Creativity, Design Thinking and Interdisciplinarity

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Introduction: Thinking Creativity, Design and Interdisciplinarity in a Changing World

The World Changes

Creativity, *Design Thinking*, and *Interdisciplinarity*, these are three concepts that emerge in fields of study and practice apparently different but deeply complementary in the end. These three concepts come into strong resonance insofar as they seem naturally to share and convey the same spirit of openness, collaboration, and innovation. This seemingly natural link is reinforced by the spirit of our time (our *Zeitgeist*) characterized by social, intellectual, and academic conditions that are conducive to interdisciplinary communication and creativity in education, research, business, social and cultural practices. Think and act creatively, at the interface and beyond the disciplines, in an agile and insightful way of design thinking to analyze, understand, and solve complex theoretical and/or practical problems: these ways of thinking, doing, and being reflect a current trend that is clearly oriented toward openness and cross-fertilization of knowledge across multiple domains. Creativity, design thinking, and interdisciplinarity can be considered in this context as major trends of the early twenty-first century, even if they are not—and may not become—dominant in an academic, economic, and social contexts where the disciplinary order still imposes its prerogatives. Detection of these background trends makes it possible to amplify their status of *weak signals* (Ansoff, 1975). This appeal to interdisciplinarity, creativity, and design is largely noticeable in our academic, economic, and cultural environment and must be attentively and anticipatively heard and noticed. This book aims to contribute to this exercise of epistemological and strategic intelligence that shows the strength and potential of so-called weak signals but whose echoes are increasingly stronger. It is time to think about links between these trends, and renew thought and practice in a more interconnected perspective, in order to strengthen ties between communities of researchers and practitioners working in and on creativity, design, and interdisciplinarity. If this book has an originality, it is that of proposing a space of reflection that meets the expectations and questions of a large community of researchers and practitioners

who work either on or with design thinking, creativity, or inter- and transdisciplinarity, or at the interface between these areas.

The values of dialogue and openness are borne by more or less para-academic organizations, such as the P21 (*The Partnership for 21st Century Learning*[1]) which promotes the 4C abbreviation (Communication, Collaboration, Critical Thinking, Creativity), four key competences to position and develop in a constantly changing learning society. In the same vein, the World Economic Forum Future of Jobs Report[2] highlights the 10 top skills that will be needed for students and workers in the digital and transdisciplinary world of tomorrow. By 2020, these competencies should include ability to solve complex problems, critical thinking, creativity, ability to coordinate with others, negotiation, cognitive flexibility, or emotional intelligence. It is a question of thinking differently, thinking in a more collaborative, creative, and interdisciplinary way, whether in academic research, teaching or with a view to professional integration into jobs of the future that are as yet unknown and to be invented. The trend is toward sound reflexivity on ways of thinking, being and doing, learning to learn with agility throughout one's life, and solving complex problems in a rapidly changing world and not simply accumulating an endless list of disciplinary knowledge.

It is not only para-academic or non-governmental institutions that are aware of these values, movements, and attitudes that move the lines between boundaries. Research funding agencies have become aware of the need to promote and develop interdisciplinary and creative research, understood as a means of advancing knowledge and accelerating scientific discoveries. Among other national, European, and international funding agencies, the US National Science Foundation (NSF)[3] promotes and supports innovative research projects that require the involvement of several disciplines while exceeding their strict limits to develop new or emerging fields. The NSF relies on a relatively consensual definition of interdisciplinarity and widely shared among the research community in interdisciplinary studies. It is thus defined in a National Academies report:

> Interdisciplinary research is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice. (Committee on Facilitating Interdisciplinary, Research, 2005, p. 2).

Building upon interdisciplinarity, the NSF takes a step even further to strengthen collaboration, creativity, and innovation, inviting researchers to take risks and to

[1] See: http://www.p21.org: «P21, The Partnership for 21st Century Learning (formerly the Partnership for 21st Century Skills), was founded in 2002 as a coalition bringing together the business community, education leaders, and policymakers to position twenty-first century readiness at the center of US K-12 education and to kick-start a national conversation on the importance of twenty-first century skills for all students».

