



Science in education for design

FEDA VUKIĆ
BOJAN KRISTOFIĆ

Graduate School of Design,
Faculty of Architecture, University of Zagreb
Kačićeva 26, 10000 Zagreb, Croatia

Correspondence:

Feda Vukić
Graduate School of Design
Faculty of Architecture, University of Zagreb
Kačićeva 26, 10000 Zagreb, Croatia
E-mail: fvukic@arhitekt.hr

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Abstract

Higher education for design, following historic heritage, is situated within the domain of art, although the central public institution in Croatia was established as an interdisciplinary and inter-faculty studies at the University of Zagreb, Faculty of Architecture at the end of the nineteen-eighties. However, the general social development, economic conditions, technological and scientific trends, both in Western culture as a whole, and in Croatia in particular, point to the need for more complex structure in association of different scientific disciplines, and in inking science and art in the higher education for creative disciplines like design. Discussion in paper identifies theoretical framework as a "knowledge heritage" in foundation of the role of practice and theory of design in such a step forward, if it should be drawn from the past to the future? Throughout the discourse some examples of good practice for university education in the contemporary design are presented, and paper ends with discussion on suitability of design education in general. Paper is the result of a quest for theoretical platform of a new, interdisciplinary approach to higher education for design, which supports the project strategy and problem solving approach, collaborative practice, team interaction and involvement of scientific knowledge in the field of art and, vice versa, artistic creation in scientific field.

INTRODUCTION

In a world of continual communication networking, constant economic changes, deep threat to the natural environment and questionable social future, the key issue considers design as a "a tool for creating or removing obstacles," to use Flusser's discussion aiming to analyze the concept of "material object" (1). His questions through an analysis of the term "object" is indeed pointing to the very concept of the subject, i.e. the philosophy of the material creation, and thus the meaning of systematic planning for material creation. What is the meaning of material creation today (and tomorrow), after two hundred years of industrial modernization, following the concept of 'large scale economy', which had spent vast resources filling the biosphere with the amount of objects of questionable functional and symbolic value? What type of higher education for sustainable design is adequate for the future than, and what type of lessons can be drawn from the panorama of theoretical ideas on design.

Flusser, of course, points to the cognitive quality of the object, as the product of design process, which, of course, raises the question of meaning of design itself and social justification of the process of material production. Consequently huge challenges in natural and cultural environment raise the question on cognitive and creative dimensions of

higher education for design. As a profession that already has a history, certainly studied and written, through institutional and research platforms, design could be evaluated through the past and re-created as the basis for the conception of new of education concept, as a kind of "theory of change" (2). Certainly, the general value of design profession, as a kind of dynamic change depending on the context and the terms of reference, has a standard recognition, but what kind of change is needed to design education today, to be viable for tomorrow? Historical overview of theoretical concepts on design points to the fact that virtually entire history of the discipline has been marked with reflection on such a viability, on the conceptual level that needs to 'see' the future and be flexible as a platform. The educational process for design moreover has been envisioned as a generator of qualified individuals with the creative potential of creating new and still even non-existent reality.

If this is so, if the creation of new comprehends cognitive basis of design quality that Bolz sees as the process of using the produced object, throughout user-object relation (3), there are certain arguments in favor of need for constant innovation in education for design, today perhaps more than ever before in the history of industrial modernization.

In the midst of the global crisis of neoliberal model of 'large scale economy' and social system of nation-states, practitioners, theorists, historians and teachers are forced to design re-examine their social position and legitimacy of their professional and social life. Already by the mid nineties, at a time of economic prosperity considerable Western European countries and the USA, on the wings of the termination of the Cold War, the demise of the USSR and the Eastern Bloc and the opening of new markets, at a time when the rapid evolution in communication has become a global phenomenon and the Internet makes the first mass action; already then, therefore, especially in Anglo-Saxon countries (in which the discipline of design theory and history had emerged developed and academically respectable verified), suspected in the long-term viability of the particular structure of the field of work of professional designers and strict division between graphic and the industrial design, architectural and urban planning. Already in 1995 Margolin claimed "the boundaries around these problem areas have begun to crumble under the impact of technology, strategy, governance, social forces and new intellectual currents. Consequently, the division of design practice now suddenly is inappropriate and ineffective. This situation has led to users design services began intensively to rethink the role of the designer." (4). Buchanan in 1992. wrote that future designers will "be more and more focused on investigating the role of design in sustainable development and the integration of human beings in the wider ecological and cultural environment, forming such an environment when it is desirable and possible, or when adapting it becomes necessary." (5) Twenty years later, that future has definitely arrived. Of course, this does not mean that the activities described by Buchanan

already become globally widespread activity, but it is quite clear that this was the direction for design practice and theory to move to, as a eventual part of a model of sustainable development. As already indicated, the resulting need for a new design method is evident, since the very context of design and visual communication, as products and services for the mass production and consumption (which until now has been the basic framework of the historical origins and development of the professional practice of design) is in a crisis which certainly is not superficial, but rather structural.

After a long period of separate development of artistic and scientific disciplines, it seems that the situation is gradually being born, following to the availability and sophistication of IT tools, when the integration of seemingly heterogeneous fields will be necessary. It is widely understood that the design thinking and design creation could be at the center of this integration. In such a framework for the present challenges to civilization, an altered education for design could be the foundation for future sustainable development, making design theory and practice a part of a new cognitive and creative force. Bearing in mind that the widest context of global crisis, of course, is the ultimate threat of ecological disaster, Margolin accurately determined opposition of two basic directions of development of (Western) civilization – so called. "sustainable" and "expansion" model of the world (6). Particularly interesting is the following observation: "In contrast to a sustainable model, most businesses and many consumers act according to the model of the world that I would call expansion. According to this model, the world consists of a market in which products primarily function as symbols of economic exchange." (7). It is quite obvious that professional design (as it is now conceived) gives legitimacy to the existing, expansion model of social development. Margolin reasons: "Two social development programs (...) are not only in conflict, but on the path for crash (...). This is evident in the ever wider gap between the rich and the poor – both in global and in local context, the development of information infrastructure that one privileges, and excludes the others, as it is evident in a variety of environmentally hazardous situations which begin to permanently damage the planet." (8)

Theory of design is a discipline that in the near future, using the experiences of more or less related scientific disciplines, could form its own body of knowledge, to produce a structured platform of incentive ideas for transforming the professional practice of design, in terms of truly participatory civic political action. To implement such an action in complex social mechanisms, it is necessary to transform the education for design according to the principles of sustainable interdisciplinary method of heterogenous knowledge integration of heterogeneous knowledge. Because, "as the art of conception and planning, design occupies a strategic position between the sphere and the sphere of ethics and that of availability of social change. That is its strength. (...) Design persistently invents its main subject, so it is not restricted to an obsolete product categories. The world expects new things

from design. That is the nature of design." (9) And to create a new, adequate infrastructure and a development model for the future, learning from the past experiences is needed. And that to demonstrate the ways in which the theoretical concepts on design, from the beginning of the consolidation mechanisms of mass production and consumption, as such, to a period of a few decades ago, helped to considerate on sustainable practice of design because in midst of economic, political and cultural change.

