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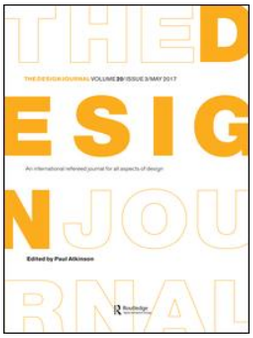

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Theoretical studies and practical tools for a systemic design educational paradigm. Applications of Systems Thinking principles to design education.

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Abstract: The paper analyses the relationship between currently changes, about cultural paradigm, and systemic designer's education. It represents a critical moment, because a suitable learning gives opportunities to practice abilities necessary for the communication with the complexity of social systems. In future scenarios concepts of complexity, systems, sustainability, "interdisciplinarity" and "transdisciplinarity" are the foundamental part of design language. So the design world gets closer to "the systems thinking" and the theory of complexity, conditioning its methodologies that becomes "systems oriented". Through the critical analysis of some case studies, we want to analyse different methods used to get closer students to the systemic approach and trying to create a deep collaboration between theoretical studies and practice. Finally we would like to draw attention to some features of non conventional education, which are more affected into the development of a systemic awareness and which are useful to define a systemic educational model for design studies.

Keywords: Systemic view, Ecoliteracy, Systems thinking, Transdisciplinary approach, Project-based learning

1. Introduction

The paper's aim is to analyse theoretical and practical tools useful to define an alternative educational model for the systemic learning of design discipline. Firstly, we would like to draw attention to some features of non conventional education, which are more affected into the development of a systemic awareness and consciousness. We are going to consider those tools and methods that are able to modify our way of thinking.

The research structure is arranged into three main steps:

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- in the first one, we are going to define the scientific and cultural framework around this topic;
- the second step is dedicated to the analysis of some considerable case studies in systemic and holistic design education;
- the last one is structured around the comparison between case studies and the definition of general guide lines for an innovative design learning approach.

By the application of different research methods, which included the critical review of contemporary literature and the analysis of some non conventional didactic tools, the paper tries to investigate the contribution of Systems Thinking principles into the application of the systemic approach to education.

2. Background and Scientific Framework

Looking at needs of actual context and innovative courses of design research, we can notice that designers have to face a very complex scenario, characterized by an high level of interconnection between their components. In this condition, we can ask the following questions:

> Nowadays, what is the meaning of design project?
>
> Which kind of way have to undertake designers and design research?
>
> Which kind of design innovations are more suitable in Western societies, in which people's essential needs are satisfied? (Pasca, 2010).

The actual ecological and energy crisis asks to industries and to the production field to rethink and redesign our life style and consumption model, considering energy and resources saving. We are living in a dynamic and complex scenario and for this reason designers have to undertake a revolutionary transition path toward ecological and social responsibility. Also, this condition requests to designer to increase their cultural background to easier communicate and work in collaboration with other experts. For this reason it is necessary to suggest innovative educational courses for designers, because they have to dialog and collaborate with different experts in not well defined disciplinary fields. Designers should learn those abilities to be a process innovator, improving relations between different components of the system. The origin of design discipline is interdisciplinary in itself , but nowadays the “Academia” should increase this interaction between different research fields. Richard Buchanan (1992) notices that there were many misunderstanding between people involved in the theoretical design conference of 1974 in New York, because they discussed different topics around “wicked problems”, typical features of complex scenarios.

So “Systemic Design” is a recent design field that promotes a different and more suitable approach to complex problems, trying to integrate Systems Thinking to Human-Centred Design. Facing the increasing complexity of actual systems, sometimes traditional design methods are not suitable. Therefore it is necessary to define alternative methods and methodologies that consider the importance of connections and relations. The Systemic Design concept refers to a wide research paths and its origins are in the General Systems Theory (Bertalanffy, 1968), in Cibernetic studies (Wiener and McCulloch, 1947), in Complexity (Prigogine, 1987), in Living Systems studies (Capra, 2014) and in the Organizational Learning Theory (Senge, 1990).