[2] See: http://reports.weforum.org/future-of-jobs-2016/.

[3] See : https://www.nsf.gov

submit transformative research projects that can transform existing scientific paradigms. Relying on the 2007 report 'Enhancing Support of Transformational Research at the National Science Foundation', the National Science Board presents its findings and recommendations for NSF to enhance its ability to identify and fund transformative research. NSF has adopted the following working definition:

> Transformative research involves ideas, discoveries, or tools that radically change our understanding of an important existing scientific or engineering concept or educational practice or leads to the creation of a new paradigm or field of science, engineering, or education. Such research challenges current understanding or provides pathways to new frontiers.[4]

A permeable interface is clearly perceptible between interdisciplinarity and new forms of research qualified as 'transformative,' 'innovative,' 'high-risk,' 'creative,' 'frontier,' or 'breakthrough' research. Beyond the official boasting and the multitude of reports that point to the need for interdisciplinarity and creativity, the basic idea that emerges here is why and how interdisciplinarity can be creative, why and how creativity is interdisciplinary and likely to tackle the decompartmentalization between disciplines, and finally what is the role of design thinking in this game, in the new ways of developing and practicing research.

A Dialogic and Trialectic Vision

Interdisciplinarity, creativity, and design thinking are objects of study that are constitutive of rather autonomous fields of research but whose connections can be highlighted. These three theoretical and practical objects relate, respectively, to interdisciplinary studies, creativity studies, and design studies, each field claiming itself a certain interdisciplinary openness. Indeed, interdisciplinarity is a crosscutting theme: Creativity is not reduced to a strictly psychological approach, it is also social, cultural, economic, and finally, design does not belong solely to designers; it is studied by specialists from several disciplines. Each of these areas of research has reached an advanced stage of development. They are structured, with some flexibility, around relatively specific theories, concepts, and methods. And they make sense within scientific communities, research networks, and national and international associations that are not necessarily connected. These states of significant scientific development are more and more documented in handbooks that testify to the production, importance, and coherence in the diversity of these different scientific communities. Progress in research on interdisciplinarity, for example, is presented in publications that describe a structured body of knowledge, while avoiding a disciplinary paradigm that would be sterilizing for the development of the field (see, e.g., Darbellay & Paulsen, 2008; Frodeman, Thompson Klein, &

[4] See: https://www.nsf.gov/about/transformative_research/definition.jsp.