Theories on Design

In the context of second industrial revolution and the spread of liberal economic model in late XIX century, a problem of art methods applied on serial and machine production has arisen. The right (sustainable as to put from the perspective of today) and justified methodology and aesthetics of art creation for a new era of machines for the first time was discussed by William Morris, the great opponent of utilitarian objects production, as based on inconsistent and formal usage of historical styles rhetoric. "Morris was the first artist (...) who has come to the conclusion that the foundations of art have become loose and able to decay in the centuries that followed the Renaissance, especially in the aftermath of the Industrial Revolution." (10) challenging the Renaissance concept of the artist as a born genius, responsible only his own music and completely immune to the utilitarian needs of the time, Morris wanted to affirm the practical and philosophical settings of medieval art, where the artist, for whatever discipline he specializes in, worked with all, collectively, the guilds and craft cooperatives, including a number of assistants and artisans, in the social hierarchy of equal participants. However, instead of the resurrection of arts and crafts cooperatives accomplish by running the medieval type, Morris and partners had founded the company in 1861- Morris, Marshall, Faulkner & Co., with the program "a painting, carving, furniture making and working in metal," and thus underlined the paradox of the dichotomy of his theory and practice. Indeed, although "Morris says: 'I do not want art for a few, as well as education for a few, or freedom for a few' and asks the big question that will decide the fate of art in our century: 'What will we do if it is not art share with others?'" (11), and so close to the principles of early socialism (in the spirit of the philosophy of Thomas More and Karl Marx), he intended to develop modernization program on an extremely traditional methods, refusing to use the increase in production technology. Therefore Morris's agenda, although philosophically stimulating, was somehow loose. Nevertheless, "we owe it to him as an ordinary residential house turned into a valuable object of attention of the Architect and chair coverings or vase into an object of the artist imagination." (12) Another important achievement was Morris's theoretical proposition that "it is impossible to separate art from morality, politics and religion," which is to say that the art gradually began to be seen as activity directly caused by the current socio-economic context, and the political and ideological hierarchy of society.

The impetus for transformation of Morris' ideas to coherent theories came from two Americans, a pioneer of modern architecture, Louis Sullivan and Frank Lloyd Wright, author of essays and manifestos *Ornament in architecture* (1892). and *Arts and Crafts of the Machine* (1901.). Sullivan strongly pushed for a new understanding of ornament, which was based on the simplicity and unity of form, texture and color, with a firm belief in the use of modern building materials (iron and its derivatives). Wright, as the first truly integrated modernist builder, fully renounces ornaments, crafts and any form of classical applied art, and expresses undeniable faith in the power of the machine, challenging even the sense of artistic work in favor of a rational, planned and repeatable scientific and engineering work and research. Opposing Morris, Wright magnifies the industrial age, saying: "If this force should be eradicated to let civilization live, then civilization is already doomed to failure." (13)

Somewhat later, Adolf Loos had defined beauty of art as "the degree to which it achieves utility and harmony of all parts in their interaction", and engineers in the broadest sense had proclaimed as "general managers (...) of the kind of culture which today is decisive" (14) in his essay *Ornament and crime*, and this is the culture of technology and industry, but not redundant and decadent, but thoughtful and spiritual kind, for everyone to participate, share and use. The ideal of Loos is the mass culture in which the scientific and technological potential, and therefore artistic creation, and design objects and meaning should be for the mass production and use. And that in to use the material, political and spiritual emancipation for all members of society, providing them with everything necessary for a smooth development at all levels such a definition of mass culture was the basis of the educational program of Bauhaus, the first institution in which the industrial design is taught as an interdisciplinary profession as we know it today.

Foundation of Art and Design Schools – Introduction of Industrial Culture

The origin of the concept of Art & Design Schools can be traced back to the lively debates in the UK in the mid XIX century, when three parliamentary committees adopted the relevant conclusions (15), with the aim of improving the culture of industrial products, and manufacturing production. From these official reports, which date back about 1851. when in a newly built Crystal Palace in London "a big exhibition of the products of industry of all nations" was set, had emerged the first educational institutions to shift the focus of creative education from a narrow field of art to the wider format adopted to the model of serial mass production, that is – design. All this takes place at a time of intense consolidation of material and symbolic levels of liberal social structure and the associated economics. Programs of the first schools of art and design respect duality of the then material and symbolic production, both at the level of small workshop series, and at the level of mass machine production, un-

der the English conceptual labels like 'handicraft', 'artistic craft' and finally 'design'. (16)

The idea of humanization of industrial objects and symbolic content through the integration of art and science, in order to discover their proper aesthetics and functionality for the modern era, thanks to the influence of Morris's parallel occurred in the U.S. and Germany in the early 20th century. In Germany, for the 1898th established innovative workshop producing furniture in Dresden – Deutsche Werkstätten, which modeled on the British example had employed various experts: architects, artists and designers, on a mission to create the most appropriate way of quick and inexpensive, but high-quality mass production pieces. According to Pevsner, it was almost a world precedent then, as the workshop of applied and decorative arts in general were not employing the finest from the world of 'fine' art, be they painters, architects or sculptors. For the first time artists actually attended in the industrial production practice. When Hermann Muthesius returned from London to Germany, everything was ready for the establishment of Deutscher Werkbund, and the work of the association represented "the most important step towards establishing universally recognized style outside experiments by individuals" (17). But the methodology has been disputed. Muthesius wrote: "The main task of our time is to allow the form to regain their rights and the quality of crafts must be the content of each work of art reform that begins today." (18) But the goal was not only enrichment of human material environment by the Werkbund. "Far more important than the material aspect is the one spiritual: the form stands above purposes, materials and techniques. Purpose, materials and techniques can be unquestionable, but with no form we are living in the harsh and cruel world. More than ever we are faced with much larger and more important task of understanding the intellectual awakening and revival of architectural sense." (19) This ambitious target is much broader than mere economic production of objects or affirmation of a new design aesthetics or designing with automated machine tools. Moreover, the role of a prominent artist in a responsible industrial production was the transformation of the society as a whole, a development of an entirely new awareness of the beautiful and functional among the wider public, which, no doubt, included a strong role of education, as well as unconditional collective action among artists, architects, engineers, craftsmen and other professionals to achieve this goal, which should lead to the development of distinctive national product. (20) The thesis on spiritually conditioned matter is a foundation to such a vision. "Culture is impossible without absolute respect for form and having no form is a synonym for lack of culture. Form represents a higher spiritual need in the same ratio as purity represents a higher bodily need. Rawness of form in a truly cultivated man causes almost physical pain..." (21)

