Interaction Design and Architecture(s) Journal - IxD&A, N. 15, 2012, pp. 18-30

Is complexity tameable ? Toward a design for the experience in a complex world.

Carlo Giovannella[1,2]

[1] ISIM Garage Dept. of Education Science and Technology and [2] Scuola IaD
University of Rome Tor Vergata
via della ricerca scientifica 1, 00133 Rome, Italy
giovannella@scuolaiad.it, info@mifav.uniroma2.it

Abstract. By going to the root of complexity I show that it can be simplified only if apparent. The true complexity - arising from the peculiarities of the laws governing the interaction among n components of a "natural" system and, as well, from the "topology" of the latter - requires to deeply re-think the approach to the design: operative framework, expectations, methods, evaluation. Complexity leads also to refocus on: i) the central role and relevance of the person, as core of the experience mediated and supported by technology; ii) the peculiarities of the context; iii) their mutual and unpredictable co-evolution. Accordingly one has to redefine the framework of reference and, as consequence, to empower the individuals through the dissemination of an adequate design literacy.

Keywords: Design & Complexity, Design for the Experience, Evaluation & Monitoring, Design Literacy

1 Introduction

Norman's recent book "Living with complexity" provides some useful indications that may help to tame the complexity [1]. These quasi-common sense recipes are applicable whenever systems and/or processes can be engineered (i.e. broken down into modules) and their evolution described step by step, possibly even by mean of checking lists. However, most natural processes, including our experiences, are not repetitive and/or highly operationalizable and one cannot reduce their richness and complexity [2]. For example physicists, and more in general scientists, when attempt to model complex phenomena do not proceed by *problem modularization but, rather, through simplification strategies*: the phenomenon is first reduced to its essentiality/ideality and once that a satisfactory model is found, one starts to consider, one after the other, additional elements that increase the complexity of the problem/system (they can take the form of perturbations, non-idealities, introduction of further degree of freedom etc.). Each time scientists succeed in expanding a model/theory (sometimes following its falsification) they enlarge the range of possible falsifications but, on the other hand, they gain in generality and in apparent simplification. Just to give an example of apparent simplification (which incidentally

can be seen as a measure of the beauty of a theory): you may have the impression that it could be very simple to apply the law E = mc2, but first of all you must know in what context it makes sense to use such beautiful expression and, thus, you are inevitably forced to dig into the complexity that such formula hides.

It may happen that increasing the complexity of the problem, or equivalently of the system, our point of view and our approach to modeling have to vary. For example, we cannot treat the same way material points, solids, liquids or gases, and use the same conceptual approach to describe their properties and behaviors. *Every time we are facing an increase of complexity our toolbox could and should be expanded, although we should be aware that it will be never powerful enough to prevent our knowledge to become less and less precise*. Often we have to give up a part of knowledge in order to be able to predict, at least in part, the future behavior of the systems. Basically the purpose of sciences and of all models/theories we produce can be synthesized in: *use the observations made in the past to understand the present and predict the future* (for sake of clarity it maybe worthwhile to stress that: i) the ability to predict depends on models and theories that we elaborate; ii) experiments could be also mental). Nevertheless one should be aware of all possible limitations of such procedure (usually called "scientific method"), some of which I will discuss to some extend in the next paragraphs.

Designers have a different goal than the scientists: they do not just want to know to understand but, hoping to have understood, they, then, try to suggest modifications of scenarios and stories, by redefining spaces, artifacts, services, etc. ... Due to the complexity of the systems, however, their ability to predict the effects of the interventions is not granted.

In any case, trivially, you need to know to understand and to design: thus, inevitably, we need to go at the root of complexity.

2 At the root of complexity

When a system is complex ? And what is the source of its complexity ?

According to the Latin, "complexus" is what is woven together, a set of parts that are in "interaction". For science, the complexity is revealed when the entities in interaction are at least three. The reason is that when you deal with three entities that interact in an unrestricted space you are not able to predict any longer in a deterministic way the dynamical evolution of the system for whatever set of initial conditions; and does not matter if you know the law governing their interaction (law that, by the way, is always determined by the intrinsic properties of the entities taken in consideration).