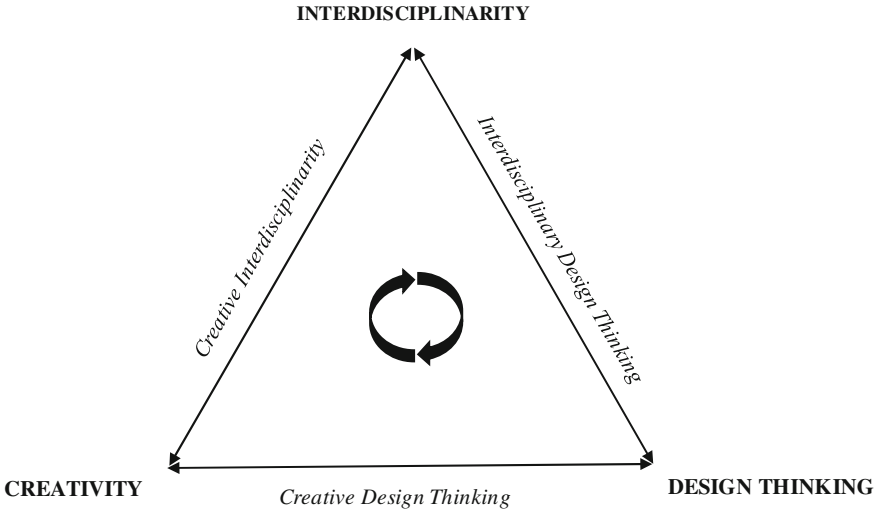

Fig. 1 Interdisciplinarity, creativity, design thinking

Mitcham, 2010; Hirsch Hadorn et al., 2008; Repko, Szostak, & Buchberger, 2013). Similarly, studies on creativity have reached this level of manual setting, presenting this interdisciplinary field of studies in the complementarity of theoretical, conceptual, and methodological approaches (see Glăveanu, 2016; Kaufman & Sternberg, 2010; Runco, 1997; Runco & Pritzker, 2011). As for design, it also federates researchers from different disciplinary horizons which make it an object of study. The journal *Design Studies* (The Interdisciplinary Journal of Design Research[5]) is particularly emblematic of the fertility of this field of research. More specifically, design thinking is the subject of numerous publications, guides, and manuals defining the stakes, methods, and fields of application (see Brown, 2009; Cross, 2011; Plattner, Meinel, Leifer, 2010).

The aim of our collective book is not to present a state of the art or advancement in each of the areas, but to propose points of contact and articulation between these fields of study that meet around convergent interests. Figure 1 illustrates this linkage between the three fields of study.

It is a matter of opening a constructive dialogue between these three fields of study which have not been closely linked yet. By mobilizing a principle of *dialogical* thinking (Morin & Le Moigne, 1999), the interrelationships between interdisciplinarity, creativity, and design thinking are not contradictory or antagonistic, but associated with a complementary way without being resolved into a unifying superior synthesis. This dialogical vision makes it possible to envisage a trialectic dynamic in the interactive movement between the three poles of Fig. 1. The objective here is to offer researchers a space to explore possible recursive

[5] See: www.journals.elsevier.com/design-studies.

relations between these domains. This opening to a circular causality and not a simple juxtaposition between fields of studies makes it possible not to exclude one or the other pole of this triad. According to the third included principle ('tiers inclus,' Lupasco, 1951), each domain is likely to contribute to the development of the other two and vice versa. Let us briefly define each field of study and show how they can connect as in a Möbius strip.

Interdisciplinarity

If the desire to create bridges between disciplines is an integral part of the history of science (Gusdorf, 1983), it can be agreed that the thematization of the issues of interdisciplinarity in the production of knowledge emerged in the 1960s and 1970s (Thompson Klein, 1990). Although definitional subtleties can be debated endlessly, a consensus around the definition of interdisciplinarity—as already indicated above—has spread widely in the scientific community (see Darbellay, 2005; Huutoniemi, Thompson Klein, Bruunc & Hukkinena, 2010; Piaget, 1972; Thompson Klein, 1990). Unlike the multidisciplinary approach which most often reproduces divisions between disciplines by simple addition/juxtaposition, interdisciplinarity attempts rather bring together two or more established disciplines, so that they interact dynamically with each other. Based on a multidisciplinary vision of knowledge, this interaction between disciplines aims at questioning whether to transgress the boundaries between them. With the objective of analyzing and understanding the complexity of an object of study or solving a theoretical or practical problem, this first phase of interaction should lead to a fine articulation and integration of the various complementary points of view in a negotiated and global perspective among the partners involved in the research process. Interdisciplinarity, which goes beyond the mere juxtaposition of disciplinary points of view, involves the collaboration and integration of specific disciplines in relation to a common object.

The process of dialogue between disciplines requires that each researcher deploys the analytical skills and tools of one's own discipline while opening one's mind to the methods of other disciplines. The object of knowledge is complex and emerging; it is at once more than the mere sum of disciplinary knowledge and irreducible to one discipline. The collaborative approach and the integration of disciplinary knowledge can take place at different levels: for example, borrowing or transferring concepts, theories, or methods between more or less distant fields; mechanisms of hybridization, transgression, or transformation in contact and crossing between disciplines; or the creation of new fields of research by coupling two or more disciplines. With the power of the ideas that drive interdisciplinary work (open-mindedness, thinking outside the disciplinary box, transgression of borders, hybridization, exploratory divergence and convergence–integration, etc.), interdisciplinarity presents several points of contact with the creative process (Darbellay, Moody, Sedooka & Steffen, 2014). We therefore name this link

Creative interdisciplinarity (see Fig. 1). Interdisciplinarity, insofar as it is conceived and practiced as an innovative approach between and beyond disciplinary boundaries, joins the theoretical and practical developments of creativity. In the same vein, interdisciplinarity connects with design thinking, not only because it is diffused through many disciplinary fields and practices and because it calls for an interdisciplinary approach, but more fundamentally still because the way of thinking of the designer in the broad sense also aims at the conception and solution of complex problems in an innovation perspective centered on human experiences which is not limited to disciplinary boundaries.

