Design Teaching: Identification of Innovative Educational Outcomes.

Prof. Nicola Crea
Faculty of Arts & Humanities, Coventry University
Coventry, East Midlands, CV15FB, UK

ABSTRACT

Complexity of the design profession is progressively increasing. Design schools must educate future designers in different areas of knowledge. To become designers, students need to acquire specific intellectual abilities. Are these being taught today? In which form? To answer these questions, a hypothetical list of thinking qualities has been defined, informed by the work of widely recognized authors. This involved the comparison of the most relevant pedagogical perspectives in order to understand the best timing and the most effective acquisition process. The final result is a final map of a pedagogically correct design thinking educational path. It has been achieved combining designers desirable thinking qualities with the best way and time to acquire them. With extensive use of alternative internet forms of teaching the fast growth of virtual development technologies will allow more time for the thinking and creative process. The purpose set for this study was the improvement of curricula and communication in order to respond to the needs of the evolution in progress. The impact on design teaching programs is significant. It opens up to a wide discussion about the real priorities of design education and how these choices can be functional to the presently opening scenario

Keywords: Design education, pedagogy, future development, new teaching subjects.

1. INTRODUCTION

To perform their activities designers must express competences in different areas of knowledge and must have acquired specific intellectual abilities. One of the main objectives of high education courses is to create a professional figure able to act, think and take decisions according to the requirements of his activity. Teacher should transfer "designerness" in order to build up on the student mental ability in order to create a "Designer". This means the acquisition of an approach to problems, a mentality, an attitude to discovery, creative or speculative abilities, sensibility, taste refinement, entrepreneurship, and any further quality that makes a design professional. For design teaching we should make some considerations: Teachers do not transfer specific knowledge in order to make students able to apply it systematically. Through the skills they have learnt students must produce innovation, these are new ideas and anything different from what has ever been done before or even different from what they have been taught. Teachers should teach project development techniques (methods and tools for concepts and ideas management) without interfering with student's creativity. A significant effort is made to transfer design thinking and problem solving skills when students don't have any experience on the subject.

If we try to identify more in detail what these personal qualities are, by common sense, we can list: mental freedom, open mindedness, refined sensibility and perception, creativity, intuition, curiosity, analytical/critical abilities, strategy in complex situations, entrepreneurship, passion, emotional involvement. Today design schools are concentrating their efforts on courses focused on practical skills development and less on the refinement of intellectual skills (other than implicitly). Many of these are considered as fruit of natural inclination. The common belief is that most of these cannot be taught, being part of individual natural predisposition; design schools, in fact, very rarely offer courses on these subjects. If there are no opportunities to learn or enhance these abilities systematically, how can students individually grow and therefore improve their performance? Some qualities may not be developed in typical design education courses. As a result, today students at the beginning of their design studies are generally not properly prepared to apply design thinking process in context and they struggle in an independent process of growth. They typically improve some of these desirable characteristics along their courses of studies practicing within their design projects. This happens unfortunately in a casual manner, without an organized teaching procedure and without a consolidated practice. It may depend on: educational approach, teaching environment, type of projects, interaction with other students or the attention that teachers place on these specific matters. From an ideal professional profile for a designer, based on widely recognized theories, we will try to define a priority list for the different qualities to be developed. The research, also supported by major pedagogical principles focused on creative development, describes what the desirable evolution for a designer could be and it aims at findings related to the challenges of interdisciplinarity, technical development and globalization. The purpose is to understand what kind of impact these considerations may have on subject matters, curriculum content and what could be alternative methodologies applicable in future design education.

2. METHOD

The research aims to identify which are the skills or abilities that should be acquired or further developed, what would be the best time in the education path and how to use the natural learning process in human evolution for this purpose.
The process has been carried out in three steps:

1) Defining, according to widely recognized authors (Guilford, Gardner, De Bono and Jaoui) a hypothetical list of thinking qualities that designers should have developed for their practice.
2) Acknowledge/understand, according to the most relevant pedagogical perspectives, what would be the most effective acquisition process and the best timing within an individual development.

3) Create a map for a pedagogically correct (theoretically ideal) design thinking educational path, crossing the previous data outcome (designers desirable thinking qualities and the best way and time to acquire them.

