

Transdisciplinary knowledge: A systemic approach to design education

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# PROCEEDINGS

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insider knowledge

Fifth International Conference for  
Design Education Researchers  
9-12 July 2019  
Middle East Technical University  
Ankara, TURKEY

**Editors**  
Naz A.G.Z. Börekçi  
Dalsu Özgen Koçyıldırım  
Fatma Korkut  
Derek Jones

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## Transdisciplinary Knowledge: A Systemic Approach to Design Education

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**Abstract:** Historically, the design discipline has been strictly connected to the productive sector. For this reason, past design education was mainly related to the world of arts and crafts and technology. With such a vertical specialization, designers could not deeply grasp the potential repercussions of their design choices. Their commitment was largely tied in with mass-production and unconstrained technological innovation. Increased awareness of the complexity of the world has emerged in the last decades. Designers nowadays are requested to achieve new transversal skills and competencies, to cope with the incumbent metamorphoses of cultures, societies, economies, and natural environments. Thus, a linear mono-disciplinary outlook is not anymore adequate in design pedagogy. Educators need to embrace a holistic approach and to activate new collaborations, to train experts capable of configuring and managing complex design activities. This paper analyses the rise of systemic thinking and its reverberations on design studies, with an overview of geographical and temporal contributions. It invites to reflect on the role of present-day designers and on the importance of embedding humanistic and economic values in the design knowledge. Furthermore, it illustrates the directions for a systemic transdisciplinary education in Master's degree programs and Ph.D. courses in Design, aimed at providing the necessary tools to a new and responsible generation of professionals. The awareness of their important and influential roles in society should be inspiring and lead to the creation of innovative entrepreneurial activities.

**Keywords:** *systemic design; transdisciplinary education; awareness; societal influence; relational mediation*

### 1 Grasping Dynamic Complexity

It was the first half of the twentieth century when the primary signs of a rising and diverse dimension of the reality surfaced. The complexity of worldwide phenomena was no longer explainable as a number of events or a variety of elements. The emergence of new events interconnected with each other, and their increasing frequency in an invisible yet powerful network, testified the appearance of a novel view of the environment and the rise of unexplored fields or



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investigation. This *network thinking* has influenced not only the vision of nature but also the way to consider scientific knowledge (Capra, 1996, p. 38). Discoveries of new laws and mechanisms, like the quantum theory, came up from biological and natural sciences, marking the passage from the Cartesian and Newtonian paradigms to a holistic and ecological view of the circle of life. They proved to be essential in incubating the first theorization of systemic thinking from micro to macro scale. These steps led to the publication of the *General Systems Theory* by Ludwig von Bertalanffy (1968), a milestone in systems studies and their following evolutions. Today, in the early 21st century, the consciousness of the complexity of the world is a shared matter of fact. It happens whenever people look at the dynamics concerning the society without any possibility to separate the single event from the strong or more slackened correlation with other circumstances, already occurred or still underway even in different and diverse contexts.

The issue of complexity has extended its boundaries over time and, from being a matter for specialists, became a discussion in the public domain. This is due to its direct involvement in people's lives as much as the progressive and internalized understanding learned through personal experiences. In fact, the reality, seen as the natural realm in which mankind takes part, instead of mankind having his own essence and an independent existence, subsists also at the design level. Humanity intervened on the reality, modifying the world since its origins, in search of practicable alternatives through the efforts of improving it. These interventions aimed at making the world more correspondent to his interests, needs, and values that have certain importance and urgency at a given time. The act of designing, as well as the personification in the figure of the designer, advanced with the same premises but more competently and with more structured methodologies as a consequence of the propulsive push of the industry and of its strength, and because of the job enrichment. If the existence and the extent of complexity were ignored until one century ago, it's because the act of intervening attributable to the design held consequently limited forms. Design was performed by restricted *modus operandi* working for compartments of problems not considering them as a whole. Design at the time of the unveiled complexity has to reach a great knowledge that allows finding the causal and relational network of events where it is called to operate. The connection between the systemic discourse and transdisciplinarity is founded on the fact that complexity cannot be considered without taking into account all its congenital and multifaceted factors. This also implies the ability to view and explore still unknown concurrent and causal factors that are too complex to grasp intuitively (Alexander, 1964). The substance on which the designer has to confront with has broadened from the communication of products to objects, from the organization of services to the intervention in complex systems.