Long before the opening of the Bauhaus school, Peter Behrens, one of the founders of Deutscher Werkbund, had understood the industrial civilization as a "new na-

ture" as well as a platform for sensual and perceptual re-organization of human consciousness, which demanded "an entirely new kind of environment" (22). According to Behrens, it meant new means of relating to industrial production and its products – objects and meanings, and that he had found in the culture and art. Seen as a massively available cultural content this has become a new industrial culture horizon. (23)

Elaboration of Interdisciplinary Education as Social Mission

"The ultimate purpose of every visual art is a whole building!" wrote Walter Gropius in the program of Staatliches Bauhaus in Weimar, the school founded in 1919, connecting the Weimar Art Academy and School of Arts and Crafts, along with the newly created Department of Architecture. All the way to 1928, while he acted as director Bauhaus strived for systematic training in arts and crafts, and it was the first higher education institution that brought together teaching on art theory, industrial production, business and commerce, alongside relevant artistic content. Bauhaus was created as a utopian social project whose purpose was to abolish the hierarchical relationships between artists and craftsmen, masters and apprentices, and focus on the refinement of the spirit of their wards in intensive material creation. The ultimate intention of the Bauhaus was to gradually deliver free education to all interested parties regardless of age, gender or race, which become impossible when the last director of the Ludwig Mies van der Rohe was forced to turned the school into a private educational institution. Overall, the program of the Bauhaus was a complete break with the former tradition of education in the arts. "Today art work is in isolation from which it could be saved only through the collaborative effort of all conscious artistic craftsmen. (...) Architects, sculptors, painters, we all must work to restore Trades! Art is not a" profession. There is no essential difference between artists and craftsmen. Artist is an artisan in ecstasy. (...) Craft skills are essential to every artist. In them is the main source of his creative imagination. Let us create, therefore, a new guild without class distinctions that raise an arrogant wall between craftsmen and artists!" (24).

The Bauhaus manpower was not divided on teachers and students, but the master, master assistants and apprentices, because during the training, each participant learned craft from some of the broad palate offered, and at the end got of a license for independent work. Masters who guaranteed influx of avant-garde tendencies in Weimar came from all over Europe, all by themselves champions of modernism, among which some stayed longer and some shorter in Bauhaus, but all shaped the school curriculum – Johannes Itten, Gerhard Marcks, Oskar Schlemmer, Paul Klee, Wassily Kandinsky, Theo van Doesburg, to name but some.

The concept of teaching organization in which apprentices and assistants had the opportunity to test their knowledge and skills in actual practice during the studies, working with masters in different orders and projects,

that was the example that a number of schools followed later on, around the world. Bauhaus cherished idealistic spirit of unity between artists, assistants and apprentices, who have jointly participated in many 'extra-curricular' activities, which were actually very precisely positioned in the general curriculum, with the aim of enriching the culture of students and develop their sensitivity for different forms of creative expression. "The joint will (be) a comprehensive plan, structural utopian projects – public buildings and churches – are the future. Facilitate the cooperation of all the masters and students – architects, painters, sculptors in the design – with a view to gradually achieve harmony of all the components that make up the architecture. (...) will be promoted as friendly relations between masters and pupils outside lessons in the form of lectures, poetry, music, costumed party." (25)

In the education field of architecture, sculpture and painting lessons to apprentices covered the trade skills, drawing and painting, as well as theoretical and scientific lectures, and progressed over through three courses – the first for apprentices, second to assistant masters and third for masters. A fluctuation between fields was desirable.

Basically, the influence of Bauhaus spread quickly throughout Europe in all the areas that the school has developed, and the program of school served as the basis for most of the relevant educational curricula for design, and for the institution that was somehow the direct successor of Bauhaus programs in Germany – Hochschule für Gestaltung in Ulm, which in the midst of rapid expansion of capitalist state in the postwar boom raised questions on the sustainability of this social model.

A deeper lesson of Gropius' philosophy is the very concept of radically moving away from the idea of traditional education in the arts, from the ideal imitation of historical styles and their application in a given context – instead, the school is closer to the idea of synthesis and cooperation between different creative professions (26). Based on the specific Waldorf and Montessori pedagogy, a shift has been made towards wider area of creativity, with a view to making the creative ability to create material and spiritual growth of human beings (27). Finding the best possible solution for an innovative education curriculum in arts, set a path to the global invention of higher education for design. (28)

Environment Design and Sustainable Development – Lessons from the Ulm School

It is a historical fact that Hochschule für Gestaltung was not the first nor the last design education institution in Western world, but for sure it was the most innovative one. It was passing through considerable changes and periods of theoretical and practical training and research, but especially during the last few years really represented a relevant intellectual forum of imagining new possibilities and learning theoretical foundation for design education. The school was founded by Geschwister-Scholl Foundation, whose "purpose (...) was to establish a school

that would, as stated in its constituent document," one being the union of professional qualifications, the formation of culture and political issues." (29) Although the original idea was to establish a school of social studies and natural sciences, a Swiss architect and designer Max Bill, former Bauhaus student, persuaded the founders of the need to establish a school for design, rather than the humanities, since his belief in architecture, industrial design and visual communication as the areas that had the opportunity to integrate various scientific and artistic disciplines in a project that could offer a tangible platform for industrial, cultural, and thus the political renewal.

So the Ulm School actually become the first institution that has developed interdisciplinary educational curriculum for design originally based on a four-year school model, with the first year of preparation and subsequent choice of one of four departments – industrial design, construction, visual communication, with particular precedent at the time – department of information, unfortunately, soon discontinued. The role of the preparatory year was to introduce students to the basics of a universal methodology for subsequent work, either two-dimensional or three-dimensional media, and provide them with a foundation of understanding of cultural and social changes of industrial revolution onwards, and finally to equip them with exact scientific and mathematical tools, indispensable in design for industry. (30)

Even a cursory examination of the original school, signed by Max Bill, her first director (until 1958.), reveals an obvious impact on higher education institutions for design globally, and in Croatia, since the Graduate School of Design at the Faculty of Architecture which, although today it is not the only institution for education of designers, certainly was the first one to implement interdisciplinary model of education for industrial design and visual communication joined with characteristic scientific, rational outlined hinterland.