Creativity

Creativity can be broadly defined as the ability to produce ideas or products that are both original and adapted to the context and constraints of specific tasks (Sternberg & Lubart, 1999). Creativity refers to a process that is both general/generic and relatively specific depending on its areas of application (Plucker, 1998). According to a multivariate model, which by definition is complex and involves several interrelated variables, the creative process mobilizes several resources at the confluence of several research domains. The creative process involves—by degree and variable weighting according to individuals and areas of expertise—conative, cognitive, and emotional factors specific to each individual, which are in dynamic interaction with the environmental context in which the creative activity takes place. The analysis and understanding of creativity in an interdisciplinary, global, and integrated perspective can only be achieved by taking into account all these dimensions and their interrelations. Creativity is thus an object of study perfectly eligible for an interdisciplinary approach, and it diffuses cross-borderly in educational, economic, social, and cultural issues. As stated above, creativity connects with interdisciplinarity, not only in the sense that it is an interdisciplinary field at the interface of psychology, sociology, management, etc., but also in the sense that it participates to interdisciplinarity and is likely to contribute to its development. Based on work concerning divergent-exploratory thinking, convergent-integrative thinking, generation of new ideas and cognitive flexibility, creative personality traits (openness to new experiences, tolerance to ambiguity, risk-taking), and cognitive styles (Lubart, Mouchiroud, Tordjman & Zenasni, 2003), advances in studies on creativity are numerous and very much in line with interdisciplinary knowledge production mechanisms (Darbellay, 2015). From a trialectic perspective, if the link can be woven between creativity and interdisciplinarity, as depicted on the double arrow in Fig. 1, creativity, like interdisciplinarity, is brought to connect with design thinking.

Design Thinking

Design thinking is a process that focuses on collecting user-need feedback, experimenting, generating prototype models, gathering feedback, and redesigning in a cyclical way. Design thinking is a way of thinking that was first developed and applied to design tasks (e.g., create a new toothbrush design), but then was enlarged to other kinds of problem-solving. Design is, by nature, a creative activity in the sense that it is generative, leading to a production (a design concept, a prototype). However, not all design thinking leads to highly creative output. Thus, there are degrees of creative success. We designate this link between creativity and design by the expression *Creative design thinking*. Creative design thinking focuses on the creative (original and adaptive) aspects of this process. When engaged in design thinking, some outcomes are more creative than others, more or less disciplined or undisciplined. How can creativity and interdisciplinarity be fostered when engaged in a design thinking process by designers, researchers, students, etc.? Design thinking is also a way to approach and solve problems that may extend beyond the more traditional design-oriented activities. When seeking ideas (outcomes) in general (outside the specific design domain), design thinking can be used as a method/tool to help people get the most creative ideas. Thus, creative design thinking can serve outside its original context, in different disciplines and areas of activity. This would be a transfer from design as a creative process to other disciplines, to accelerate the flow and generation of ideas between and beyond disciplines in the treatment of complexity, innovation, and discovery. This process takes meaning beyond disciplinary boundaries; it transcends disciplines and allows the development of interdisciplinary and collaborative work.