Starting from these considerations, the paper presents a brief introduction on the evolution of the design discipline and the approaches that consider the complexity of the systems. It will further illustrate two relevant cases in systemic design education, carried out at Politecnico di Torino. These are useful to reflect on new perspectives of educational paths and on how to iteratively structure them. The paper presents relevant reflections to this scientific field of study, shedding light on the emerging aspects of the complexity in educational contexts, broadening the dialogue with the design community.

## 2 A Systemic Design Approach

The rising of complexity is read neither as the appearance of a new phase of design history nor as an exercise of creativity nor as a new consistency of the material with which design creates. The feature that has imprinted the new flow of knowledge should be read as the intrinsic characteristic of the world where we live and where humanity has brought forth by its own operations. Systems of services, healthcare systems, city-systems, the governance of natural resources and of territories, and business strategies are all examples of complex systems. They represent the unavoidable necessity to take on the responsibility of their undeniable presence, understanding and actualizing new modality of designing where the previous attempts failed or showed to be not completely effective. Complex systems are those related to the major issues at the global level, part of the reality being the active property of its phenomena and equally those which are meant as a matter of study and design. The meeting and the contamination among systems studies, system thinking, and design occur in the wake of the awareness that contemplates the natural laws closely related and interdependent in the same way the processes that rule the social, economic and political human life in the ecosystem do.

Designing in the world today, cannot be limited in studying and implementing daily objects produced by industry because the result would appear reductive, partial and not thought of. Reality calls for multilevel reflections and design activities simultaneously stretch out to more languages and are conducted following more international directions toward the achievement of the results (Ekuan, 1997). The earliest notices of an augmented level of complexity in design activity emerged in the 1950's in industrial environments. They argued the requirement to adopt

new approaches that would ferret out interdisciplinarity and help manage the overall high quantity of coexistent variables. Consecutive researches and studies confirmed the magnificent systemic relationship across global issues, realizing the traits of persistence and interconnection. The trend that consolidated and on which the current systemic culture is established marked the detachment from the mono-disciplinary and specialized orientation which characterized the first half of the 20th century. The convergence of the project *lato sensu* and systemic culture was, among others, due to a step forward in the education that revised the design teaching with the integration of more technical knowledge with others from humanities. These passages outlined and foresaw the hybrid nature on which the profession is counting ever more. One of the most significant contributions in that sense refers to an avant-garde school, the *Ulm School of Design* (Hochschule für Gestaltung Ulm), that introduced an educational design system influenced by new fields of study like cybernetics, system theory, information theory, semiotics and ergonomics among others. Nonetheless, different current schools that deal with the systemic thinking in complex sciences do not foster the bond with neither design sphere nor design thinking (Jones, 2014).

It is hard to delineate the exact contours of what systemic design actually is. This intent has not found unanimity yet, as several definitions and various fields of application coexist. Some scholars recognize and locate it in strict relation with research on environmental themes, entrusting it a key role in the reading and in the development of systems in the productive processes with particular attention to their relationship with the ecosystems. Systemic design in these terms treats the complexity at both material and relational levels, studying connections and reactions among materials, resources, processing procedures and natural surroundings. The attention that design can pay on these multiple aspects is appreciable, focusing more on one or another, and is worth undertaking as much as any other investigation. One of the present interpretations defines systemic design as “a design-based approach that outlines and plans the flow of matter running from one system to the others, pursuing a metabolization process which should reduce the ecological footprint and generate profitable economic flows” (Bistagnino, 2014). The systemic design can have a varied scope and impact numerous sides: it can deal with the reduction on the ecological footprint, the generation of sustainable economic perspectives, the creation of new business models within new paradigms, it can be responsible of the limits of growth, the enhancement of local resources of a precise territorial district and the rebalancing of the employment market. In recent years there have been copious efforts in tracing with more clearness a unitary identity of systemic design, a meeting point between system thinking and design thinking. They share a common vision of design in general terms as a practical problem-solving epistemology, to be considered a third culture adjacent to science and humanities (Cross, 1990). The knowledge in design, repositioning itself among the disciplines, is creating an evolving space in time, increasing its own competencies from the level of knowing shapes, processes, methods, and practices, to other actions. Designing today means assuming the act of describing, mapping, proposing and reconfiguring complex services and systems (Jones, 2014), forecasting, anticipating, inspiring scenarios and changing behaviors. “Design is now becoming more about listening, asking, understanding, and drafting new possibilities and alternative realities” (Muratovski, 2016, p. 14).