The important original intention of the Ulm School, however, in which the Max Bill enthusiastically invited to the tradition of the Bauhaus was again a strong and robust integration of the three levels of design for the human environment in industrial era (indeed – design culture) – built environment (architecture and urban planning), the environment of objects (industrial design) and symbolic environment (visual communication). Indeed, it is no wonder that the fifties, due to the dynamic post-war reconstruction, the School had established information department – which was actually the first higher education program of systematic education for copywriting and design of verbal content in the mass media in Europe. If Gropius and his followers, despite his rational constructivism, still believed in craftsmanship as a necessary component of education for designers, the Ulm School, had found adequate requirements for the new industrial age in which mass production and big businesses began to play an increasing role, and promoted science – mathematics, physics, chemistry, and social sciences – as the basis of logical and efficient methodology for design industry. Although this approach may

initially work enthusiastically toward renewed liberal capitalist countries of the West, after Max Bill resigned as director, the new management board of the school become theorist and designer Tomas Maldonado, designer Otl Aicher and sociologist Hanno Kesting, who had upgraded theoretical discourse at the school, and thus education program began to change.

On the one hand it has become a priority project of finding out the needs of consumers with regard to the offer of industrial production and the production of symbolic meanings, on the other hand it was equally urgent question of the nature of aesthetics in design and visual communications, because, according to Maldonado, it became clear that aesthetics is just one of the factors in the creation of the product, and by no means the most important, since besides beauty factor, there are "the productive, constructive, economic, and even symbolic (ones.) Industrial design is not an art, nor is an industrial designer an artist." (31). This quote directly supplements the following: "During the first phase a designer was a constructor, an inventor and draughtsman. Ford himself was a major designer of his time. During the second phase, designer was an artist, regardless of the fact that was his aesthetics intended for the 'few' or the 'many'. In the third period, the designer will be the coordinator." (32) Regardless of the method of present and future designers for expressing their creative impulses, either closer to engineering, to scientific understanding or to artistic skills, implicit Maldonado's maxim holds true especially today – the designers must be aware of the social processes that surround and shape, so that they could influence and change them with knowledge from their specific professional position. These designers can be brought only through education that cannot be limited to certain areas of particulate disciplines.

In 1966 Maldonado dedicated to sound detection of problems in education for design in the paper *Towards the environmental Design*. This was in a less upbeat note, which suggests that school, despite the best efforts, has not met all of its objectives. The visual landscape of the human environment – culture – in relation to somewhat conservative and rigid fifties has changed, and addressing industrial designers, Maldonado ruefully concludes, "never before has the need been so great and never before we were used so little" (33). He simultaneously recognizes the importance of the original utopian project of modernism: "To confirm this take a look at the types of tasks currently invested with your energy and your best ability: it is the opposite of all the tasks that were programmatically brought by pioneers of modern architecture forty years ago" (34), and along he criticizes ironic, even cynical post-industrial standpoint of social and economic status quo.

With such a legacy the ideas from Ulm only today gain strength and are becoming fully clear. Gui Bonsiepe, one of the protagonists of Ulm School and creator of the then efforts for innovation in education curriculum for design, still active today, advocated the concept of design as an "interface", and thus to design education as a flexible

framework with designers as actors within creative teams who have no leader, but a collaborative practice of creating optimal solutions to various problems, discreetly present in the material and symbolic culture (35). This was the early preconception of later idea of "metadesign" – a concept of collaboration not only between designers, but with users in full.

With regard to the whole new field of culture that seemingly opens and which should also ensure the freedom of communication and sharing of symbolic meanings – the field of Internet, international networked digital culture – the coordination, planning, and involvement in a variety of areas, not only in humanities but also in computer sciences, will have an increasing role in the daily creative work of designers. The question is whether the existing educational institutions for design are able to prepare future professionals to do so. (36)

The Science of Design?

While the effect of the Bauhaus, and later the Ulm School, established a kind of a pattern for practice of the European collectivist theories on design in the United States, the progressive design theory, and the concept of education for design, had developed something different. During the thirties, in the midst of depression, industrial design aesthetic styling, which was structurally a kind of applied arts concept, but with a different formal repertoire, and aimed as critical differentiator of products on the large market. After WWII, a number European artists and scientists in exile, released knowledge and talent at the disposal of winners in the struggle against fascism – and so in the process of post-war reconstruction the international modernist movement of the utopian project close to socialism became a utopia of other type – the basis of the future society of plenty and the strongest expansion of the world economy, which has lasted until today.

Architect, designer, inventor and philosopher R. Buckminster Fuller, extraordinary maverick of interesting and intense life trajectory, focused primarily on the questioning of such a social and economic model. His holistic worldview has a foothold in the typical American Protestant pragmatism, and the European avant-garde modernist theory. But Fuller's comprehensive scientific and philosophical system was primarily devoted to the study of major problems for human existence in the entire civilization and the biosphere. He created out of discipline boundaries with no reference to outdated political ideologies that are essentially the other factor of the growing segmentation of human knowledge for accumulation of profit, and undoubtedly slowing down the development of sustainable models of the world. Basically, Fuller is an idealist who based his optimism on negation of dominant anthropocentrism – his projects envisioned the man as placed in the broadest possible context of the physical, chemical and mathematical laws and not the ephemeral and temporal political changes.

Therefore, Fuller's understanding of industrial revolution is optimistic, since it is perceived in context of the

overall progress in technology of natural resources usage, within the process of developing a social system from feudalism to "industrialization", which, according to him, has the potential to fulfill the basic necessities of life for all people aboard the "spaceship Earth". Fuller reduced the resources on three simplest limitless categories, which form the basis for sustainable and responsible industrial production – energy and mass, contained in the atoms of 92 known chemical elements of the periodic system; energy as radiation and gravity, continuously available from the "infinite inventory in space" (37), and energy as the human intellect, which interactively increases by use. According to Fuller the future development of industry and technology should be focused on the coordination of the use of used and exhausted resources to date (both in terms of recycling), and on the assimilation and processing of other categories of energy, which not only comes from renewable sources, but is virtually inexhaustible. The third category meanwhile has to continue to promote the development of different educational system, which will educate people on the principle of sustainable synergies – "Interaction of the two or more shared actions so that the total effect is more than the sum of two or more independent effects." (38).