Considering the research way undertakes by the DAD- Design and Architecture Department of Politecnico di Torino, we can notice that Systemic Design focuses on the local sustainable development through designing relations between different actors involved in local activities and economies. Systemic Design tries to promote an alternative economic model, able to create a local network in which outputs of a process become inputs for another activity (Bistagnino, 2011). Living System's structure and organization are considered as the best example to refer in designing of human activities flows and cycles, through “biomimicry” processes. Some of the most important principles of Systems Thinking are included in design language, like concepts of “webs”, “autopoiesis and self-regulation processes”, “dynamic balance” and “emergency”. Systemic Design works on on different and interconnected dimensions of societies: economic, social and cultural. Its main aim is to establish generative relations between these human systems dimensions, looking at the wellness of whole ecosystem. Inside this process it is essential to recover the individual and collective awareness about the importance of active role of each system's component, which is involved into definition of system's structure itself. The first step to change the people's awareness is to launch a transition way from a linear educational model to a systemic one, deconstructing the idea of a rigid, hierarchical and competitive education and recovering qualitative values. Designing following Systems Thinking principles means that people can understand the systemic structure of living systems, in other words people have to become ecoliterate (Capra e Luisi, 2014), choosing a Constructivist Learning approach (Vygotsky, 1978). The Constructivist Learning Theory is developed by J. Piaget during Fifties and it cultural and scientific background refers to J. Dewey's experiential learning, enhacing the role of PBL-Problem Based Learning (learning by active inquiry) and learning by doing methods in deep education (Dewey, 1910), to cognition studies by H. Maturana and F. Varela (1978) and to epistemology of complexity (Morin, 1993).

Jonassen (1994) supports that in Constructivist Learning Theory knowledge is considered like:

an active construction by awareness person;

the result of “situated learning” processes, strictly linked to the learning context;

the result of collective collaboration and interaction between all actors involved into learning process.

In addition to enhace individual and collective active role, we want to focus on the importance of tools like cooperative learning and project-based learning in the educational process of construction of a solid awareness to face problems in a complex scenario. Other main focuses are the interdisciplinary and the transdisciplinary approach, like more suitable methods to undertake future challenges in education. This paper wants to investigate aims and tools using by different educational experience, academic and not, and using a worldwide research approach. Also we want to evaluate the effectiveness of different didactic methods in the development of a systemic awareness.

3. Transition in education experiences: a worldwide approach

Looking at some of the most important international programs like Horizon 2020, Agenda 2030 or Green School's projects, we can notice that the global scientific community agree to consider education like a crucial aspect for the sustainable development. There are many different educational

experiences around the world that promote alternative learning approaches to traditional one and that consider ecological studies like the “fil rouge” which can connect different disciplines. Particular attention turns to the education of young generations, through pragmatic courses that guide students in the process of ecological consciousness development. Below we are going to analyse some influential non-conventional educational experiences, that directly or not apply some important principles of Systems Thinking and methods of Constructivist Learning Theory.

Some of the most important institutes or research center in Systems Thinking applications are MIT-Sloan School of Management, that refers to important research studies of J. W. Forrester (1918-2016) and P. Senge, the NECSI- New England Complex Systems Institute, a small research center that was founded in 1996 in Cambridge (Massachussets), the “sLab- Strategic Innovation Lab” in Toronto (Ontario, Canada), the Systemic Design Research Network, that is a cooperative learning community founded in 2011 in partnership with the Oslo School of Architecture and Design and the OCAD University, and the Donella Meadows Institute in Vermont (USA).

