a follow up to some of the authors' ISEA 2017 paper "Towards an inventory of good practices for transdisciplinary collaboration." A key issue identified there was how to develop training methods for teams that bridge very different research, development and assessment methodologies. In this paper, we propose design methods to improve transdisciplinary collaborations, with a particular discussion on the emerging community of practice that seeks to enable art-science collaboration. An ISEA workshop is also proposed to make explicit the methodologies described.

Keywords

ArtScience, design methods, transdisciplinary collaboration, education, training

Introduction

A contemporary dichotomy in western, and other, academic and industry circles is articulated between science-engineering and art-humanities. This dichotomy can take different forms; for example, hard and soft, quantitative and qualitative, logical and creative, objective and subjective, and so on. Many of these are false, or oversimplifying, dichotomies or reductionist thinking that have lessened our human ability to solve complex problems. These dichotomies are not new. As pointed out by Davis (2018), the roman polymath Marcus Vitruvius Pollio advocated many of the holistic approaches being debated today.

Nonetheless, some new integrative thinking has emerged to counter this current artificial reductionism in today's digital culture. For example, the 'STEM to STEAM' movement seeks to develop initiatives that integrate the arts, design, and humanities with science, technology, and medicine (e.g., Malina, Strohecker, & LaFayette, 2013). However, there is a clear need to develop new methods for transdisciplinary collaboration that take into account todays digital culture context (Mejia, Malina, & Roldán, 2017, p. 685). In this paper, we reflect on the use of design methods to improve transdisciplinary collaborations in order to overcome the chiasm and biases of these false dichotomies.

Within that framework and for the purposes of this paper, transdisciplinarity entails not only crossing disciplinary boundaries but also crossing sectors of society to include all the stakeholders involved or affected by an issue (Repko, 2007, p. 15). Within this approach to transdisciplinarity, design practices are particularly relevant because they are concerned with 'doing' to solve problems. Thus, using design methods in collaborations between researchers and citizens helps to focus not only in social appropriation of knowledge but also in addressing problems that are pressing in place based territories.

Scholars, for long, have discussed whether the design practice is an art or a science. For example, in Calvera (2003) authors debated the relationship between art and design. Arguably, design is both art and science. Some authors have strongly contended that design practice is different from science to avoid the common confusion that scientific research methods can be used to solve design problems (see Krippendorff, 2007). In this paper, we discuss how design methods incorporate mindsets and techniques from both art and science, such as embedded observation borrowed from ethnography and sociology, or fast prototyping that echoes of sketching by visual artists. This integrative designerly approach leads us to propose that design methods are a potential tool for transdisciplinary collaboration.

Art and science, Art Science, ArtScience, Sciart (and more…)

For the past several hundred years, the paths of artistic expression and scientific endeavor have diverged increasingly, prompted by developments within academia and industry (such as the emergence of disciplinary departments of study and the division of labor, respectively). Moreover, the divergence kindled the philosophical questions of "what is (good) art?" and "what is (good) science?", further separating the two in ways that have led to a profound difference of identity between scientists-engineers and artists-humanists despite their similarities in practices and philosophies (Leach, 2011, pp. 144-146).

For the authors, art has the following general characteristics:

- Art, like design and science, is a creative endeavor.
- Artists try to change the perception of humans through attaching meanings to experiences .
- There is research in art and design, which is similar to research in science.

For the authors, science has the following characteristics:

- Science is the human activity which seeks to understand causal mechanisms in phenomena that can be observed by humans.
- Scientists seek to produce knowledge and understanding that are not biased by the human cognitive apparatus.
- Scientific research seeks to predict things that happen in the world.
- Engineering, design, and other applied sciences use design methods.

Although art and science seem to be identifiable categories, some human activities are ambiguous or integrative. For Strosberg (2015), art and science today often share the same tools and materials and technology becomes their main connection (p. 23). Frayling (1993) argued that there is not much difference between art and science. He said that the history of institutions and media has shaped stereotypes that have mistakenly separated art and science practices; for instance, in their practice, artists do research activities and scientists do creative activities (p. 3). For these reasons, integrating artists and scientists in collaborative work is a cultural and institutional challenge.