Fuller had not comprehended conventionally neither the industrialization or the role of the designer in the process. On the contrary – his concept of "comprehensive designer" was founded on visionary interdisciplinary education which in 1949, when he published an article on that issue, was not available anywhere, and not even today in the form in which it was originally conceived by Fuller. "Comprehensive designer represents a new synthesis of artist, inventor, mechanic, objective economist and evolutionary strategist. (...) The first thing a designer needs to do is to provide a new and improved standard of living for all people of the world. He must design a process to gradually accommodate two billion people in home, or move them to another house (...), combining each world center and penetrating into autonomous dwellings of highest standard even on the most remote places of the globe." Fuller's language itself, his original poetic/scientific, intuitive-rational discourse is one possible synthesis of synergies theory in the form of essay, and thus the basis for a new way of thinking, which is still equally topical today. (39)

What is particularly interesting about his idea of "design science" is an approach to former artistic practice as experimental, but also scientifically measurable human activity, which creates a theories, patents and innovations available to everyone, according to the principle of free distribution, in stark contrast with the present trends in flow restrictions of relevant information and intellectual property, which slows down and prevents them from free share.

Design Activism

As Fuller himself Victor Papanek too was an opponent of differentiation among scientific and artistic fields and segmentation of different areas of knowledge for the

purpose of rapid specialization of young people with the aim of producing highly effective individuals within the system.

Adopting a holistic worldview of Fuller, Papanek had defined design more broadly than the context in which it had originally established itself as a professional practice. Thus he had confirmed the interdisciplinary nature of design as a crucial feature of his theoretical and practical work. In his body of theory design is understood as a *modus operandi* that has the power to integrate dispersed knowledge in the process of finding innovative tools for sustainable development. This led Papanek to sharp criticism of the existing production systems, analysis of the relations between producers and consumers, as well as a try to define the needs and rights of the latter (following various social theorists as Erich Fromm, Herbert Marcuse, and others), which is systematically laid out in his book, *Design for the real world* from 1971.

"Design is the key to all human activity. Planning and creation of the pattern-form for any action that leads toward a desired, foreseeable end, is an integral part of design process. Any attempt to separate design in order to make a thing for its own sake, is against inherent value of design as a basic, fundamental matrix of life. Integrated design is comprehensive: it aims to take into account all the factors and adjustments necessary in the decision making process. It tries to look at existing data and trends and constantly extrapolates and interpolates from future scenarios that generates. Integrated, comprehensive, anticipative design is the process of planning, which is done through a variety of disciplines on their mutual interfaces." (40)

What was Papanek's concept of education for sustainable design? He has based any future research and creation in design on setting up the following questions, which are universal with to all of humanity, but in particular local contexts should encourage different interpretations of seminal material and spiritual production, "which are the optimum conditions for human society on Earth? What are the parameters of global ecological and etiological system? What are the limits of our resources? What are the human limits? What are the basic rules of human conduct in the household on the planet Earth? And Finally – what do we not know?" (41) It is clear that there are very few local and global institutions of higher education for design which attempt to answer these questions. According to Papanek it should be done in at least two ways: "designers and design studios should immediately begin redirecting at least a tenth of their talent and hours to solve the social problems, which are subject to such action. (...) This would mean that designers refuse to participate in the work that is biologically and socially destructive (...). Just that would be a giant step towards the common good." (42)

Papanek had envisioned the structure of experimental design schools, which he described as an open, democratic institutions of limited physical and human capacity, organized according to the principle of work community

focused on developing smaller projects relevant to their immediate environment. Schools would be funded by state and private subsidies and incentives by selling their products. Profit could only be returned to schools, as a deposit for development of teaching and further projects. Papanek was fantasizing about such small network of institutions in different local environments, and ultimately around the world, which would allow the dislocation and mobility of students, and connecting of different international teams of specialists, dedicated to solving particular problems of local community. It would be a non-linear diagram of global education in design and its allied arts and sciences, in which state institutions and NGOs would find its interest to immediately benefit from design. The critical complexity of such a system derives from the complexity of the problems to be solved, which is a process yet to be implemented. New social concepts such as are "microeconomy" or "fairtrade", as alternatives to large scale economy, could eventually be more productive context for development of Papanek's revolutionary ideas. (43)

Towards a New Synthesis of Science and Arts

Design culture of Scandinavian countries, particularly in Finland, have been developed in their own, original version of the material and symbolic production in the context of industrial modernization. In 2004, when Finnish Government had decided to integrate that several local universities from different fields (science, technology, art) in a single institution with the aim of increasing efficiency and research potential of the entire Finnish higher education system, it was soon proposed that a new institution should carry the name of Aalvar Aalto, Finnish designer and architect, who himself is almost a metaphor of culture of innovation in Finland. The new Aalto University was formed in 2010. on adjoining of the following institutions – Helsinki University of Technology, The School of business and management, and the University of Art and Design. The new university was designed exactly according to principle of synergy, so based on the original infrastructure of institutions it had established six schools with a brand new program – the sum of all their educational potential is now perceived more powerful than their individual efforts. These are the School of Arts, Design and Architecture (Aalto ARTS), School of Chemical Technology (Aalto CHEM), Business Studies (Aalto BIZ), School of Electronic Engineering (Aalto ELEC), School of Engineering (Aalto ENG) and Science Study (Aalto SCI). Each school has several immediate specialized departments, and separate scientific and creative laboratories, and several research units that cater to both full-time students of the University, as well as foreign MA students or doctoral studies and professional scientists and artists while working on specific projects. Thus, innovation and generation of new ideas and knowledge occur at the boundaries, that links these regions, which integrated in a common institution continuously cooperate interweaving of artistic and scientific experiments

and research. Also, it is important to note that the central university student association – AUS (Aalto University Student Union) – has considerable autonomy and independent decision on the majority of the administrative issues, for example, the exclusive jurisdiction of the competent ministry, or the state, such as housing, food, health services, recreation, and the like. AUS acts, in fact, as the part of executive of the University, while the basic institutions of government through Aalto University Foundation Board implement public – common – interest in education process.