The complexity of a system emerges, therefore, not so much from statics but rather from its dynamical evolution, which is determined by the characteristics of the interaction (it is not by chance that the interaction is the key element of the "systemic" [3]). In fact, following any perturbation, it is the interaction that drives the evolution of the system towards the achievement of a static or dynamic state of equilibrium (homeostasis) or the generation of self-organizing out of equilibrium fluctuations. The difference among systems that tend to homeostasis and those that produce self-

organizing out of equilibrium fluctuations lies mainly in the dynamic feedback (see also the distinction between type I and type II cybernetics [3]): negative in the first case, positive and unsupervised (at least in most simple systems) in the second. It is also important to stress that the emergence of any stable structures needs a continuous injection of energy and, as well, the existence of "significant" interactions on different scales, to overcome the effect of the background noise.

Among the emerging structures that reveal at the best the impact that a short-range interaction could have on a large-scale there are certainly the continuously changing shape of flocks of birds or schools of fish. Equally revealing are all properties of a system that are not attributable to characteristics of individual entities that compose it (consider for example: the characteristics of an individual atom and the properties of a material that emerges from the interaction among the atoms that compose it).

Looking more closely the dynamical evolution of the systems mentioned above one comes also to the conclusion that each entity of such systems can be part and contribute to the dynamics of different clusters [4]. This kind of complex dynamics can be applied also to all social networks, like Facebook, and more in general to any interaction on the web, as we already highlighted on F&D journal in 1994, at the dawn of the Internet.

The existence of self-organizing out of equilibrium fluctuations, of which human is the best example, and more in general all kinds of emergent properties, should be enough to convince the reader that *natural processes are almost never easily modularizable and indeed any attempt to divide them will cause a deep distortion of their essence*.

A careful study of complex systems shows that one ingredient that contributes at most to define their degree of complexity is the so called "frustration" [5] that we could translate in the diversification, or non-coincidence of intentionalities and goals of the entities that compose a system. The frustration derives from the variety of possible "orientations" that, due to the interaction, are suggested to one entity by the others, being the nearest neighbors the most influencial ones. To give a visual representation of frustration let consider a school of fish moving in the sea. If you observe its dynamics you will realize that fishes "feel" the swimming directions of their neighbors. Such direction are not always all coincident; sometime you will observe neighboring streams of fishes swimming in the opposite directions and at the border between such streams you will be able to see a layer of fishes that are temporary "frustrated" because they do not know which stream they have to follow. Actually, one of the most appropriate system to illustrate the concept of frustration and its effect on statics and dynamics would be a spin glass but I am sure that its description would be too far away from the cultural background, interest and intentionalities of the reader of this paper ... and we do not want to frustrate her/him !

In general *frustration works as a sort of generator of possibilities that are made available to the system during its dynamical evolution* (technically speaking: it provokes the accumulation of a surplus of energy that, following a perturbation, allows the system to explore dynamically a limited portion of its phase space).

For sake of completeness I would like to observe that in very rare case (see ref. 3 and 5) and for relatively simple systems (not those of interest in this context), the "frustration", especially if not very intense, may not be sufficient to generate particularly complex dynamics, because the systems, depending on the specific

boundary conditions and stimuli to which are subjected, may rearrange into "configurations/forms" compatible (commensurable) with the frustration. Note that the word "form" was not chosen by chance because even many of the forms produced by nature, often taken as a model of harmony [6], are the outcomes of specific processes of growth at the base of which there is a competition between two states/configurations that are not commensurable.

It is pretty obvious that, within the above descriptive framework, the "*motivation*" *of an entity can be seen as a source of internal energy that may overcome the effect of frustration*. When the "intentionalities" of many entities agree they may lead to the emergence of privileged directions of dynamical development and/or evolutionary patterns, and in some case they may induce also the appearance of particularly ordered configurations that allow to separate the system into parts without substantially altering any property of the subsystems. This, however, does not mean that the system is divisible in modules, but, rather, that its properties show a "scale persistence" (and, eventually, self-similarity [7]).

Another important ingredient that contributes equally to the non-deterministic evolution of a complex system is the "disorder". The presence of a slight differentiation in the local configurations/contexts would be enough, in fact, to amplify the effect of the frustration and make the dynamical evolution largely unpredictable, even for very simple systems.

Let's stop here and draw some intermediate conclusions.

We believe that the arguments presented so far should be sufficient to shed light on the roots of a true systemic complexity and to convince the reader about the unpredictability of the evolutionary trajectories that may derive from such complexity.