Recently, some universities are increasingly offering academic programs and research in art and science. One example, in which some authors are affiliated, is the ArtSci Lab at the University of Texas at Dallas. ArtSci lab states that "[they] are a transdisciplinary research lab—helping the arts, science, and technology communities by pursuing initiatives of societal urgency and cultural timeliness;" one of the used methodologies is designing projects with collaboration between artists and scientists from the inception. In France, initiatives such as the SACRE PhD program (https://collegedoctoral.univ-psl.fr/doctorat-psl/programme-doctoral-sacre/) trains PhD students across art and science disciplines. The Carasso Foundation (http://www.fondationcarasso.org/fr/event/la-chaire-arts-sciences) also recently created the first university chair in Art Science bridging disciplinary institutions.

One critical issue that justifies the need for arts/humanities and science integration is the recognized demand that science and technology should not be separated from social practices and belief systems in human groups. In the Frankfurt School, science had a social function, which means that scientific problems are expected to respond to a collective interest (Horkheimer, 1998). Helga Nowotny, former President of the European Research Council, has called for 'socially robust science' (Nowotny, 2003, p. 151-153). The multiples initiative of art and science in their different flavors all aim to tackle the demand for social-centered ways of knowing.

Design methods

One of the core issues in the history of design methods is the tension between intuition and rationality. Design education in Europe and the US originated in art and craft schools; thus, designers relied primarily on creative intuition and implicit knowledge. In early 20th century, western design education was based on the master-apprentice model, in which novice-students practiced in studios with expert-instructors to learn design crafts. Some traditional learning techniques include analyzing exemplars, sketching, prototyping, and critiques. These techniques are based on intuition because little evidence from the real-world is used for decision-making. In the 1960's, the design methods movement appeared, and several of its proponents, such as early Christopher Alexander advocated for rational methods in design to address the increasing complexity of design problems (Alexander, 1964, pp. 8-11). Soon, the excitement about more logic and less intuition in the design process was questioned by Alexander himself and others; in the 1970's, 'second and third order' design methods emerged exploring the participation of the users in the process and revisions about the role of intuition in design thinking (Cross, 1984, pp. 303–307). Particularly, the work of Rittel showed that rational approaches from engineering and science are insufficient to address 'wicked' problems of planning because these problems are ill-defined and elusive (Rittel & Webber, 1973, p. 160). The discussion between rationality and intuition is also present beyond design; for instance, within the cognitive science communities researchers now seek ways to 'train' intuition and imagination (see http://www.cognovo.eu/)

A seminal work in design thinking is the book *Designerly ways of Knowing* by Nigel Cross, which positions design as a third 'culture' different from both (a) arts and humanities and (b) science. He suggested that designerly thinking is an alternative different from artistic and scientific thinking (Cross, 2006, p. 018). For example, he said that whereas scientists use analysis to solve problems, designers use synthesis. Cross explained:

> *The designer is constrained to produce a practicable result within a specific time limit, whereas the scientist and scholar are both able, and often required, to suspend their judgments and decisions until more is known – 'further research is needed' is always a justifiable conclusion for them (p. 023).*

Nigel Cross (2006) distinguished between scientific, artistic/humanistic, and designerly ways of knowing to capture the idea that different disciplines use different research and development methodologies to make sense of the world, its phenomena and its processes. Each discipline develops different evaluation methodologies to assess what is more or less "good" within its own approach. Cross noted differences between the sciences, arts/humanities, and design in the phenomenon studied, the appropriate methods, and values (see table 1).