This has ensured an enviable autonomy of universities as primarily non-profit institution whose priority is quality education and continuous production innovation, both in terms of material goods and new scientific, artistic, design, discursive and other concepts. Part of Aalto School of Arts, Design and Architecture is Aalto Design Factory – an open infrastructural platform for post-graduate students to experiment, present and show, lease an office for start-ups and get to know the real world of doing business in design. (44)

It is clear that the quality of experimental design can not be achieved without mutual adequate support between science and art, since design is powered and developed on intellectual and industrial resources that generate these disciplines. Emerging as a result of their networking, design can become an effective tool in solving specific local and even global industrial, economic and communication problems, synthesizing new knowledge in the creation of appropriate products for the sustainable development model of society. The Aalto model makes the most encouraging example for development of education in nation-states of 'small format', which have experienced industrial modernization on the margin, with the particularities of local type. Korvenmaa noted continuity of innovation as the key concept when describing the project of Aalto University, as a significant step forward in the development of design culture. And this culture could become a part of national resource only by development of new and sustainable education model, which is interdisciplinary, at the intersection of science and art. (45)

A Cognitive and Creative Alternative

Design-Based Learning is a relatively new concept in education ranging from pre-school educational institutions to higher education institutions. From the last decade it was implemented within individual educational programs in the EU and US, among which as an example of the theory and practice will be shown Technische Universiteit Eindhoven in Netherlands, along with some parallels to the work of a professor W.H.F.W. Wijnen, coordinator of conceptualization and implementation methods of Design-Based Learning into the curriculum of a number of colleges through a variety of interdisciplinary projects. Design is designated here in the broadest, Papanek's, meaning "to plan and create a form for any action that leads to desired, predictable order," according to an earlier quote. So, it is a methodology of acquiring

knowledge and skills, and problem solving, which counts on verifiable results of experimental research as a verification of their goals. And according Wijnen, it is a "type of education with an emphasis on products created as part of the education process," but immediately adds that "It is not only the final products. Cognitive process is also very relevant." (46) Also, he continues, "Design-Based Learning, as here conceived, explicitly assumes the form of university education appropriate for developing academic skills, such as personal reflection activities, critical analysis of the tasks of designing, broad interpretation of all factors relevant to design, study and classification of modern scientific knowledge into the process, etc." (47) The fact that almost a commonsensical setting must be emphasized through theoretical argument, perhaps shows the extent to which intellectual and creative crisis is affecting educational institutions, even in the most advanced countries. Outdated methods of education no longer bear fruit nor guaranteed exit from the crisis, since it was partly caused by these ineffective methods.

As the theoretical findings from the recent past analyzed in this paper, a new concept of education tends to move away from the segmentation of knowledge, differentiation of skills and exclusive specialization of young professionals. Experience has shown, that such a traditional education practice results in inadequate general education, an inability to understand larger contexts for individual actions, and, ultimately, insufficient development of cognitive abilities and lack of interpretative mental tools effective in dealing with any rational or logical problem to be solved. "Design-Based Learning can be defined as a concept for technical university classes, in which students work cooperatively and actively in multidisciplinary design tasks, in order to achieve qualifications for creative professionals able to integrate all relevant aspects of education, for analysis of existing technical systems, assessing their quality, functionality and price, with the ultimate goal of designing new products and systems of greater efficiency." (48) It is, in fact, the ideal interpretation of design methodology in the strict sense, in the context of higher education in different fields, since such a methodology favors cognitive apparatus to non-systemic learning school lessons, or the application of such learned material in the idealized, inadequate and unrealistic conditions. In doing so, this methodology is not necessarily used only in the higher education – its basic structure is logical and fairly simple, so it is already beginning to be used in some pre-school and primary school educational institutions, considering that such a methodology helps children to exercise abstract thinking based on the particular and real (be it the cases, data or processes). It helps children to correctly perceive the system in which certain processes take place, and not just individual components of the system.

For example, at Stanford University, projects were initiated in the past few years testing Design-Based Learning methodology among the youngest, primary school population. An official statement by the institution on project: "DBL is a kind of project-based learning, which

involves students in a process of developing, building and evaluation of products that they designed themselves. (...) Activities based on design stimulate students to develop pride over their achievements, strengthen their self-confidence as thinkers, designers and actors, out of which they will benefit throughout the life-long education. DBL develops successful learning context for students' active participation and self-construction of knowledge, rather than passive learning about science in books and lectures." In the case of this particular project, it was a question of the design of earthquake-resistant cases of material available in the household, and the subsequent evaluation of the quality of these items by digital tools. (49)

The project was useful for children in several ways: it provided with an opportunity to develop manual skills of design and execution of complex systems from extremely simple resources, which includes the development of motor skills, coordination of movements, cognitive understanding and abstract thinking. Then it helped in mastery of digital tools relatively complex for their age, which increases their computer literacy and security in the use of technological innovations, and ultimately, it provides with a sense of belonging and involvement through continuous teamwork, which ultimately has a positive effect on self-confidence and self-esteem.

In short, although it is currently conducted at institutions with significantly larger budgets, stronger resources and broader capabilities than the local, the fact is that the Design-Based Learning methodology is relatively simple, easily applied, and highly adaptable to different contexts, so it should be subject to more in-depth studies. The effectiveness of this methodology, with the necessary variations in the complexity of the basic assumptions in education from pre-school to university level is important. It is a synthesis of various theoretical, educational and production concepts and ideas chronologically described in this paper, therefore DBL is a potential roadmap for future development of higher education in design, art, and perhaps in science too. (50, 51)

CONCLUSION

Theoretical and critical thinking on design, in particular from the experience of these theories applied to education, raise opportunities for creation of a new concept of higher education for design. Historical examples are fundamentally involved in the formation of the concept, profession and education curriculum for design within industrial modernization context. Due to popularization of a systematic approach to the creation of material objects and symbolic structures, "design", as conceived and practiced today in the higher education system, has become globally recognized as a cognitive and creative practice, or "form of intelligence" as a skill that "everyone has" (52). And if design becomes a didactic form even for the educational system that precedes higher education, does a chance occur to change for the better in higher education curriculum for design?

Is it possible to create a concept of education for design in which the circumstances of the natural and social environment could be identified, at the crossroads of precedent and the actual industrial revolution? Is a long term planning of educated professionals quantity needed in a social context possible? At what level of social needs, in what way, by which social actors and according to what parameters? Following what type of development strategy? In general education and in education for design in particular, to paraphrase Margolin, there is a clear need for interaction, following his critical analysis of relations between the designed material object and design of acting in social dynamics (53). Remarkable evolution of mass communication platforms and virtual social networks since the mid-nineties onwards has made this thesis sustainable.

However, there is no longer a need to recognize interaction as technological, machine/service-user relation only, but in a much broader level, mostly due to the crisis of the Western European model of economy of large scale, the model based on the idea of economic growth by any price. The key lesson of previously described examples of theoretical reflection upon design is precisely – exceeding of disciplinary limits, seeking the concept and practice of education for design that should be oriented somewhat differently from still dominating model of catering professionals to global mechanism of mass production and consumption.