In conclusion, systemic design, hardly definable as a discipline itself, takes shape more as an orientation, as an emerging practice aimed at facing systemic problems through methodologies and approaches in a chorus that possesses a holistic vision and an oversight on multidisciplinary. The role of schools and education is indispensable to realize and nourish those practices, to encourage this process in the direction of a stage of maturity, made by experimentation and contamination of thoughts. Education must reform itself and implicate a change in its system of values and, in order to compare, listen, and understand the world and its realities, it has to teach how to act in advance. New professionals need to work as a team and among teams, with the view of manifold participation not only between experts but also with citizens. According to this reference point, everyone is a conscious designer in the statement, assessment, and revision of programs for the future society (Peccei, 1981).

### 3 Transdisciplinary Higher Education

As described above, the rise of systemic thinking and its resonance on the design world has been undoubtedly an attempt to deal with new challenges and to follow the evolution of contemporary trends. The systemic reasoning, due to its intrinsic principles, is not complicated but rather complex (from the Latin *cum plècto*: interlacement, weave). It surpasses the rigid and outdated Manichean and Cartesian strands of thoughts, embracing an inclusive, holistic vision. Due to these characteristics, it is not immediately communicated and understood. Without previous notions and experiences, it may be hard to assimilate. Systemic higher design education is thus of great adaptability to superior degrees of pedagogy like Master's degree programs and Ph.D. courses instead of Bachelor's. A systemic education is characterized by three prominent levels of interaction between disciplines: multidisciplinary, interdisciplinarity, and transdisciplinarity (Piaget, 1972), defined in order of their levels of efficacy. Multidisciplinary is intended as the use of solutions borrowed from another discipline. Interdisciplinarity, instead, is an interactional exchange of knowledge

among two disciplines, aimed at the enrichment of both. Transdisciplinarity is not only the interaction of separate branches of knowledge but the integration of them as a whole (Celaschi, Formia & Lupo, 2013, p. 5). The fluidification of disciplinary boundaries is manifestly a necessity of keeping up with the times and to educate designers to their role of mediators and integrators of knowledge and needs (Celaschi, 2008, p. 44). At this moment in time, design educators should, in fact, be talking less within the design community, on behalf of more fruitful dialogue with other disciplines, broadening the gaze to complexity as a world-shaping force and trying to help explain it (Fry, 2009). This interplay is an internal prerequisite, but first of all a peremptory condition of a current being and of the responsibilities that design is tied to (Peruccio, Vrenna, Menzardi & Savina, 2018, p. 755).

It is needless to say that a typology of knowledge like that is oriented toward the professional formation of accountable figures, with a vast and transversal set of skills. Younger designers, with a well-rounded educational background, are supposed to be able to conceive innovative products, services, and systems with the intent of improving collective conditions, towards a shared responsibility. Such a mindset goes well beyond the current institutional and societal arrangements, envisioning a radical paradigm shift that would help to deal with the uncertainties and metamorphoses of the present and future times. Education moves from the exclusive exchange of theoretical knowledge and the execution of practical formative projects to the substantial raise of deep awareness, capable of achieving a self-regenerative power, essential engine for this change of direction (Bistagnino, 2011). Compared with other teaching methods with the final purpose of training specialized profiles, a systemic approach to education results in the formation of highly knowledgeable subjects with a horizontal and generalist grounding. Ongoing research recognize that design students are suggested to take in information from many sources, rather than attempting to develop deep expertise in a particular field. Far from being a weakness, this represents instead the real strength of a generalist (Rodgers, 2007, p. 7).