3. RESULTS (1) / THINKING QUALITIES

The psychologist J. P. Guilford started analyzing the structure of intelligence and peculiarities of creative thinking and identified the two fundamental elements of the creative process: convergent and divergent thinking. In 1954 he published with R.C. Wilson, P.R. Christensen and D. J. Lewis, in Psychometrika [1] a study titled "A factor-analytic study of creative-thinking abilities", mentioning that *"in this study an attempt was made to isolate and define abilities in the domain of creative thinking, particularly as it applies to science, engineering, and invention"*. Eight main factors were identified as components of the mental elaboration, implicit in creative thinking processes: Sensitivity to problems, Fluency, Flexibility, Originality, Penetration, Analysis, Synthesis and

Redefinition. H. E. Gardner, developmental psychologist at Harvard University, best known for his theory of multiple intelligences, identified several critical points in our present educational system [2]. In his publication "Five minds for the future", he argues that teaching is not synchronized with the education needs of the students and that the amount of knowledge to acquire is so wide that it is impractical to teach all that is necessary. The constant change of technologies, knowledges and vision of the world makes school teaching obsolete. We should overcome the present division in disciplines that always gives us a partial view of reality, with a multidisciplinary perspective of knowledge. The possible ways to address these issues are to establish a system of permanent education. Along the individual intellectual development, we have to define what essential competences we need to acquire. We need to discover what would be the appropriate timing for a coherent evolution process. Gardner proposes five forms of intelligence that would be necessary to develop in order to answer to the outlined deficiencies: a disciplined mind, to analyze different approaches to an issue, to learn the ability to

References Mind Functions	GUILFORD *Factors of creative thinking*	GARDNER *Five minds for the future*	DE BONO *Six thinking hats*	JAOUI *P.A.P.S.A.*
EMOTIONS Emotional impact Personal implication	Sensitivity to problems	Ethical mind	Red - Emotions	Perception
LOGIC AND THOUGHT Rational approach Search for solutions	Penetration	Disciplined mind	White - Objectivity Yellow - Optimism	Analysis
CREATIVITY Research Production of ideas	Fluency Flexibility Originality	Creative mind	Green - Creativity	Production
CRITICAL APPROACH Deal with problems Elaboration process	Analysis Synthesis	Synthetic mind	Black - Criticism	Selection
APPLICATION/EXECUTION Deal with others Relationship with contest	Redefinition	Respectful mind	Blue - Management	Application

Figure 1.

define priorities and to catch relevant concepts; a synthesizing mind, to be able to select information and knowledge, to think within an interdisciplinary framework, perceive the essential of things, identify strategies; a creative mind, to develop a personal sensitivity, to identify a personal path and the will to explore; a respectful mind, to understand multi-culture, flexibility of context, complexity of mind and human inter-relations (to see differences as opportunities); an ethical mind, to learn to share, to approach common causes with the integration of competences and to work in the common interest. For Edward De Bono [3] major thinking categories are, in terms of design thinking process and related to innovation, creativity

and problem solving practice: Emotional thinking, Creative thinking, Objective thinking, Positive thinking, Critical thinking and Management thinking. He isolated the different components of the process developing his tool "Six thinking hats". His idea is that when we design, or more generically we search for the solution to a problem, we deal with a number of logic attitudes that generally are overlapping. Judging an innovative idea, in a discussion, participants tend to defend their position rather than compare their opinions. De Bono is proposing to align the different points of view within a common thinking category. Each category, however, we assume it needs specific competence, related qualities and skills. To be more specific

before emotional thinking there are sensibility and sensitivity. Open mind pre-disposition and free thinking attitude support the creative thinking processes. A disciplined and logic mind produces objective thinking. A critical spirit is necessary to evaluate negative aspects of things. Management thinking abilities are essential to plan, schedule and organize project activities and strategies. H. Jaoui has been proposing for decades the application of creativity in the industrial environment with his agency GIMCA. He identified [4] five elements of design thinking in a creative process P.A.P.S.A., they are: perception; analysis; production; selection; application. These represent, for Jaoui, the major elements involved in the practice of problem solving. Jaoui's description of the creative process structure, combined with the considerations and the outcomes of Guilford, Gardner, and De Bono, allows us to build a comparison map (Figure 1) developed mainly to identify which are the common qualities identified and which are more desirable to manage problem solving practice. By crossing the design thinking analysis of the cited authors, it is possible to draw a comparison of the different conceptions and analyze what are the more relevant common elements. At a first evaluation it appears that many of these elements are in common, even though they are named differently. As results of this comparison, the following map shows what are the elements that can be considered as foundation of the design thinking process: emotional thinking; creative thinking; objective thinking; positive thinking; critical thinking and management thinking.