One possible approach to development of new educational curriculum could be found within already proposed binary model of education "on design" and education "for design" (54), an approach that combines "design based learning" in primary and secondary schools with specialist education on the level of higher education, and which could prove for efficiency even on historic experience of design establishment in a non-market oriented social systems (55).

If such an approach would become real it should exceed the boundaries of disciplines, today (and for tomorrow), and – it seems – especially of the limits of science and the arts in the new interdisciplinary and integrating higher education model that will allow the formation of different design disciplines. And these should be found within conjunction with the creative needs that in some social sectors are more on the artistic and socio-humanistic part and in others more in the engineering and technology side.

Design could be an element of balanced development of society, but – it seems – on a very different educational grounds than those from the context of large scale economy. With lessons learned from historical examples of innovative thinking on practice of design, education could start with a new approach to "process, result and a value" of a profession which matters a lot in terms of productive change (56). Elaboration of theoretical and methodological discussion on design in the context of economy of large scale and market competition has created a variety of stimulating critical insights and ideas, even in social contexts

that were ideologically opposed to liberal economic model. These models today could prove inspirational for education in a world of emerging new social and economic relations.

REFERENCES

1. FLUSSER W 1999 *The Philosophy of Design*, Reaktion Books, London.
2. WALKER J A 1990 *Design History and the History of Design*, Pluto Press, London.
3. BOLZ N 2001 *The Function of Design*, *Designreport 4/01*: 104–106., prev. u: Vukić F (ur.) 2012 *Teorija i povijest dizajna*, kritička antologija. Arhitektonski fakultet Sveučilišta u Zagrebu, GMTK, Zagreb, p 493–497
4. MARGOLIN V 1995 *Expansion or Sustainability: Two Models of Development*, *The politics of The Artificial, Essays on Design and Design Studies*. 2002 The University of Chicago Press, Chicago and London, p 78–92, prev. u: Vukić F (ur.) 2012 *Teorija i povijest dizajna*, kritička antologija. Arhitektonski fakultet Sveučilišta u Zagrebu, GMTK, Zagreb, p 459–468
5. Ibid, 80.
6. Ibid, 81.
7. Ibid, 81–82.
8. Ibid, 82.
9. Ibid, 83.
10. PEVSNER N 1936 *Theories of Art from Morris to Gropius*, uvodno poglavlje u *Pioneers of Modern Design*, Peregrine Books, London, ponovljeno izdanje 1986., prev. u: Vukić F (ur.) 2012 *Teorija i povijest dizajna*, kritička antologija. Arhitektonski fakultet Sveučilišta u Zagrebu, GMTK, Zagreb, p 140–156
11. Ibid, 22.
12. Ibid, 22.
13. Ibid, 31.
14. LOOS A 1910 *Ornament and Crime*, *The Industrial Design Reader*: 74–8, Edited by Carma Gorman, Design Management Institute and Allworth Press, prev. u: Vukić F (ur.) 2012 *Teorija i povijest dizajna*, kritička antologija. Arhitektonski fakultet Sveučilišta u Zagrebu, GMTK, Zagreb, p 84–88
15. FORTY A 1986 *Objects of desire*, *Design and Society*. Thames and Hudson, London, p 1750–1980
16. COLE H 1852 *On the International Results of the Exhibition of 1851, Lecture XII, Second Series, December 1, 1852*: 521–539, D. Bogue, London, u izvatcima objavljeno u: *The Industrial Design Reader*: 3–11, Edited by Carma Gorman, Design Management Institute and Allworth Press, Allworth Press, prev. u: Vukić F (ur.) 2012 *Teorija i povijest dizajna*, kritička antologija. Arhitektonski fakultet Sveučilišta u Zagrebu, GMTK, Zagreb, p 17–22
17. PEVSNER N 1936 *Theories of Art from Morris to Gropius*, uvodno poglavlje u *Pioneers of Modern Design*, Peregrine Books, London, ponovljeno izdanje 1986., prev. u: Vukić F (ur.) 2012 *Teorija i povijest dizajna*, kritička antologija, Arhitektonski fakultet Sveučilišta u Zagrebu, GMTK, Zagreb, 140–156
18. MUTHESIUS H 1912 *Jahrbuch des Deutschen Werkbundes*, E. Diedrichs, Jena, objavljeno i kao *Aims of the Werkbund*, *The Industrial Design Reader*: 82–84, Edited by Carma Gorman, Design Management Institute and Allworth Press, prev. u: Vukić F (ur.) 2012 *Teorija i povijest dizajna*, kritička antologija. Arhitektonski fakultet Sveučilišta u Zagrebu, GMTK, Zagreb, p 89–90
19. Ibid, 83.
20. MUTHESIUS H, VAN DE VELDE H 1914 *Statements from the Werkbund Conference of 1914*, *The Industrial Design Reader*: 88–92, Edited by Carma Gorman, Design Management Institute and Allworth Press, Allworth Press, prev. u: Vukić F (ur.) 2012 *Teorija i povijest dizajna*, kritička antologija. Arhitektonski fakultet Sveučilišta u Zagrebu, GMTK, Zagreb, p 95–97
21. MUTHESIUS H 1912 *Jahrbuch des Deutschen Werkbundes*, E. Diedrichs, Jena, objavljeno i kao *Aims of the Werkbund*, *The Industrial Design Reader*: 82–84, Edited by Carma Gorman, Design Management Institute and Allworth Press, prev. u: Vukić F (ur.) 2012 *Teorija i povijest dizajna*, kritička antologija. Arhitektonski fakultet Sveučilišta u Zagrebu, GMTK, Zagreb, p 89–90