“In a world of specialists, there is a need for those who can reach across disciplines to communicate and who can bring diverse experts together in a coordinated effort” (Owen, 2007, p. 24). That being so, it is not the main responsibility of the academia to educate specialized profiles for the sole sake of satisfying the needs of the design market. Significant to the purpose of education is the kind of qualitative knowledge that is transmitted. As illustrated by Celaschi in *Man at the Centre of the Project* (2008, p. 23), design has the great contemporary potential to bridge the gaps between theory and praxis, possible and realizable. Design as a discipline assumes a central position from where it stretches out mutual connections and influences with other domains. It can be inscribed between four different systems of knowledge, diametrically opposed to each other. These are Humanities and Technology, and Art and Economy. A transdisciplinary systemic education is based on the transmission of values, the result of the tensions between Economy, Management and Humanities. Systemic knowledge is dealing both with necessities, needs, and new possibilities (Figure 1). It does not mean that systemic designers are not educated to be sensitive to aesthetic appearance, form, and functions, but surely these characteristics assume a secondary level of priority at the design phase.

With regard to these considerations, the study programs here introduced for the sake of the argument are a second level Master’s Degree in *Systemic Design*<sup>1</sup> and a cutting-edge Ph.D. course in *Management, Production and Design*<sup>2</sup>, both already delivered at Politecnico di Torino (Italy). The Master’s degree prepares graduates capable of configuring and managing the complete industrial product design activity, with the aim of achieving zero emissions. It aims to promote a design culture that places man at the center of his social, cultural and environmental surroundings. One of the main academic labs, the *Open Systems Lab*, lasts one semester and is organized in four interconnected courses. The principal one, entitled *Systemic Design*, teaches students to design relations and systems aimed at activating new business models. Three complementary courses strengthen the study, giving support from the fields of economy, engineering, and humanities: *Economic Management of Projects* helps define the economic assessment, evaluating outcomes and new resources, *Procedures for Environmental Sustainability* offers technical knowledge for a responsible design awareness and *Theory and History of Open Systems* provides the cultural background in which systems studies originated. Graduates in Systemic Design have the skills to interact with specialists in other sectors, to develop the design of open industrial systems and new and ecological products. Concerning the Ph.D. programme in *Management, Production and Design* this aims at training design and engineering researchers who are able to carry out research activities in the fields of design, technology, organization, economics, management, and policymaking. Among the rich educational assortment of courses addressed to students with disparate backgrounds, the set of

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<sup>1</sup> Presentation, course programme and specifications of the M.Sc. in Systemic Design “Aurelio Peccei” are available on the official website of Politecnico di Torino. [https://didattica.polito.it/laurea\\_magistrale/design\\_sistemico/en/presentation](https://didattica.polito.it/laurea_magistrale/design_sistemico/en/presentation)

<sup>2</sup> An overview of the Ph.D. programme in Management, Production and Design, can be found on Scudo – Doctoral School website. <http://dottorato.polito.it/gpd/en/overview>

lectures in *Design Studies* consists on the historical-critical reading of contemporary design processes, systems, services, and experiences, to provide the interpretative tools to analyze the phenomena in fieri. Students have the possibility of comprehending the many methodological/design processes in use today, in order to acquire the skills to consciously design systems at a high coefficient of innovation.

Both the above-mentioned higher education programs serve as self-explanatory cases, from which it is possible to extrapolate precious directions for a transdisciplinary systemic education, recognize its limits and the necessary implementations.

