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## **The Alta Scuola Politecnica experience on teaching design and innovation**

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### **Abstract**

Design education is a highly debated topic since decades, yet the focus on multi-disciplinary classes has gained a paramount importance due to the multi-disciplinary nature of today's global challenges. This short speech contributes to the discussion through the description of the Design Methods and Processes course at Alta Scuola Politecnica (ASP), an original educational experience jointly developed by Politecnico di Milano and Politecnico di Torino with a highly selected number of MS students from Architecture, Industrial Design and all branches of Engineering.

After positioning this discussion with respect to the relevant literature, the speech describes the educational model of this course and the reflections made after 8 years of implementation.

More in detail, it describes a mature educational model conceived to reach a proper balance among the following matters: theoretical foundations on design methods and processes; practical guidelines on the use of specific design tools; industrial perspective and practices on design methods; team-based activity on real-world design problems. This model, although inspired by the specific pillars of the ASP school (e.g. 1-week multi-disciplinary classes), has led to considerations and insights that transcend the ASP educational context and, thus, can be of help to any educator interested in organizing multi-disciplinary design courses. Indeed, no specific background competences are asked to ASP students before attending the course except for a strong motivation for team-working activities while, every year, the mix of students' background is variable.

Second, by closing the gap between design theory and practice, the model aims at answering to some of the research issues regarding the contribution of problem-based learning approaches in education. The model demonstrates how structuring the educational path as a problem-analysis-and-solving process enables to more clearly explain to students the essence of the design workflow since the jargon used, as well as the logical reasoning behind it, is not constrained to any specific discipline.

In turn, students show to catch the essence of the design workflow thanks to the educational path structured as a problem-analysis-and-solving process. However, dealing with multi-disciplinary task demands a careful composition of students' teams since it can positively/negatively affect the learning experience as well as students' motivations.

**Keywords:** design education, design creativity, innovation, project-based learning

(P2)

## **Topic-based Course Design for Enhancing Creativity and Innovation Skills**

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### **Abstract**

Educators in higher education are facing several challenges due to diverse changes in the social systems that support the institutions. In addition, learning styles have changed drastically from generation to generation, and it is required to innovate pedagogical approaches. In this regards, numbers of institutes have launched educational program to foster creativity and innovation skills. There have been many reports that explain the results of those programs such as the ideas generated, survey results on the course, etc. However, it is still questionable that we could develop fundamental understanding for creativity and innovation through those programs and that it really motivated learners to initiate an innovative work for their future career.

This study presents a course design for enhancing the fundamental understanding and developing the skills for creativity and innovation, and increasing the motivation of learners. Two different types of class were conducted. In the first group, students were asked to conduct a case study on the process of successful inventions and generate their own new ideas. In the second group, fundamental theories regarding the learning and creativity were taught and students were asked to apply them to their own study and research. The results showed that the first group reported more likely duplicate case studies and generated common ideas. However, in the second group, students could recall their own experiences of individual flow and have aspiration for social flow, and were motivated to apply the acquired fundamental knowledge on creativity and innovation to their research.

This study has many limitations in terms of its research design, sample numbers due to its natural settings. We need discussion to improve the skills to facilitate teaching and enhance our learning experience.

**Keywords:** creativity education, innovation skill development, course design

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## **Design Education as An Enabler For A Rural-Urban Creative Economy**

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### **Abstract**

Indonesia is allegedly reaping the benefits of the demographic dividend in 2030 with productive working age groups up to 70 percent of the total population (the current population of Indonesia is 268,543,601). The benefits for the so-called demographic bonus began to show the result with the rise of the millennials; academicians, young entrepreneurs, highly skilled youth, craftspeople who gathered to become local creative enablers that move the wheels of the creative economy in the cities and villages. Out of seven Unicorns (start-up companies valued at more than US\$1 billion), four of them are from Indonesia. Even more, the UNESCO Creative Cities Network (UCCN) has announced the designation of one of the cities in Indonesia as a UNESCO City of Design along with 21 cities worldwide in December 2015. The designation reflects the world's recognition of the present and the future contribution of a city as a vibrant center and enabler of sustainable development for the economy and innovative culture that involves everyone: academicians, business, creative communities, government, and the media. This presentation will show how design education can be an effective enabler.

### **Keywords:**

Design education, creative economy, creative industry, creative city

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## The Emerging Phenomenon of Open Source Hardware Design

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### Abstract

The spread of ICT and cheap low-size production tools like 3D-printers led to the development of open design, i.e. community-based and open source development of physical products also named as open source hardware design. This innovative organisation of product development based on a new conception of copyright as well as decentralised and voluntary work offers a disruptive alternative to conventional industrial product development. It provides a great opportunity for continuous improvement of products as well as formidable potentials for product innovation and incubation of new businesses.