We are deeply convinced that the reader, who knows very well how complex are all experiences s/he lives, have found many useful elements to better frame such experiences. It comes out that *if one does not want to reduce the richness that derives from such complexity, one should approach the world of possibilities* and feel closer to oriental cultures, *think* - as did the Baroque artists or many authors active in the sixties [8] - *in terms of open work* [9], *become aware that one designs for the imperfection* [10].

The adoption of such philosophical perspective, however, does not imply the renounce to the "intentionality": on a local scale the dynamic of a river maybe not predictable but we know that the river will flow anyway into the sea due to the effect of a well known driving force: gravity; the dynamics of the financial market, as we learned from the recent crisis, is not always predictable but, nevertheless, we continue to predict trends on the basis of models and observables. In other words, as shown above, we do not renounce to improve our understanding of complexity and elaborate models and theory. We are just becoming more aware that the deterministic approach does not always work and that we should, like it happened for the thermodynamics, look for a different approach.

In a so fluid world one possibility is to re-focus her/his own design activity on the *person* that, in a sort of Renaissance 2.0/3.0 (and beyond any ethical principle), recovers her/his centrality and may represent a new *beacon*, maybe also because of the dissolution/weakness of most of the structures of the context in which s/he is interacting. In studying complex system, in fact, one can always focus on the behavior

of a single entity that is immersed in a mean-field (context) generated by the sum of the interactions with and among all other entities that make part of the system.

Within this framework, our interest, as designers, is to develop, although not in an exact/deterministic manner, a description of the experience and identify its relevant dimensions as regards to: a) the individual; b) the context in which s/he interacts and co-evolve [11]; c) the characteristics of process.

Despite of the apparent banality, the elaboration of such description is not trivial at all, as we have shown in the past [17], and it is the base from which one should start to avoid that complexity does not become a pretext for vagueness. It will be the focus of the next section.

3 Experiences as multidimensional spaces person in place centered

So far, there have not been many attempts to describe and define the dimensions of an experience. The most significant ones may be grouped into two categories: a) those that attempted to define the experience in terms of its intrinsic features (models that we might call "structural"); b) those that tried to follow a more "operational" approach and came to the definition of a set of experience's qualities starting from the analysis of individuals considered as "users" (user experiences and qualities). Among those belonging to the former category we would like to mention shortly the model proposed Nathan Shedroff [12] that, being convinced about the possibility to design experiences, has coined the term "*experience design*". This term, used also as title of a recent book by Hassenzahl [13] is subtly but profoundly different from the one we prefer to use: "*design for the experience*"; we believe, in fact, that to design an experience is even unethical and, on the contrary, one should design to support experiences, paying attention that, at same time, they preserve as much as possible their naturalness and increase their "openness". Coming back to the Shedroff's model, he identified six basic components of the experience: significance, intensity, breadth, duration, triggers, interaction. Triggers include all possible stimulations of the senses (inputs) and activation modes of the brain (linked to the recognition of concepts and symbols); interaction refers to the degree of active involvement and is closely related to the intensity that refers to the degree of engagement, and ultimately, to the attentional resources involved in the experience; duration refers, obviously, to the temporal dimension of experience; breadth is connected to the commercial and evocative face of the experience, not very unlike from what is commonly called brand experience; significance, finally, embraces expectations, cultural factors and personal considerations which may all contribute to the quality and memory of the experience. Among criticalities of such model: the fact that intensity and interaction cannot be considered independent (maybe also due to the rather limited meaning assumed by interaction) and, more in general, the rather fuzzy definition of some other dimensions.

As far as the "operational" approach is concerned we would like to mention the set of user qualities (UQ) proposed by Jonas Löwgren [14], developed within the framework of the digital design, but whose validity extends well beyond the limits of that domain. Löwgren has grouped them into five categories: those that can motivate

the user - anticipation, playability, seductivity, usefulness, relevance - those that give a meanings to an experience - ambiguity, surprising, para-functionality -, those that characterize the interaction with all elements contributing to the generation of experience (artifact, service, etc..) - fluency, autonomy, pliability, immersion -, those that put in relation the experience with the outcome at social level - identity, flexibility, personal connectedness, social actability - and finally those that put in relations structural qualities and ideals - efficiency, transparency, elegance -, that might be someway compared with the breadth component of the Shedroff's model. Of course we cannot dwell on detailed of each user quality, but we would like to stress how this model highlights in an explicit manner the need to consider additional dimensions of the experience - such as the social one, the whole spectrum of possible motivations (see also [13]), etc. - some of which are strongly localized on the individual and other widespread in the society (including the so called hedonic qualities).