Collective Intelligence in Action

The contributors to this book were asked to look at these complex links between interdisciplinarity, creativity, and design thinking, links that are not yet evident in the scientific community. The researchers gathered here come from different fields of study on interdisciplinarity (*interdisciplinarity studies*), creativity (*creativity studies*), and design thinking (*design studies*), as well as various disciplinary anchors in these fields (from psychology, sociology, epistemology, etc.). Thus, they represent a multidisciplinary configuration and each one has engaged in this new reflection by opening up to other perspectives. All the contributions try to work on this dialogical approach. Each does it with nuance sometimes focusing on either creativity, design thinking or interdisciplinarity, but without losing sight of the connection to other areas. In this perspective, the book is structured in two complementary movements. The first is to reflect on the possible articulations and convergences between creativity, design thinking, and interdisciplinarity (*Thinking About Creativity, Design Thinking and Interdisciplinarity*, Part I). Muratovski

opens a first way by showing that the concept of design is constantly evolving in an increasingly complex economic and social world. The first chapter takes care to examine current trends in the field of design and its progressive opening to interdisciplinarity (*Towards Evidence-Based Research and Cross-Disciplinary Design Practice*, Chap. 1). Beyond the simple execution of a project, designers have increasingly mastered various research methods ranging from ethnology and development to case studies, action research, and human-centered design. From the perspective of innovation, the use of evidence-based research that transcends disciplinary boundaries allows better implementation of accountability, transparency, and trust in designers' work. Based on the lessons learned from the literature on creative design, Szostak shows that the interdisciplinary research process is akin to a creative design process (*Interdisciplinary Research as a Creative Design Process*, Chap. 2). Following similar steps and using similar strategies, the two processes combine conscious and subconscious thinking. Interdisciplinary researchers who aspire to be more creative and interdisciplinary instructors who want to encourage students creativity are here advised on how to integrate creative practices into different stages of the interdisciplinary research process. It goes without saying that this development of interdisciplinary creativity is not without psychological or institutional obstacles. The costs and benefits of these strategies need to be weighed in the interests of integration and global understanding.

Ambrose continues the reflection by highlighting the major challenges, problems, and opportunities generated by globalization in the twenty-first century (*Large-Scale Interdisciplinary Design Thinking for Dealing with 21st-Century Problems and Opportunities*, Chap. 3). Addressing these issues requires creative and interdisciplinary reflection and collaboration to enable individuals and teams to remedy the dogmatism that hinders the perception of complexity. It is necessary to combat dogmatism in all its forms and, in particular, disciplinary dogmatism. Dogmatism is an obstacle to interdisciplinary and creative work. The use of visual metaphorical artistic design serves as a strategy to simplify and synthesize complex ideas and reinforce interdisciplinary reflection on creative design. In the same anti-dogmatic vein, Thompson Klein explores the relationship between creativity, design, and transdisciplinarity, with an emphasis on collaborative research (*Creativity, Design, and Transdisciplinarity*, Chap. 4). Beyond differences and conceptual nuances, the three terms are related to shared characteristics, those of novelty, crossing boundaries, generativity, synthesis, criticism, and reflexivity. Transdisciplinary approaches generate new hybrid modes of inquiry and action that bridge gaps between critical theory and projective design, and between social, political, and normative practices and concerns. Conceptual forms of thought also rely on the creative dimensions of practice, fostering relational knowledge while being open to subjectivity and unexpectedness. The resolution of transdisciplinary problems is reinvigorated as a creative art of invention, accentuating discovery and learning. The divergence–convergence processes are also exploited to show how they generate new approaches through combinatorial innovation.

In fifth chapter (*Cross-disciplinary Creativity and Design Thinking*, Chap. 5), Tan presents cross-disciplinarity as a process that places humans at the center of scientific and cultural practices. Creativity and design thinking are once again highlighted as renewal operators capable of answering complex and practical problems. Cross-disciplinary creativity is likely to favor design thinking. The mechanisms of creativity (convergence, divergence, emergence) join the humanistic values of design thinking (harmony, authoritative conversation, and respect). The principles of interaction, continuity, and complementarity contribute to the emergence of a creative synthesis to find ethical solutions to complex problems. Worwood and Plucker (*Domain Generality and Specificity in Creative Design Thinking*, Chap. 6) point also to the growing importance of design thinking in professional and educational environments (from maker spaces to prototyping laboratories, to design thinking in teaching). By examining the existing literature on the creativity and domain specificity, they link up with creative design thinking. Between similarities and differences, design thinking is considered in its generality and especially in creative contexts.