GROWTH PHASES	Childhood											Adolescence													Adulthood			
EDUCATION FRAMEWORK	NURSERY			NURSERY SCHOOL			PRIMARY SCHOOL					JUNIOR HIGH-SCHOOL			HIGH-SCHOOL COLLEGE					UNIVERSITY					SPECIALIZATION PROFESSION			
AGE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	...
JOHN DEWEY	...			SPONTANEOUS NEEDS - PLAY					SOCIAL CULTURAL VALUES			ABSTRACT KNOWLEDGE EXTENSION			...													
EDUARD CLAPARÈDE	STAGE OF PURCHASE AND EXPERIMENT											STAGE OF ORDER AND EVALUATION							PRODUCTION STAGE									
	P*	L*		GENERAL INTERESTS AND «WHY»				SPECIALS AND OBJECTIVE INTERESTS				SENTIMENTAL, ETHICAL, SOCIAL, SPECIFIC, SEXUAL PREFERENCES							WORK INTERESTS									
JEAN PIAGET	SENSORI-MOTOR STAGE			PRE-OPERATIONAL STAGE			CONCRETE OPERATIONAL STAGE					FORMAL OPERATIONAL STAGE																
KURT FISHER	ELEMENTARY EMOTIONAL STAGES											ABSTRACT THINKING CRITICISM, OPPOSITION AND REFUSAL – SELF AWARENESS – DRAMATIZATION – ABSOLUTIZATION - ELABORATION																
JEROME BRUNER	ENACTIVE STAGE				ICONIC STAGE							SYMBOLIC STAGE																
MARIA MONTESSORI	CHARACTER DEVELOPMENT				SELF-AWARENESS GOOD/BAD PERCEPTION				SOCIAL AND MORAL-AWARENESS FEELINGS			...																

Notes: **P*** = *Perceptive interests*   **L*** = *Languages interests*

Figure 2.

4. RESULTS (2) / PEDAGOGICAL ORIENTATIONS

If we consider the content of figure 1 (first column) as reliable categories of thinking related to the design process, we need now to identify an appropriate path, along the education process, to grow and refine each of these specific qualities. To define this properly, it is necessary to compare the most renowned pedagogical theories and design another reference map. Pedagogy has provided widely recognized experiences from: John Dewey [5], Edouard Claparède [6] [7], Jean Piaget [8], Jerome Bruner [9], Kurt Fischer [10], to name the most relevant. Considering the complete development of individuals as the combination of physical, spiritual and intellectual factors, in our case, we should refer mostly to significant studies addressed to the improvement of intellectual qualities, such as: open mindness; natural pre-disposition; free-thinking attitude; creative processes ability. To better finalize our analysis we can add the work of Rudolf Steiner [11][12][13] (1861-1925), Maria Montessori [14][15] (1870-1952) and Loris Malaguzzi [16] (1920–1994), that reflects the proposed orientation toward a more creative and a less prescriptive form of educational path. In fact, they all developed schools that focus on individual qualities development, free-thinking and care for potentials of personal growth. As a priority in the analysis, we considered those who gave a chronology to their proposed educational path, in order to be able to compare their different indications. The map in Figure 2 that stems from this analysis shows consistency among the various perspectives and demonstrates that discrepancies are negligible. Different evolutionary periods describe cognitive peculiarities for each age of growth. The desirable intellectual and mental qualities outlined in Figure 1 are aligned with the most appropriate time for development outlined in Figure 2.

To identify the correct period of evolution we have to clearly understand how receptive learners are and what kind of process they go through. From Figure 2 we can understand that the design thinking process has roots in the very early stages of human development and that some mental attitudes and thinking qualities can be acquired right at the beginning of the education process. For the first three years we go through an unconscious process of development where emotions start their building process. In the next three years we start developing language, active experience and will. Through play children develop creativity, fantasy and imagination. To see the

beginning of logical and disciplined thought we have to wait until the age of six. With adolescence, at around twelve years old, children typically develop a strong critical attitude that if positively channeled could set the bases for structuring critical thinking. With maturity, at around eighteen, nineteen years of age, an individual should have completed his path to build abilities for evaluation and synthesis. Right after he could be ready for the proposition of new ideas using logic-deductive thinking, imagination and symbolism (use of code languages as in music, mathematics, etc.).