However, the emergence of open source hardware design still suffers from a limited availability of supporting methods and online tools helping to face the organizational challenges raised by distributed collaboration of non-contractually engaged volunteers. Because of a lack of adapted structuring mechanisms, open source hardware design projects are still restricted to the development of products of low complexity and quality, i.e. prototypes or toys for do-it-yourself hobbyists. In order to compete with today's standards of industrial product design, open design shall be provided with adapted methods that ensure significant process efficiency and economic viability.

In this presentation we will introduce the concept of open source hardware design and explain how it is different for open source software design. Then we will propose a characterisation of the typical actors' profiles and the notion of community. We will also introduce a tool for evaluating the openness of a product or a process and the link with the communication tools used by the communities. This work is based on the analysis of more than 200 OSH projects and the interview of more than 20 makers. The project has been developed within the framework of the OPEN! Project co-funded by French ANR and German DFG agencies.

**Keywords:** Open source hardware design, collaborative design, design methods

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## **Morphological Design of Soft Interfaces for Enhancement of Human-Robot Physical Interaction**

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### **Abstract**

Haptics is an integration of science and technology for applying the sense of touch in control of computers. It also brings understanding of human interaction to technology. Touch is not only a simple physical tactile contact, it is a complex mean for conveying communication during interaction between a human and the surroundings (such as human-human, human-machine, human-virtual reality, and so on). Therefore, the future of human interaction is not only about technology, it is also about the determination of social influence through physical interaction. In this talk, I would introduce our latest development of soft universal physical interactive interface, from small to large scale, with affordable technology for enhancement of human physical interaction in actual and virtual environment. Before that, I would introduce the general idea of morphological design in development of such devices in soft haptics field.

**Keywords:** Haptics, human-machine interaction, soft interface design

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## Creative problem solving and artificial intelligence

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### Abstract

Daily, we face a wide range of real-world problems. Sometimes, our solutions to these problems are new, creative, and successful. These solutions empower us to transform the surrounding world, improve our quality of life, and extend our human attributes beyond what is currently possible. However, creativity and the success of our solutions are normally perceived as occurring simply by chance, talent, or hard work. The origin of human creativity is poorly understood, and semantic measures that could predict the success of generated creative ideas are currently unknown.

In this study, a dataset of design problem-solving conversations in real-world settings is analyzed by using semantic measures. The study demonstrates that a divergence of semantic similarity, an increased information content, and a decreased polysemy predict the success of generated ideas. The proposed semantic analysis approach allows fast computation of selected set of the semantic factors in real time thereby demonstrating a potential for support of the creative problem solving process, in particular, the assessment of successful and unsuccessful ideas generated in the process of creative problem solving, or assessment of the effect of external feedback on the developed design solution.

These results advance design research by identifying real-world processes in human problem solving that are relevant to the success of produced solutions and provide tools for real-time monitoring of problem solving, student training and skill acquisition. Moreover, the results support the development of technologies for computer-assisted enhancements of human creativity or for the implementation of creativity in machines endowed with general artificial intelligence. Such assistance will allow us to select only those ideas that will be innovative, creative, and ultimately successful. Furthermore, this will save resources and prevent us from investing effort in ideas that are less creative and unsuccessful.

An ongoing work on a system that allows real-time monitoring, analysis and feedback on the basis of identified semantic measures is discussed.

**Keywords:** design creativity, design cognition, semantic analysis, problem solving, design process, design computing, artificial intelligence

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## **A framework for Vietnamese Cultural Product Design**

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### **Abstract**

The style of product design for a country or a nationality is influenced by its essential traditional cultures and lifestyles. This paper shows a framework for Vietnamese cultural product design. Our main goal is to show how cultural aspects can be considered in the early stage of the design process. Product development was analyzed by means of cultural attributive analysis, design concepts table, design principles, literature review, and expert opinions. In addition, interviews were conducted with some Vietnamese designers to know the influence of culture aspects on product design and to propose an enhanced framework for designing products.