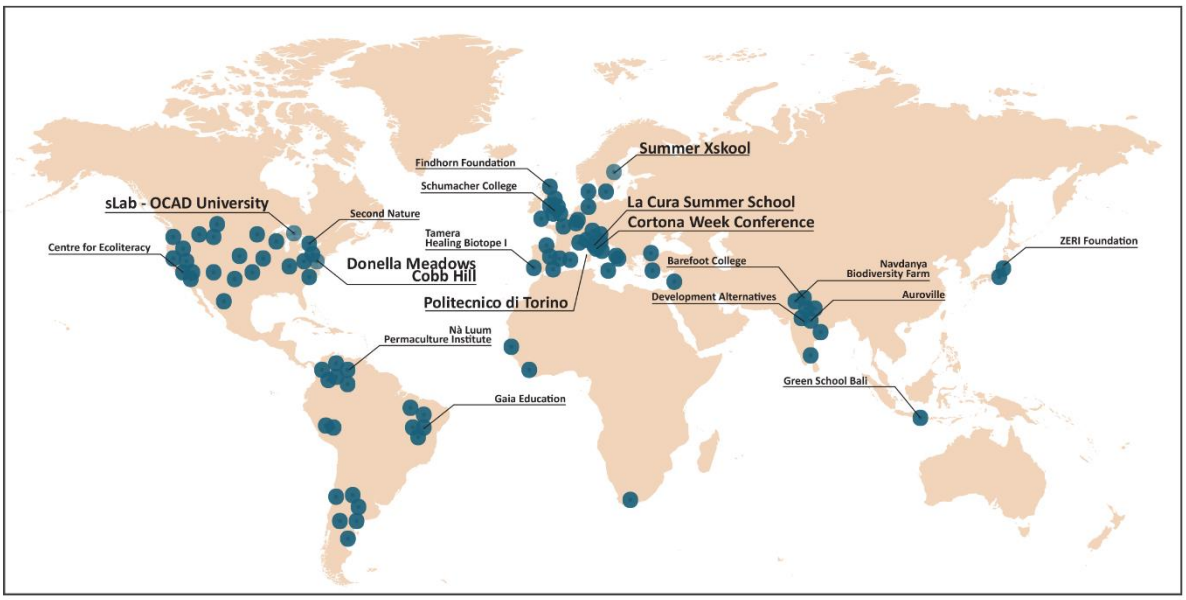

Figure 1. The map shows some influent case studies in transition education experience.

The last one is a research center that was born following the foundation of the INRIC- International Networks of Resources Information Centre in 1981. The INRIC is a global network of informations and knowledge sharing between academics, researcher and environmental activists who are involved in sustainable development movements. The Donella Meadows Institute supports sustainable activities of Cobb Hill farm, a local and intentional community organized like an ecovillage or a cohousing and situated in Hartland (Vermont). This living and learning experience was born from the personal desire of Donella Meadows, co-author of the book “The Limits to Growth” (1972) and a pioneer of environmental movement. She wanted to realize a local community in which people can live a learn together, sharing resources, knowledge and materials and undertaking sustainable way of living. The Donella Meadows Institute was founded in 1996 in Norwich with the aim to connect economic, social and ecological systems in a sustainable way. Another institute's aim is to develop in common people the awareness of living in a finite planet and that it is so wrong to follow the idea of an infinite growth. Researchers and volunteers try to apply Donella Meadows studies about Systems Thinking and dynamic of systems. They suggest some applications of Systems Thinking in everyday life, providing tools, resources and support in decision making activities, in systems mapping and in the

definition of aims for a sustainable local development. The institute supports the creation of a local network that connects different productive and economic activities in the territory. The research center tries to apply principles of Systems Thinking to local transition economies and resilience and Cobb Hill farm represents an important example of sustainable living and development.

The “sLab- Stategic Innovation Lab” is research center, founded in 2008 and linked to MDes in Strategic Foresight and Innovation (SFI) at OCAD University of Toronto. The center leads studies on design thinking applications, on social innovation and on future studies. It is a “growing community” in which are involved students, professors, researcher, business administrators and experts in many interdisciplinary and holistic research paths.

The Master Degree course in “Systemic Design” a Politecnico di Torino is focused on the application of Systems Thinking approach to design field. Courses structure tries to create a multidisciplinary and interdisciplinary learning environment, getting closer design studies to humanistic, social, scientific and economic ones. Situated and cooperative learning are important educational methods and “working on the local context” is the central activity of the educational path. The local scenario is described by a qualitative approach that underlines its features using flow maps of raw material and energy across local systems. The main purpose is to develop into students abilities of trans-disciplinary analysis and teamwork learning, that are useful to redesign our production model from linear to systemic. Educational activities are organized using the “boss-less” structure: theoretical lessons are replaces by the “learning by doing” method and by the “project based learning”. The professor plays the role of “mentor” and he gives the possibility to teamworks to self-organize their educational path.