GROWTH PHASES	Childhood											Adolescence													Adulthood			
EDUCATION FRAMEWORK	NURSERY			NURSERY SCHOOL			PRIMARY SCHOOL					JUNIOR HIGH-SCHOOL			HIGH-SCHOOL COLLEGE					UNIVERSITY					SPECIALIZATION PROFESSION			
AGE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	...
EMOTION	EMOTIONAL EDUCATION																											
PERCEPTION				CREATIVITY FANTASY IMMAGINATION PLAY																								
LOGIC AND THOUGHT							OBJECTIVE AND LOGIC THINKING																					
PROPOSITION							POSITIVE THINKING																					
CRITICAL APPROACH												CRITICAL THINKING																
APPLICATION EXECUTION																			MANAGEMENT THINKING									

Figure 3.

5. RESULTS (3) / CROSSING DATAS

Evaluating and comparing the cited studies on pedagogy and education, relating them to the outcome of the first map (desirable qualities for students starting studies about design thinking and/or problem solving,) we obtain a map (Figure 3) that shows, as a pragmatic indication and proposal, how the learning of major competences composing design thinking can be integrated inside a general education framework. From this map we can identify key factors, it shows graphically the deployment of abilities, skills and competences developed along the learning process and the coherence between the qualities to acquire and the receptive potential of individuals in the respective development phases. It has to be considered that at the end of the educational process, with the beginning of work activities, the outlined qualities should all have reached their completion in order to properly support a professional application of a thinking process.

6. DISCUSSION

The aim of the research was to describe how present curricula in design schools, informed by ideal criteria, could be improved. These improvements are based on a desirable evolution of design education from a pedagogical point of view. The purpose was to understand what kind of impact these considerations may have on subjects, curriculum content and what could be the alternative methodologies applicable in future design education. The third map (Figure 3) shows a pragmatic indication on how the learning of major competences that constitute design thinking can be integrated inside a general education framework. As a result, the map shows graphically a timeline of deployment of mental abilities, intellectual skills and specific competences, along the learning process. It shows, as well the coherence between the qualities to acquire and the receptive potentials of individuals in the respective development phases. At the end of the educational process, at the beginning of working activity, the learning process needs to reach its completion, in order to properly support the thinking process. If a learning process starts earlier it has more time for development. The emotional development that starts at birth and proceeds all along the individual growth has a longer time for practice and application, meanwhile the critical attitude, which only starts at adolescence, will have a shorter development time. Much needs to be done in our educational processes in respect to thinking processes, particularly in the design education area. Any improvement in this direction would be significantly beneficial to those beginning studies related to creativity, problem solving and design thinking.

7. CONCLUSIONS

It is critical that in the future courses with a teaching content related to development of the thinking process and the involved individual qualities will be introduced. Currently Design schools concentrate more on courses focused on practical skills development where the time devoted to intellectual refinement (other than implicitly) is less relevant. If we consider that the fast development of IT will allow progressively more time to focus on the thinking and creative process rather to the building up of manual skills, we are facing a radical change of perspective in terms of education content and the teachers' role. From "learning by doing", PBL (Problem Based Learning), focusing on learning complexity, interdisciplinary, team work,

discovery and self-learning process [17], we can make a further step ahead in support of individual growth. Roskilde University and Aalborg University, in Denmark, Maastricht University, in the Netherlands, and McMaster University in Canada, that were founded in the '60s and '70s, when the reform of pedagogy originated, have established University programs within a problem based and project organized (PBL) practice. The theoretical roots of PBL began to receive serious consideration in the '90's. The PBL tradition builds on the experiential learning that was formulated by David Kolb [18], John Dewey,

along with Oskar Negt and Alexander Kluge's theories [19] of the development of work education and along with the development of political consciousness formulated at the beginning of the '70's. The development of specific individual qualities will allow a design student to become a designer as much as a student from a medical school becomes a doctor or a student of a law school becomes a lawyer. The table below (Figure 4) shows a list of desirable personal, intellectual practical abilities and competences that should be part of the knowledge outcome for students completing a higher education

LEARNING CATEGORIES	COMPETENCIES
ESSENTIAL SKILLS *(Practical abilities)* **I know** *how*	• *2D / 3D art work* • *Digital fluency* • *Technical drawings* • *Workshop skills* • *Craftsmanship / modelling* • *High tech facilities / IT management*
INTELLECTUAL SKILLS *(Design thinking process)* **I can** *do it*	• *Problem finding* • *Problem solving* • *Ideas production and management (creativity)* • *Synthesis of complex processes* • *Psychology and perception* • *Project management*
INDIVIDUAL QUALITIES *(Mental abilities)* **I am** *able to*	• *Cultural anthropology awareness* • *Interdiscilplinary knowledge management* • *Critique abilities* • *Team work* • *3D thinking / mental modelling* • *Implicit & explicit communication management* • *Emotional intelligence*

Figure 4.