Both classes of models, however, beyond the level of clarity with which they have been developed/described and the different approaches that distinguish them, use spaces of representation in which the dimension characteristic of the individuals are mixed with those characteristic of the context. Some of such dimensions, moreover, are also highly dependent on the peculiarities of the process, that are never made explicit.

Our point of view differs from the previous ones for either the methodological approach and the results to which it leads (i.e. the space of representation of the experience). In fact, we began with the identification of a process whose characteristics might be compatible with the description of an experience and then we tried to identify the largest as possible number of quasi-independent dimensions that contribute to the description of an experience, either from the perspective of the *person* and from that of the *context* in which s/he is acting, interacting and coevolving.

As far as the definition of a suitable process is concerned we tried, according to philosophical position suggested at the end of the previous section, to identify those features that may characterize at the best the behavior of all organisms of any complexity. The result was the organic processes (OP) [15] based on three parallel layer of functionalities:

- investigate: the environment to collect information & learn;
- elaborate: the information to design/produce;
- communicate: the "products" by means of "actions" (that, in the case of very complex organisms, may imply the use of highly structured and conventional languages).

Unluckily we cannot discuss here the details of the organic process – that can be found in [15] - but we would like, anyway, to stress that although the functional parallelism is typical of all processes performed by living organisms it is ignored by all the most popular processes that, like the cyclical ones, take place along a single track (although they may contemplate a partial overlap of the time-windows assigned to different specific tasks).

After having defined the characteristics of the process we tried to identify the characteristics of a personal experience that can be considered universal and meaningful. In doing that, we came to the conclusion that the definition of the

multidimensional space of the personal experiences follows the integration of:

a) personal characteristics;

b) dimensions of the human interaction;

c) any further dimension that can help to describe, in a manner as complete as possible, an "experience".

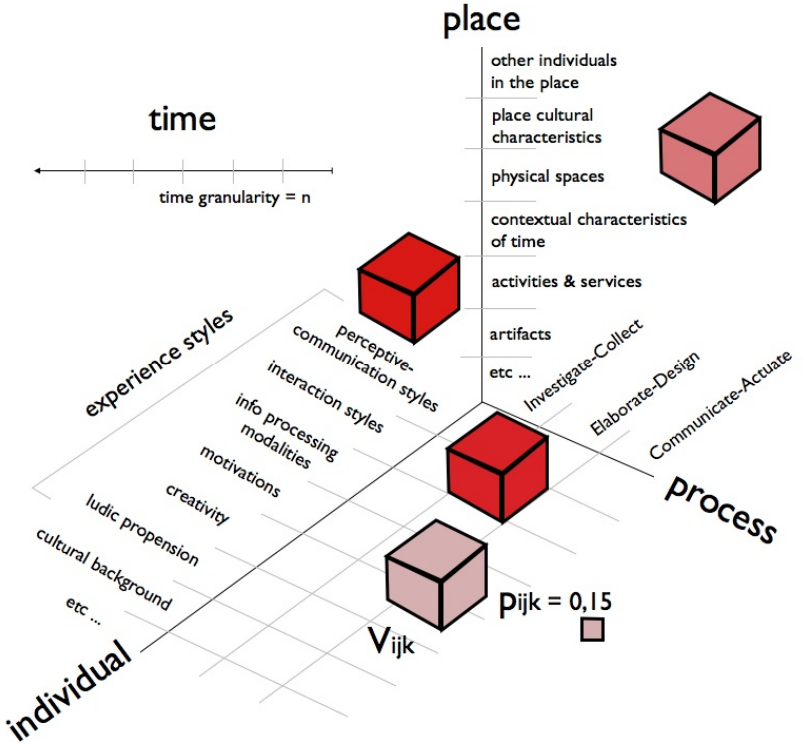

Fig. 1. the 3D space of representation of the experience plus the time dimension. Filled cubes: examples of hypothetical meaningful voxels, Vijk; the color saturation is proportional to the weight/density, pijk, associated to the voxels