Another important experience that promotes educational activities linked to the learning context is the “Summer Xskool”, organized by the the design theorist John Thackara in collaboration with the Konstfack- University College of Arts, Craft and Design, in Stockholm. Workshops take place during one week, in which international students and professors have the opportunity to share knowledge and different points of view, starting from the analysis of local context. During the summer school students investigate how design practice and innovation can be useful for local people in interaction with living systems, looking at local sustainable development. Local activities, like organic food market or food production system, are involved in learning process and they become learning hub, in which students can directly evaluate the impact of their design proposals. Workshops take place in a collaborative way and people involved into summer school's activities work together to elaborate products, services, networks and communication platforms that suggest more sustainable actions. The first and the second edition of Xskool took place in natural setting of Grinda Island, near Stockholm. In that place students faced the complexity around transportation system, food system, water and waste management, looking at them with an holistic approach.

Workshops are structured into two main steps:

- the first one in which students analyse the local context, underlining relations, networks and flows between components;
- in the second step, they choose a smaller subsystem, they deep analyse its main issues and finally they elaborate suitable solutions to them.

Grinda Island environment became an open-air laboratory, that gave to students the opportunity to reflect on some crucial features in sustainable development. This summer school is addressed to those architects and designers who want change their design way and during this week they can experience different approaches.

“Cortona Week” is a summer school focuses on interdisciplinarity and spirituality. It is addressed to graduate students of ETHZ- Swiss Federal Institute of Technology and of ZHdK-Zurich University of Arts and it take place every year in September in Cortona (Arezzo, Italy). The Cortona Week experience was born by P. L. Luisi, chemistry professor in ETHZ and co-author of “The systems view of life: a unifyng vision” (2014), and it refers to the “Aldbach meeting” in 1983. The Alpbach meeting is the inspired event for another experience, the Mind & Life Institute of Francisco Varela. This summer school takes place during one week and it is composed by conferences, workshops, artistic and meditation experiences. People involved can share their reflections on spirituality, holism and transdisciplinarity. Cortona Week is a learning experience that combine scientific disciplines with artistic and humanistic ones. This approach wants to educate a young generation of leaders aware about the opportunities of Systems Thinking in changing processes. During the morning session participants can learn different point of views about some theoretical issues and in the afternoon they can experience different corporal and artistic activities, like meditation and yoga. The summer school's main aim is to suggest some starting point to reflect about transdisciplinary approach. The learning experience represents the opportunity to develop humanistic thinking in students with a scientific and technical background. Promoting this kind of learning path is the first step to suggest more responsible action and a critical thinking systems oriented.

The summer school “La Cura” is another example of learning experience, organized for the first time in August 2016 by S. Iaconesi, O. Persico and La Cura teamwork in collaboration with ISIA of Firenze (Italy). The aim of this summer school is to investigate the importance of relations and networks in complex and even more connected ecosystems. It took place in five days and people are involved in theoretical reflective inquiry and practical experiences about the role of human body in a iperconnected scenario. They tried to apply a transdisciplinary approach to investigate this research field, including the analysis of Big Data, infographics, communication tools and wearable technologies. The final result of this week is an interactive wearable tool that was showed during the event “Condividere la Conoscenza” in Triennale di Milano. The summer school is one of many activities leaded by La Cura project, that focuses on the importance of sharing network and relations like tools to support wellness of whole aspects of society.

Case studies here essays represent only a small part of a wider global scenario and we can find different experiences of non conventional education. This examples show us the need to undertake a radical transition toward alternatives educational models in design fields, looking at the sustainable development of future societies.

4. Critical Review and Guidelines for a Systemic Paradigm in Education

Analysed case studies show the structure of different educational paths, but some of them have shared aims:

- supporting students in the development of critical thinking;
- promoting ecoliterate courses;
- stimulating the participation and active role;
- setting up collaborative relations between people and ecosystems;
- supporting the development of a responsible and aware leadership;
- cultivating creative and divergent thinking.