**Keywords:** Cultural product design, cultural aspects in design

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## **Integrating Humanistic Interaction and Clothing Design**

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### **Abstract**

Revolutionary changes have been occurring at an unprecedented rate in the fields of clothing. Researchers have generally focused on high-tech approaches to implementing smart clothing design with multifunction. Nevertheless, the complex sociological attributes of clothing, i.e., its interactive symbolism and properties of emotional expression, design hierarchy and design aesthetics and other aspects should not be ignored. Interactive clothing, a topic on which there is little previous research, is an evolutionary branch of smart clothing in the field of information science, which emphasizes the function of social symbols that mutual interaction or communication between the wearer and their environment based on the integration of information science and traditional clothing. This study proposes that research on interactive clothing should integrate the two opposing perspectives of human and technology, and provides a practical reference for the development of smart clothing.

**Keywords:** Clothing design, interactive clothing, cyber-physical systems (CPS)

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## **Investigating creativity inhibitors and enablers in the digital era**

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### **Abstract**

The human being is going through a digital transition century in which digital technologies (i.e., IoT, AI, VR, etc...) are totally reshaping its cognitive, individual and social development. In this transition, creativity has been recognized as one of the most important human skill that helps people in generating novel and useful ideas getting advantage of the opportunities offered by digital technologies in any field.

The fundamental questions that arise from this context concern the effects of the digital evolution on creativity skills. For design research, it has become fundamental to understand if and how the creative design process is changing accordingly to the digital changes in order to update the conceptual toolbox and facilitate and empower the expression of people creative potential.

This research, therefore, focuses on the identification of the most crucial factors that could influence creativity in the digital era. Through a literature analysis and a case-based study methodology, the research is unveiling the main digital enablers and inhibitors of the divergent and convergent phase of both the explorative and generative steps of the design process.

The identified factors and the impact of digital technologies on them will highlight reflections on how the process itself is changing. The presentation will describe how this research can provide opportunities and guidelines to empower the design process and its tools.

**Keywords:** Creativity factors, design process, digital technologies, empowering people, design tools

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## **Design theory to overcome orphan innovation – a post-decisional paradigm in public policy for quality of life**

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### **Abstract**

Great socio-technical challenges, such as Improving Quality of Life, confront public policy to the limits of decision-oriented approaches: these approaches are not adapted for the exploration of the unknown and tend to cause so-called ‘orphan innovations’, i.e. design paths that, despite their social relevance, are left orphan from any design efforts.

In this presentation, we show how recent advances in design theory and methods can help overcome orphan innovation. First, we show how design theory today addresses the great issue of the rationality in the unknown and second we show how these new grounds enable to develop methods that can be used 1) to diagnose fixation effects at the root of orphan innovation, 2) to support the emergence of design-oriented ecosystems (with new organizational forms such as “colleges for the unknown” and “architects for the unknown”), 3) to develop a post-decisional paradigm in policy making (with defixating leadership and the capacity to design decisions in the unknown).

We illustrate these results with empirical experimental results obtained on Quality of Life challenges such as “autonomy of elderly people”

**Keywords:** orphan innovation, post-decisional paradigm, C-K design theory, creativity

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## Changes of Design Thinking in Complexity Science

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### Abstract

Complexity science is one of the edge areas of up-to-date scientific development. The development of complexity science has not only caused changes in the natural sciences, but has also increasingly penetrated into the fields of philosophy and social sciences. The famous British physicist Hawking said that ‘the 21st century will be the century of complexity science’. Meanwhile, design is also evolving, it develops from traditional categories to interdisciplinary projects like complex systems. Hence, in this presentation, we argue that complexity science will provide a new way of design thinking. On this basis, four prospective changes of design thinking are presented, they are ‘no defined boundaries’, ‘connections’, ‘self-organization’ and ‘adaptation evolution’.

This presentation mainly aims at calling for more attention on the ‘complexity’ in design thinking and the need for greater achievements in design studies from the perspective of complexity science.

**Keywords:** Complexity science, design thinking

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## Ideation “in the wild” and in the laboratory

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### **Abstract**

This presentation starts by identifying an assumption in studies of design creativity, namely that the evaluation of the output from an early ideation session constitutes valid and reliable evidence for understanding creative design cognition. This important assumption is pervasive in the literature and tends to remain implicit, so the first goal of this work is to articulate it and examine its entailments. The assemblage hypothesis is identified here which indicates that the creative value of a final design solution can be reliably estimated in its early versions. Here we question this premise and propose alternatives for the study of creative design ideation that do not rely on assemblage thinking. Views on early ideation are drawn from studies of professional practitioners and from their own accounts to understand evaluation of incipient design ideas “in the wild”. The talk presents improved metrics for different stages of ideation and suggests relevant assessment regimes.

**Keywords:** design creativity, idea generation, brainstorming, professional practice