The result of such integration is the set of "experience styles" that are placed along the "individual" axis of the 3D representation of fig. 1. They includes: perceptive-communicational preferences (in/out), information processing peculiarities (sequential/global; by contrast), interaction styles (physical, social, emotional, cognitive), game attitude (divided into propensity for competition, risk, vertigo, and mimicry), creativity with propensity for divergence and innovation, motivation (in addition to the propensity not made explicit through other experience styles). Of course, many experience styles could be further detailed through a subdivision of the space of representation. Where necessary, for example, the cognitive characteristics (under interaction styles) can be exploded in attention, memory manegement, interpretive strategies, self-control, etc. The emotional perception can be specified by

means of appropriate dimensional or finite state models of emotions to compose a given mood. Similarly it is possible to explode the propensity towards the various perceptual channels, specific media and/or languages. The mode of interaction may be described by specific quantities and/or qualities such as the degree of connectivity, resolution and proximity, directeness, etc. [16] (that make part of the so called aesthetic of interaction.) Each sub-categorization implies, of course, an increase of the dimensionality of the space of representation and complicates further the use of the model. Case by case, therefore, it is necessary to select the subspace of representation most appropriate to a given experiential process.

It is important to stress that the complete orthogonality of the experience styles defined above, in the absence of appropriate measurements, cannot be guaranteed. In any case, as we shall see below, if any interdependence may become evident and there will be no possibility to decouple further the characteristics of the individuals, it will be always possible to correct the representation of the experience through the use of appropriate matrices.

As reader may have noticed the set of experience styles described above, needs to be complemented by the individual cultural background & knowledge.

Here we do not discuss the relationship among "experience styles" and the three functional layers of the organic process and refer the reader to [17].

On the third axis of fig. 1 we have represented the characteristics of the place within which the individual interacts and co-evolve. Integrating the model of ref. [18,19] with our own model of place, we can identifies the following meaningful elements: the average (or individual) characteristics of people/persona (others from our main actor) who are acting in the place, the own characteristics of the place [11] (cultural stratifications, typology, etc..), the characteristics of physical and/or virtual spaces (lighting, noise level, weather conditions, location, size, etc..), associated activities/services, interactions with other contexts/place (modalities and intensity), the contextual characteristics of time (season, month, day, hour, etc..), the characteristics of artifacts relevant to the process considered. It is not excluded, moreover, that some features of place may also emerge as a product of the interaction between individuals and environment, or among places.

The 3D space/matrix, thus, obtained (see. fig. 1) can be seen as a ensemble of voxels, V_{ijk}, each of which represents the intersection of three features. To each of such voxels can be assigned a weight, p_{ijk}, ranging between 0 and 1 to indicate the relevance of the voxel, $V_{ijk}*p_{ijk}$, at a given moment of the experience.

It is important to underline that the above descriptive model of the experience should be considered as an ideal one because does not take into account constrains/limits that may be introduced by machines/apparata[32]/systems that are involved in the mediation of the experience. Indeed only rarely such mediation can be defined ecological, transparent. Almost ever the mediation introduce filters that modify the relevance of the various dimensions of the experience. Of course one has to put enough care in distinguish between filters' effect and truly relevance of the experience's dimensions. In term of voxel-representation it means that any process can be described at any time by an ideal set of p_{ijk}. Then one can customize and contextualize the process by modifying the "ideal" p_{ijk} set, according to the characteristics of individuals, of particular contexts and/or, more simply, to the technology available to mediate the experience. Each of these operation can be

represented by a convolution of (V_{ijk}*p_{ijk}) with a suitable matrix, M. The simplest case is that of a matrix, M whose only purpose is to reshape the weights assigned to the voxels to customize and/or contextualize the process under consideration. The most complicated one is that of an "interaction matrix" that has to be used when, for example, the variation of a given characteristic influences the others listed on the same axis of the 3D space of representation (dimensional interdependence).

The fourth dimension of our experience model, "conditio sine qua non" for the representation of its dynamic, is the *time*. Its grain scale marks the speed and the "resolution" of the experience, as measured by changes over time of the quantities, V_{ijk}*p_{ijk} (nt), where n is the number of time step unities. Since the time of an experience could assume a subjective value, that may differ from individual to individual, we allow to account for this perceptive phenomenon by means of a corrective time-dependent factor, f(nt), such that the product f(nt)*nt gives the redefined temporal scale at any time.

4 Need of a new approach to evaluation

At this point since we are all convinced that “experience” is a complex process, in turns we should be also convinced that it cannot be assessed any longer exclusively in terms of effectiveness and efficiency and/or on the bases of its outcomes, especially when the main focus is on persons participating in it, and not on the process itself.