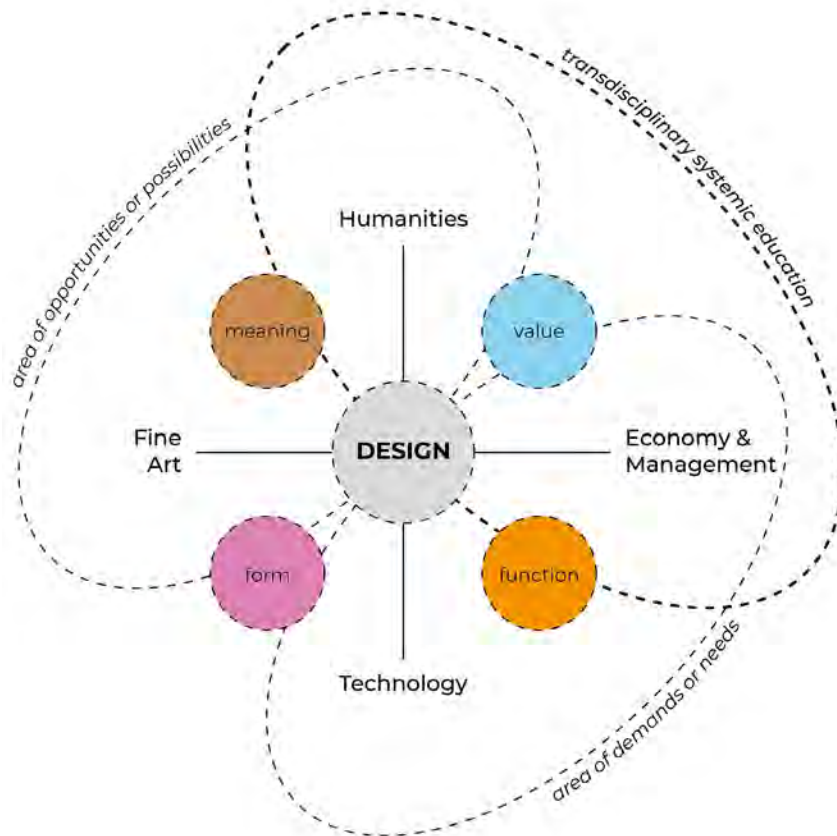


Figure 1. Design knowledge. Redesign of the authors to emphasize the field of action of a transdisciplinary systemic education (Celaschi, 2008, p. 25).

## 4 Considerations

As described by Herbert Simon in *The Science of the Artificial* already in 1969, the proper study of mankind is the science of design, not only as the professional component of technical education but as a core discipline for every liberally educated man. This valuable notion is more than ever contemporary, and the role of teachers to educate in such a transdisciplinary way is undoubtedly crucial. A systemic approach is, therefore, one of the several attempts in pedagogy to be all-embracing and comprehensive. In a world that is constantly evolving, requiring professionals to achieve a vast set of skills and competencies like creativity, collaboration, productivity, innovation, critical thinking, decision making, communication, and management (Ananiadou & Claro, 2009), a transdisciplinary systemic design education represents an advanced formula. Designers are, in fact, gradually recognizing the change of their contribution in the society, assuming more important functions in both public and private institutions. “This demands high social and moral responsibility from the designer” (Papanek, 1973, p. 14), that has to be properly educated and that should make himself fully conscious of the implications of his choices. The responsibility has to be embraced, demonstrated, taught and communicated. The consciousness of such an influential societal role is now leading to the taking up of innovative entrepreneurial careers that are of inspiration for other young professionals. Examples of virtuous and profitable activities are frequent but, as stated in the previous paragraph, systemic reasoning is not of immediate comprehension for a larger audience. It may hence happen that the world of practitioners and the markets are not yet ready to understand, welcome and incorporate a radically new kind of approach, having a preference for far long-established business models and profiles within design or other fields. In order to promote best practices,



design educators, and designers themselves, should have the duty to stimulate new win-win collaborations with architects, biologists, economists, engineers, politicians, and sociologists among others, besides transforming their knowledge into a much more powerful tool, that is the full awareness that leads to a deep commitment. Many Universities worldwide are already operating in this direction, achieving meaningful results. Parallel to one other, they are refining and sharing their studies. Apart from Politecnico di Torino, it is worth mentioning the *Carnegie Mellon School of Design* in Pittsburgh, the *Schumacher College* in Totnes, the *OCAD University* in Toronto, and the *Oslo School of Architecture and Design*, among others (Peruccio et al., 2018, p. 757). These kinds of approaches to education and thinking, somehow spontaneous, lead to “focus and reflect[ion] on the man in the context of his life, as part of a new form of Humanism that is both real and cultural” (Bistagnino, 2008).

This paper contributes to building knowledge on the emerging topic of design and complexity in education. The challenging perspectives and applied paths presented are already contributing to how professionals respond to real present-day needs. At the same time, there are still critical issues related to the effective communication of this innovative framework of competences, such as recognizing and giving credit to these professional profiles. Breaking the boundaries of traditional competencies and disciplines is not an easy task, but it is necessary to address impellent global issues with the exploration of new learning directions. Academics from all over the world are constantly called to redefine their teaching methods. The paper pictures a rising systemic approach to design education while inviting to reflect on the value of what is taught today and on the real contribution of existing mono-disciplinary courses of design study.

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**Maurizio Vrenna** is a Ph.D. candidate in Management, Production, and Design at Politecnico di Torino, Department of Architecture and Design. During his professional career in Europe and Asia, he has been involved in the development of sustainable products and services. His current research revolves around the topics of systemic design, sustainability, and the production of microalgae in urban areas.