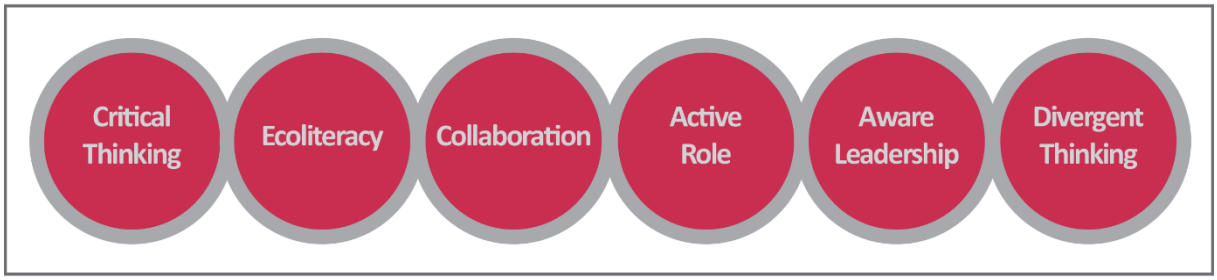

Figure 2. Common features in educational path of analysed case studies.

From the comparison between case studies, we can notice that territory and local community are very important aspects in education, because to effect changes in the real context, we need to know people that live there and their activities, trying to define opportunities and critical features. The territory is the setting in which it is possible to organize situated learning courses and the local community is an important tool to activate cooperative learning processes. These methods are useful to apply Constructive approach to the development knowledge, which is considered like the result of a collaborative learning.

The most important aims of a systemic paradigm are the education of ecoliterate people and the awareness development, which is focused on network between systems and subsystems. The interdisciplinary and transdisciplinary learning approach are applied to develop communicating abilities with other professional field. When we are talking about interdisciplinary approach, we refer to an “horizontal approach” to different disciplines, that gives the opportunity to look at the discussing topic by different and additional point of views. In the interdisciplinary approach students can use methods and research tools of different academic disciplines, creating some “bridges” between them and giving the opportunity to develop a more complete analysis of the context. In this way, academic fields, that in the past were very distant in research methods and results, now are going to get closer and they even more are sharing competences.

The transdisciplinary approach represents the next step toward a more deep integration between different disciplines. This concept was described for the first time in Seventies by the Swiss psychologist Jean Piaget during a conference and he defined transdisciplinarity like an evolution of interdisciplinary approach that focuses the attention on relations and deep interactions between different disciplines, without considering their traditional boundaries.

Effectively, Systems Thinking doesn't need a deep knowledge in all academic fields, but it focuses on the individual and collective ability to identify existing relations and also to design new ones. For Systemic Design, the transdisciplinary approach is one of the most important tool in designer education and working method. Designers, with a interdisciplinary and transdisciplinary mindset,

have abilities to understand in holistic way a complex scenario and they can apply this approach to elaborate solution for common wellness.

In this sense, systemic paradigm in design education wants to focus on the ability to make new connections and to understand existing relations that structure living systems to reproduce them in human societies.

5. Conclusions

At the end, the paper wants to underline the need to develop designer's knowledge in rethinking connections and relations of productive processes and in systemic view, it is considered one of the most important aim in future design education.

By the conducted analysis, we want to recognize following methods as useful tools to develop a systemic awareness in future designers:

- teamwork learning and community-based learning;
- learning by doing;
- situated learning;
- project-based learning and problem-based learning (to develop problem solving abilities);
- holistic analysis and evaluation, using Gigamaps and flow chart to describe systems;
- self-organizing learning, giving the possibility to students to decide in autonomy steps of their learning processes;
- peer-to-peer learning;
- boss-less education, in this didactic method the role of teacher or professor is like a mentor, who guides students in learning steps.

In conclusion, integrating this tools in the traditional education represents the first step toward the definition of a design educational model that consider qualitative values and network as important tools to menage the complexity of living systems.

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HORIZON 2020 – SCIENCE EDUCATION

https://ec.europa.eu/programmes/horizon2020/en/h2020-section/science-education

SDG 4 AGENDA 2030

http://www.unesco.org/new/en/education/themes/leading-the-international-agenda/education-for-all/sdg4-education-2030/

sLab- Strategic Innovation Lab

http://slab.ocadu.ca/

THE DONELLA MEADOWS INSTITUTE

http://donellameadows.org/

SYSTEMIC DESIGN POLITECNICO DI TORINO

http://www.systemsdesign.polito.it/

SUMMER XSKOOL

https://www.konstfack.se/sv/Om-Konstfack/Institutioner/Institutionen-for-design-inredningsarkitektur-och-visuell-kommunikation/Industridesign/Annual-ID-Seminar/XSKOOL/

LA CURA SUMMER SCHOOL

http://la-cura.it/summerschool/