The logical and very concrete consequence is that *deterministic previsions and evaluations should transform into the monitoring of the experience's qualities and into the analysis of the emergences*. Certainly it is not an easy task and, being well aware of the difficulty to define the relevant qualities of an experience - although now we have a model of the experience - one may wonder how it would be possible to perform a non-intrusive quantitative and/or qualitative monitoring of the activities that are carried on during the processes.

Luckily processes mediated by the machine generate copious amounts of electronic traces that, when properly channeled and analyzed, can come to our aid. As concrete example in the recent past, in the context of virtual environments for on-line educational experiences, we have shown [20] how starting from an analysis of the traces left in a forum, it is possible to monitor in an ecological manner the social and emotional characteristics of the on-going process by combining social network analysis (SNA) [21] and automatic text analysis (ATA) [22]. In the future we may expect the diffusion of real time analysis of emotional and attentive state through facial expressions [23], real-time gestures tracking (see the possible use of devices like kinect [24]), and of many other techniques of tracking and analysis[7].

5 The grand challenge: empowering the individuals through the acquisition of an adequate design literature

Another tangible consequence of the framework just outlined is that *individuals, since cannot refer any longer* (or at least not always) *to predefined patterns, should be able to manage and flexibly redesign their own "trajectory" according to their intentionalities and the outcomes of their interaction with the context. The practices of design and meta-design, thus, may become the cornerstone of all educational processes and everyone's cultural background* [25 and reference therein].

In fact, we believe that the *centrality of design* (here we do not refer to any specific design sector but rather to the interdisciplinary integration of all its facets) can be claimed on several levels:

i) educational: for what concerns the purpose of training processes; *the ultimate aim, indeed, should be to enable individuals to acquire reflective and meta-design skills in order to be able to continuously readjust the design process and, even, their own project of life*; in other words learner should be able to put into practice the critical method [26] (whose origins date back to ancient Greeks) that makes the so-called reflective practitioner [27] a sort of a reference model to tame the complexity of the contemporary society;

ii) process: because the *design is able to respond to complexity by allowing the flexible structuring of processes* that, from one side, can acquire the organicity of the natural systems and on the other include the iterativity typical of the scientific method; to this latter, the design adds the pragmatic, aimed at finalizing a modification of the world (not only at its understanding); therefore the design processes are not only problem-based, but also project and process based, i.e. P^3BL;

iii) methodological: for *the ability to absorb the best of what is expressed by various disciplines and to integrate all within the processes* mentioned above; consider, for example, the methodologies derived from cultural anthropology, that suitably readjusted, are used in the phase of problem setting; those derived from cognitive science used to design and implement tests; those derived from the engineering reused in the medium- and high-fidelity rapid prototyping, etc. [28,29];

iv) didactic: as demonstrated by *the continuous tension in readapting methods* outlined above *and in developing tools and procedures that can be concretely and flexibly used in different contexts and situations*, in other words by the effort to be at the same time general and flexible [30,31].

We wish to emphasize that the recognition of the *centrality of design* automatically leads to the need of an effort to spread among the new generations a sufficient level of "design literacy".

6 Conclusions ?

At the end we do not want to present conclusions but, rather, open questions and beliefs.

While the *Design for the experience*, by its nature, should be characterized by a strong attention to contexts and, overall, individuals (see the model presented in section 3), the optimization of the industrial production and the acquisition of adequate revenues lead people to the search for common "patterns" and mass solutions characterized by high levels of automation and standardization. It is not by chance, in fact, that designers continuously engage themselves in finding "glocal" concepts and solutions that being respectful of local culture peculiarities can be referred also to universal characteristics of the human behavior and that, paying attention to the emerging requirements, could also lead to an industrial production on large scale. Many questions arise then:

- if our model is a good one to describe experiences in their essence of complex process, how to use the data collected during their monitoring ? Should be used only to increase the level of awareness of the individuals participating to the process to facilitate the acquisition of a critical attitude or, rather, to enforce or satisfy specific styles and behaviors? Should it be done by a man or a machine?

- In this latter case to which extend high levels of automation can be developed and withstand the drawbacks of increasing complex and open processes?

- Would be possible to identify an intermediate level of local_universalities (glocalities) that could serve as a basis to support culturally contextualized experiences mediated by flexible technologies ?

- If does make sense to think in terms of glocal experiences which could be glocal technologies and processes that could be flexibly readjusted to adapt themselves to glocalities ?