Table 1. Cross' ways of knowing

	Sciences	Arts/ Humanities	Design
Phenomenon of study	The natural world	Human experience	The artificial world
Appropriate methods	Controlled experiment, classification, analysis	Analogy, metaphor, evaluation	Modelling, pattern-formation, synthesis
Values of each culture	Objectivity, rationality, neutrality, and a concern for 'truth'	Subjectivity, imagination, commitment, and a concern for 'justice'	Practicality, ingenuity, empathy, and a concern for 'appropriateness'

A practical, well-known, and contemporary design method is the double-diamond model (The Design Council, 2014). In Figure 1, the left sides of the diamonds represent divergent thinking and the right sides represent convergent thinking. In this model, the Discover phase can be associated to rational research processes; however, design research is often conducted under time constraints that force a flexibility in the validity of data and the goal is to inform design-decision making instead of generation of scientific knowledge. Also, the Develop phase can be associated with intuitive artistic processes. There is intuition in the process, but a difference is that the goal is to find a satisficing practical solution not to seek the sole subjective expression of the designer.

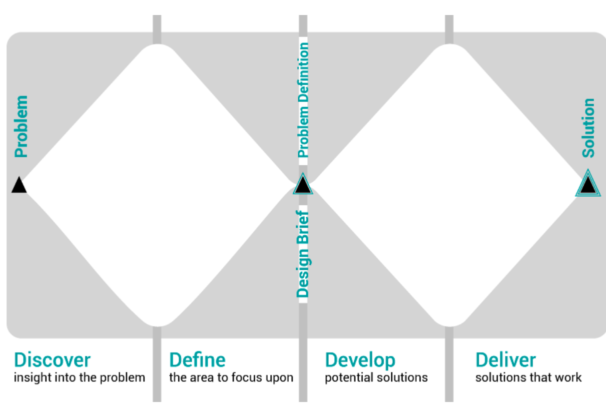

Figure 1. Adaptation of Design Council's double-diamond model. Design by Luana Carolina and João Silveira

Christian Rohrer's *Landscape of User Research Methods* (2014) proposes a visualization of the landscape of design methods within two axes: attitudinal and behavioral, and qualitative versus quantitative (see figure 2). These are more methodological tools that can be implemented depending on the situation and designer's decisions. The methodological tools on Rohrer's landscape have various purposes depending on the needs and phases of the project. Some tools are generative, used in early ideation; exploratory, for concept generation and understanding criteria; or evaluative, testing of the system. The process and methods of design described above allow designers to create possible futures, much of which would not come to be naturally.

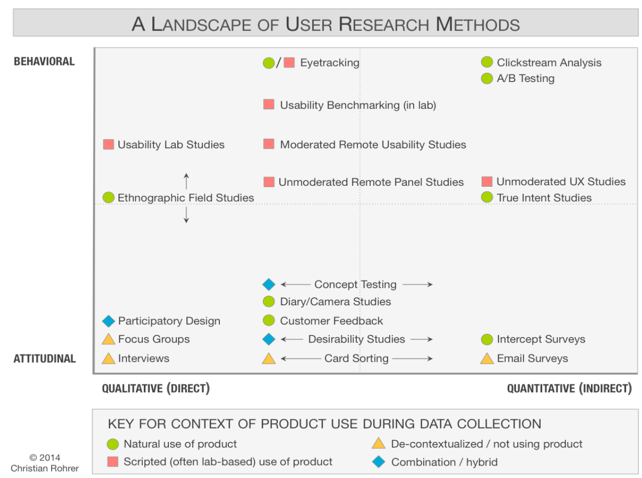

Figure 2. Rohrer's grid, showing 20 popular methodological tools of design

A recent approach in the field is codesign. It is a collaborative design practice in which two or more designers, or participants from different disciplines, come together in an articulated and integrated manner to design products and services. Sanders and Stappers (2008, p. 2; 2012, p. 30) define codesign as a specific instance of cocreation in which collective creativity is applied throughout the design development process. Collective creativity refers both to the set of creative qualities that the design proposal entails and to the creativity of the tasks carried out as part of this process (Yu, Nickerson and Sakamoto, 2012, p. 1). The codesign method is a place for the negotiation of ideas and approaches according to the knowledge, arguments, and points of view of the participants, their qualities directly influence the decision-making process (Jin and Geslin, 2008, p. 494; Klein et al. ., 2003, p. 201). The collaborative approach in codesign makes it a particular design method of interest for training people in transdisciplinary collaboration, even when the goal is not to design a product or service (e.g., designing the structure of a collaboration).