22. ANDERSON S 2000 Peter Behrens and a New Architecture for the Twentieth Century, M.I.T. Press.
23. SCHWARTZ F J 1996 The Werkbund, Design Theory and Mass Culture before the First World War, Yale University Press.
24. GROPIUS W 1919 Program des Staatliche Bauhaus in Weimar, In: *Das Bauhaus*, Hans Wingler (ed.) 1962 Rasch & co Verlag, Cologne, objavljeno i kao Program of the Staatliche Bauhaus in Weimar, *The Industrial Design Reader*: 97–101, Edited by Carma Gorman, Design Management Institute and Allworth Press, prev. u: Vukić F (ur.) 2012, Teorija i povijest dizajna, kritička antologija. Arhitektonski fakultet Sveučilišta u Zagrebu, GMTK, p 115–118
25. Ibid, 99.
26. NAYLOR G 1996 The Bauhaus Reassessed, Sources and Design Theory, Dutton, New York.
27. Ibid, 55–56
28. KAUFMANN JR E 1950 What is Modern Design?, u: *What is Modern Design*: 5–9, Museum of Modern Art, New York 1950., objavljeno i kao What is Modern Design?, *The Industrial Design Reader*: 146–155, Edited by Carma Gorman, Design Management Institute and Allworth Press, prev. u: Vukić F (ur.) 2012 Teorija i povijest dizajna, kritička antologija., Arhitektonski fakultet Sveučilišta u Zagrebu, GMTK, Zagreb, p 195–199
29. FRAMPTON K 1974 The Ideology of Curriculum/The Development of Critical Theory, In: *Ulm Design, the Morality of Objects*: 130–171, Edited by Herbert Lindinger 1991 The MIT Press, Cambridge Massachusetts, prev. u: Vukić F (ur.) 2012 Teorija i povijest dizajna, kritička antologija. Arhitektonski fakultet Sveučilišta u Zagrebu, GMTK, Zagreb, p 218–229
30. 1958 Program of the Hochschule fur Gestaltung Ulm, In: *Ulm, Quarterly Journal of the Hochschule fur Gestaltung*: 1–2, 4, 6, 18, 20, 22, No.1 1958., objavljeno i kao Program of the Hochschule fur Gestaltung Ulm, In: *The Industrial Design Reader*: 169–172, Edited by Carma Gorman, Design Management Institute and Allworth Press, prev. u: Vukić F (ur.) 2012 Teorija i povijest dizajna, kritička antologija: Arhitektonski fakultet Sveučilišta u Zagrebu, GMTK, Zagreb, p 215–217
31. MALDONADO T 1958 Disegno e le nuove prospettive industriali, u: *Avanguardia e razionalità*: 55–67, Giulio Einaudi editore, Torino 1974., prev. u: Vukić F (ur.) 2012 Teorija i povijest dizajna, kritička antologija. Arhitektonski fakultet Sveučilišta u Zagrebu, GMTK, Zagreb, p 235–240
32. Ibid, 62.
33. MALDONADO T 1966 Verso una progettazione ambientale, *Avanguardia e razionalità*: 202–217, Giulio Einaudi editore, Torino 1974., prev. u: Vukić F (ur.) 2012 Teorija i povijest dizajna, kritička antologija. Arhitektonski fakultet Sveučilišta u Zagrebu, GMTK, p 269–276
34. Ibid, 203.
35. BONSIÈPE G 1996 Design: From Material to Digital and Back, In: *Interface, An Approach to Design*. Jan van Eyck Akademie, Maastricht.
36. LINDINGER H 1991 Ulm: Legend and Living Idea, In: *Lindinger (ed.) The Morality of Objects*. Ulm Design, M.I.T. Press.
37. BUCKMINSTER FULLER R 1949 The Comprehensive Designer, u: *Your private Sky, Richard Buckminster Fuller Discourse*: 243–248, Lars Muller Publishers, Zurich Museum of Design, Edited by Joachim Krausse, Claude Lichtenstein, prev. u: Vukić F (ur.) 2012 Teorija i povijest dizajna, kritička antologija. Arhitektonski fakultet Sveučilišta u Zagrebu, GMTK, Zagreb, p 191–194
38. Ibid, 244.
39. BUCKMINSTER FULLER R 1969 Vertical is to Live, Horizontal is to Die, u: *Your private Sky, Richard Buckminster Fuller Discourse*: 280–293, Lars Muller Publishers, Zurich Museum of Design, Edited by Joachim Krausse, Claude Lichtenstein, prev. u: Vukić F (ur.) 2012 Teorija i povijest dizajna, kritička antologija: 288–300. Arhitektonski fakultet Sveučilišta u Zagrebu, GMTK, Zagreb.
40. PAPANEEK V 1971 Design for Survival and Survival Through Design: A Summation, u: *Design for the Real World, Human Ecology and Social Change*: 322–349, second edition, Academy Chicago Publishers, 2000, prev. u: Vukić F (ur.) 2012 Teorija i povijest dizajna, kritička antologija. Arhitektonski fakultet Sveučilišta u Zagrebu, GMTK, Zagreb, p 311–324
41. Ibid, 340.
42. Ibid, 341.
43. MEŠTROVIĆ M 1980 Teorija dizajna i problemi okoline. Naprijed, Zagreb.
44. <http://www.aalto.fi/en/>
45. KORVEMANNA P 2009 Finnish design, A Concise History, University of Art and Design, Helsinki.
46. WIJNEN W H F W 2000 Towards Design-Based Learning, Technische Universiteit Eindhoven, Educational Service Centre, Eindhoven, Netherlands.
47. Ibid, 4.
48. Ibid, 5.
49. <http://gse-it.stanford.edu/research/project/dbl>
50. BARAB S, SQUIRE K, Design Based Research: Putting a Stake in the Ground. *The Journal of Learning Sciences* 13(1): 1–14
51. ANDERSON T, SHATTUCK J 2012 Design Based Research: A Decade of Progress in Education Research. *Educational Researcher* 41:16, <http://edr.sagepub.com/content/41/1/16>
52. CROSS N 1995 Discovering Design Ability. In: Buchanan, Margolin (eds.) *Discovering Design, Explorations in Design Studies*. University of Chicago Press, p 105–120
53. MARGOLIN V 1995 The Product Milieu and Social Action. In: Buchanan, Margolin V (eds.) *Discovering Design, Explorations in Design Studies*. University of Chicago Press, p 121–145
54. VUKIĆ F 2011 Design for Tomorrow. In: Bennett, Audrey, Vulpinari, Omar (eds.) *ICOGRADA Design Education Manifesto 2011.*, International Council of Graphic Design Associations, Montreal.
55. VUKIĆ F 2007 The Concept of Formgiving as a Critique of Mass Production. *Design Issues*, Volume XXIII, No. 1, Winter 2007. M.I.T. Press, p 61–72
56. DILNOT C 1984 The State of Design History I–II, u: *Design Discourse, History, Theory, Criticism*: 213–251, Edited by Victor Margolin 1989. The University of Chicago Press, Chicago and London, prev. u: Vukić F (ur.) 2012, Teorija i povijest dizajna, kritička antologija. Arhitektonski fakultet Sveučilišta u Zagrebu, GMTK, Zagreb, p 343–382