Whatever the answers, our belief is that in the future Design and technologies have the duty to support the harmonious integration of all experiencial dimensions that make experiences of value for individuals ... and, as well, their monitoring

References

1. Norman D.A.: Living with complexity. The MIT Press, Cambridge, MA (2011).
2. Giovannella C.: 2009 DULP: Complexity, organicity, liquidity. IxD&A, 7-8, pp. 11--15 (2009).
3. von Bertalanffy L.: General System Theory - Foundations, Development, Applications. George Braziller, New York (2001/1969).
4. See papers published in Campbell I.A. and Giovannella C. Ed.: Relaxation in complex systems and related topics. Plenum Press (1990).

5. See for example: Giannelli A., Giovannella C., Bernaschi M.: On the interplay between disorder and Frustration in 2D arrays of Josephson Junctions. Europhys. Lett., 22, pp. 29--32 (1993).
6. Livio M.: La sezione aurea. Storia di un numero e di un mistero che dura da tremila anni. Rizzoli (2005/2002).
7. See for example: Mandelbrot B.: How long is the coast of Britain? Statistical Self-Similarity and Fractional Dimension. Science, 156, pp. 636--638 (1967).
8. the term "baroque" is used here also in the acceptation of "baroque ensembliste", see Moretti L., Tapié M.: Le Baroque Généralisé. Manifeste du Baroque Ensembliste, Centro Internazionale di Ricerche Estetiche, Dioscuro (1965).
9. Eco U.: The Open Work. Cambridge, Harvard (1989/1962).
10. Giovannella C.: Interaction Design or Design for Imperfection. ID&A, N.0, pp.37--42 (2005).
11. Tuan Y.: Space and Place. The Perspective of Experience. University of Minnesota Press, Minneapolis (1977).
12. Shedroff N.: Experience Design. New Riders (2001).
13. Hassenzahl M.: Experience Design - Technology for All the Right Reasons. Morgan & Claypool (2010).
14. Löwgren J.: Articulating the use qualities of digital designs. In: Aesthetic computing. MIT Press, Cambridge, pp. 383--403 (2006).
15. Giovannella C.: An Organic Process for the Organic Era of the Interaction in HCI. In Educators 2007: Creativity3 - Experiencing to educate and design. Univ. of Aviero press, pp. 129--133 (2007).
16. Lim Y., Stolterman E., Jung H., Donaldson J.: Interaction gestalt and the design of aesthetic interactions, in Design pleasurable products and interfaces, pp. 239--254 (2007)
17. Giovannella C., Spadavecchia C., Camusi A.: Educational Experiences and Experiences Styles. IxD&A, N. 9&10, pp. 104--116 (2011).
18. Chitoupoulu E.: Context as a Necessity in Mobile Applications. in User interface design and evaluation for mobile technology, vol. I, pp. 187--204 (2008).
19. Zimmermann A., Lorenz A., Oppermann R.: An Operational Definition of Context in CONTEXT 2007, LNAI 4635, pp. 558--571 (2007) and reference therein.
20. Giovannella C., Spadavecchia C., Camusi A.: Educational complexity: centrality of design and monitoring of the experience. In USAB 2010, LNCS 6389, Springer, Heidelberg, pp. 353--372 (2010).
21. Wasserman S., Faust K.: Social network analysis: methods and applications, Cambridge University Press (1994).
22. Bolasco S.: Analisi Multidimensionale dei dati, Carocci, Roma (1999).
23. El Kaliouby R., Robinson P.: Real Time Inference of Complex Mental States from Facial Expressions and Head Gestures, in Real-Time Vision for Human-Computer Interaction, Springer-Verlag, pp. 181--200 (2005).
24. http://en.wikipedia.org/wiki/Kinect
25. Giovannella C.: Beyond the Media Literacy. Complex Scenarios and New Literacies for the Future Education: the Centrality of Design, IJDLDC, 3, pp. 18--28 (2010).

26. Adorno T.: Cultural Industry, Routledge (2001).
27. Schön D.A.: The Reflective Practitioner. How Professionals think in action. Ashgate, Aldershot (1983).
28. Moggridge B.: Designing Interactions. The MIT Press, Cambridge, Mass (2007).
29. Benyon D., Turner P., Turner S.: Design Interactive Systems. Pearson Education, Harlow (2005).
30. Jones J.C.: Design Methods, Wiley, New York (1980).
31. Lidwell W., Holden K., Butler J.: Universal Principles of Design. Rockport, Beverly (2003)
32. Flusser V.: Toward a Philosophy of Photography, Reaktion Books (2000/1983)