Design methods as a good practice for transdisciplinary collaboration

In the design methods section above, it is shown that design (thinking and methods) is a way of knowing different from art and science. However, design methods also incorporate artistic and scientific activities within several steps. We argue here that the use of design methods is and can be a potential good practice for transdisciplinary collaboration. In this context, we understand transdisciplinary practice as a unifying fusion of disciplines, in which it is not possible to distinguish a single discipline in the process and outcome (Pombo, 2008, p.14-15). The rationale is based on the idea that the design field already struggled, historically, to develop methods and proved that neither artistic or scientific thinking alone were sufficient to address complex social wicked problems, which are the type of problems often addressed in transdisciplinary collaborations.

Design methods have been applied not only to design physical artifacts but also for intangibles like services and collaborations. High order design problems such as interactions, services, environments, and systems (see Buchanan, 1992) need more thoughtful methods and processes that usually involve the participation of different stakeholders and collaboration among designers, other disciplines, and users. Increasingly design problems are addressed by transdisciplinary teams and have shown successful integrations of diverse designerly ways of knowing (e.g., Brown, 2007). Solving problems using design methods is a potent practice to facilitate transdisciplinary collaborations. For example, transdisciplinary projects aimed for innovation tend to turn the participants into problem-solving designers, which has been the exemplary case of Aerocene, a transdisciplinary collaborative effort to accomplish lighter-than-air travel, and of IndaPlant, an attempt at merging robotics and plants to automate biodomes (Garcia Topete, Malina, Strohecker, & Thill, 2017, p. 6).

Transdisciplinary collaborations involve professionals with very different, though overlapping ways of knowing. We have argued that one of the benefits of transdisciplinary collaborations is to draw on different ways of knowing to overcome limitation and biases inherent in each when appropriate, but also to benefit with alternate methodologies. We argue against the idea of simple 'consilience' (Wilson, 1999) as a way of integrating together different ways of knowing, but draw on Slingerland and Collard's concept of using integrating methods in different ways depending on scale in time, size, or other metrics of phenomena or problems being addressed (Slingerland & Collard, 2011). We argue that design methodologies are an appropriate approach to designing transdisciplinary collaborations (which may or may not in themselves involve designers as one of the disciplines, and may or may not be about designing a product or service as the outcome of the collaboration).

Reflecting on the idea of transdisciplinarity as crossing boundaries in sectors of society (Repko, 2007), design methods can be a strategy for collaborations between citizens and experts. A potential role of design is to dynamize the social appropriation of artistic and scientific knowledge. Design itself is moving towards more collaborative approaches to solve problems and create complex sociotechnical systems.

It can be argued that a major weakness of design practitioners is the lack of reflective practice, which is critical in the flow of transdisciplinary collaboration. Most design processes often omit (or at best tacitly include) reflection as a needed part of the process. Schon's model of reflective practice can enable double-loop learning (Argyris & Schon, 1978), where the mental models and views of the world can be refined, updated and changed based on new understanding of the world. Reflective practice is particularly relevant when working with a transdisciplinary group that sometimes have varied understanding and viewpoints of the world.

The issue of how to train professionals engaged in transdisciplinary projects is rising in importance. For instance, at the University of Texas at Dallas, under the leadership of Dean Anne Balsamo a new masters in how to teach in ways that embody "STEM to STEAM' concepts is under development; this work draws on Balsamo's research such as *Designing Culture: The Technological Imagination at Work* (2011). The SACRE PhD in Paris, cited above, is a different approach. Key issues involve identifying and transferring implicit knowledge between different disciplines using apprenticeship methodologies, and experimental publishing methodologies for knowledge capture (e.g., Hall, Bermell-Garcia, Ravindranath, & McMahon, 2017).

In addition to the paper proposed by the authors, a proposal for an ISEA workshop has also been submitted. The authors look forward to collaborating with the ISEA community of practice in developing good training methods for transdisciplinary collaborations.

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Author(s) Biography(ies)

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