The second movement of the book extends the theoretical reflection while highlighting the processes and actions that characterize creative design thinking from an interdisciplinary perspective (*Thinking Outside the Box: Interdisciplinary Process and Action in Creative Design Thinking*, Part. II). Creativity is an essential dimension of the innovative design process. Nelson and Botella (*The Multivariate Approach and Design of the Creative Process*, Chap. 7) recall that many authors have proposed models to describe creative practices, both at the macro-level (the stages involved in a creative process) and at the micro-level (the underlying cognitive processes). Without normative or prescriptive will, it is a question of structuring the creative work in order to ensure an optimal deployment of the creative potential. In this perspective, the authors present the multivariate approach that situates creativity at the point of interaction between several resources (cognitive, conative, emotional, and environmental factors). In chapter eight, Nagai and Taura discuss the concept of design thinking as a factor of innovation (*Critical Issues of Advanced Design Thinking: Scheme of Synthesis, Realm of out-frame, Motive of Inner Sense, and Resonance to Future Society*, Chap. 8). In particular, they investigate the characteristics of design through the generation of concepts for a deeper understanding of human creativity driven by design (design creativity). They address also the essential characteristics of individual creative thinking, which is a fundamental skill in interdisciplinary group work. Group work is conceived from a co-creative and interdisciplinary perspective, the aim of which is to stimulate social innovation for qualitative changes in society.

Design thinking is intimately linked to a project logic, as Vial explains (*The Specificity of the Project in Design Thinking*, Chap. 9). There is a specificity of the concept of a design project that takes on meaning in a projective logic. The theory and methodology of the project benefit currently from the contribution of Information Technology (IT), fostering an agile methodology that inspires

innovative designers. Design thinking is not only thinking, but also action and realization in a perspective of design doing (*From Design Thinking to Design Doing*, Chap. 10). Craftsmen and designers work through their bodies. Design is a kind of fabrication, a creative process by nature intrinsically disordered and not necessarily and at all times guided by strict rules and methodologies. For Juelsbo, Tanggaard, and Glăveanu, the process of creation is made of order and disorder in a co-constructive dynamic. There is then a need for methodologies to teach designers these complementary principles and to obtain their adhesion. Creative design thinking can finally help get the most creative ideas, but it is through the active realization of these ideas in everyday life that these ideas take on meaning. Hatchuel, Le Masson, and Weil propose to think about creativity beyond a simple psychological phenomenon and an ability to be acquired (*C-K Theory: Modelling Creative Thinking and Its Impact on Research*, Chap. 11). They envisage a more rigorous formalization of this process of ideation and generation of knowledge. The authors present the recent advances in design theory, namely C-K theory or concept-knowledge theory. This theory assumes that creative thinking can be formally described and experimentally tested. The C-K theory introduces new interdisciplinary notions involved in any creative process: 'concept undecidability,' 'knowledge independence,' 'generic expansions,' and 'knowledge reordering.' It is a question of describing and understanding the important operators which underpin the generative and expanding logic of creative thinking. The C-K theory aims also to stimulate transdisciplinary research through the development of a science of design and the modeling of creative logic in all disciplines. In the final chapter, by Hatchuel, Le Masson, and Weil, creativity is addressed in its potential development through innovative technologies (*Technological Innovation in Group Creativity*, Chap. 12). The advantages and disadvantages of the brainstorming paradigm are read in light of this new perspective. Key factors of effectiveness are highlighted: cognitive stimulation, social comparison, and group facilitation. At the same time, it is a matter of countering production blocking, social loafing, and self-censorship. The authors highlight furthermore a new efficiency factor for creativity, namely the fun factor: The use of innovative technology in itself introduces enjoyment, which seems to increase commitment and creative performance. The authors show also how the use and choice of avatars in virtual brainstorming positively influence the creative process and offer new tools to support group creativity.

In the continuity and articulation of the two parts of the book, two interwoven movements, readers are invited to immerse themselves in reflections both theoretical and practical, at the interface of creativity, design thinking, and interdisciplinarity.

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