Design course. According to this proposal, the intellectual abilities that make a designer, can be divided in three different categories: essential skills, in terms of practical abilities, intellectual skills, in order to apply a design thinking process and individual qualities which will define the ability to have a "designer approach" to problems. This change of perspective will have effect on the mode of education and the relationship between teachers and students. How the future teachers' role will change according to the emerging scenario? In 1990, Pierre Levy, outlined what will be the new role of teachers after the wide spread use of the internet [20]. As he wrote later [21], the new culture is "*participatory*" and based on "*production and sharing of digital creations*" and that school teachers will constitute an "*informal partnership*" with students, allowing them to feel responsible for the educational project. In this new context "*The teacher cannot be a knowledge transmitter, but a facilitator, which acts as a filter between the chaos of the network and the brain of the student*". We need to seriously consider the acquisition of these thinking processes in the basic curriculum of design learning and prepare a new generation of teachers with appropriate targets. The impact to current teaching strategies could be significant. This opens up a broad discussion about the real priorities regarding the various teaching subjects

and how these choices can be made to support the possible evolution of education in the years to come.

8. REFERENCES

[1] J.P. Guilford, R.C. Wilson, P.R. Christensen, D.J. Lewis "A factor-analytic study of creative thinking abilities" – *in* **Psychometrika** Vol. 19, No. 4, 1954, pp. 297-311.

[2] H.E. Gardner, **Five minds for the future**, Harvard Business Press Boston, 2006.

[3] E. De Bono, **Six thinking hats: An Essential Approach to Business Management.** Little, Brown & Company, 1985.

[4] H.Jaoui, **La Crèativitè, mode d'emploi,** ESF éditeur-Entreprise Moderne d'Edition et Libraires Techniques, Paris, 1990.

[5] J. Dewey, **Experience and Education**, New York, NY, Kappa Delta Pi, 1938.

[6] E. Claparède, **Psychologie de l'enfant et pédagogie expérimentale,** Kundig et Fischbascher, Genève et Paris, 1909.

[7] E. Claparède, **L'éducation fonctionnelle**, Neuchatel, Delachaux, 1931.

[8] J. Piaget, B. Inhelder, **La psicologia del bambino,** Einaudi, Torino, 1970.

[9] J. Bruner, **The process of education.** Cambridge, MA. Harvard University Press, 1960.

[10] K.W. Fischer, P.R. Shaver, P. Carnochan, "How emotions develop and how they organize development" in **Cognition and Emotions** Vol. 4, No 2, 1990.

[11] R. Steiner, **Gegenwärtiges Geistesleben und Erziehung,** 14 lectures, Ilkeley, 1923.

[12] R. Steiner, **A Modern Art of Education,** Great Barrington, Anthroposophic Press, 2004.

[13] R. Steiner, **Education and Modern Spiritual Life,** New York, Garber Publications, 1989.

[14] M. Montessori, **The absorbent mind,** New York, Dell Publishing, 1949.

[15] M. Montessori, Jean-Jacques G. Bernard, **De l'enfant à l'adolescent,** Paris, Desclée de Brouwer, 1948.

[16] L. Malaguzzi, "Esperienze per una nuova scuola dell'infanzia" - **Proceedings of study seminar 18-20 March 1971,** Reggio Emilia, Editori riuniti, 1971.

[17] E. De Graaff, A. Kolmos "Characteristics of Problem-Based Learning", **International Journal of Engineering Education** Vol. 19, No. 5, pp.657-662, G. B. Tempus Publications, 2003.

[18] D. Kolb, **Experiential Learning as the Science of Learning and Development.** Englewood Cliffs, N.J. Prentice Hall, 1984.

[19] O. Negt, A. Kluge, **Öffentlichkeit und Erfahrung: Zur Organisationsanalyse von bürgerlicher und proletarischer Öffentlichkeit** , Suhrkamp Verlag, Frankfurt, 1972.

[20] P. Levy, **Les Technologies de l'intelligence. L'avenir de la pensée à l'ère informatique**, La Découverte, Paris, 1990.

[21] P. Levy, **L'intelligence collective. Pour une anthropologie du Cyberespace,** La Découverte, Paris, 1994.