Researching Design Pedagogies in different levels and fields of Education: towards a New Ideology in the Agenda of Design Education

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According to Lewis Mumford (1952), higher stages of development of a civilization are characterized by a balanced development of the symbol and tool, the art and technics. And even if Mumford was not ready to recognize both these qualities in industrial design of his times, it is now accepted that design considers science and meaning as one (Guellerin, 2011). However, division between the STEM subjects (Science, Technology, Engineering, Mathematics) and the arts in the early stages of Education (Polaine, 2011) threatens this advantageous unity of scientific background and intuitive conscience and brings the potential role of the designer to meet universal challenges and provide solutions for a better future into question. This paper examines the case study of a Design Lab for primary school pupils, supervised by the author as part of the educational programmes within the Macedonian Museum of Contemporary Art. Active involvement of 9-11 year-old pupils in the design of everyday objects justifies the necessity of the subjects they are being taught, promotes their ability to judge the objects around them and builds well-informed consumers: credibility conditions to bring Design Thinking into the agenda of primary and secondary education. Researching design pedagogies in this critical stage of education, prior to the STEM/Arts division, and analysing results in comparison with Higher Education students undertaking similar or identical projects in the School of Visual and Applied Arts and the School of Architecture, this paper aims to identify, understand and retrieve what is lost in between to inform a design curriculum where STEM is balanced by IDEA - Intuition, Design, Emotion, Art (Maeda, 2010): skills so central to design, as also crucial for everyone. Only by connecting the dots between different levels and fields of Education and by looking beyond the ideological boundaries of science and con-science, we may re-define Design as a unity and move towards a new ideology in the Agenda of Design Education.

Identifying the problem: the hegemony of STEMs over the ARTs

According to Lewis Mumford (1952), higher stages of development of a civilization are characterized by a balanced development of the symbol and tool, the art and technics. And although this balance preoccupies a unity between the areas of art and technics, today we are rather witnessing a dihotomy between them. In either the strict scientific world or the art community, it is rarely a question of one *and* other but mostly of one *or* the other, or even worse one *over* the other.

Beginning with the outbreak of the industrial revolution, moving through the digital revolution and the Information Age and coming up to our times, modern civilization shifted away from the idea of this balanced development of Art and Technics towards a total hegemony of the latter, or what we call the STEM subjects: Science, Technology, Engineering and Math. Based on the solid foundations of

scientific thinking, we perceive progress in a materialistic and technical manner, lacking any kind of holistic ontological approach on what progress really is or should be.

That brings us to the case of Design, a field laying in between the Science and the Arts, or –better said- based on the foundations of both. According to Jean Baudrillard, every single designed object around us (and actually every object *is* designed) has not only its functional and economic value (where STEM lays), but also its symbolic and semiotic value (where Arts and Humanities come in). And even if Mumford was not ready to recognize both the qualities of the symbol and the tool in the industrial design of his times, it is now accepted that design considers science and meaning as one (Guellerin, 2011). But is this generally accepted and by whom? And here is where the problem lays: a problem well known to design educators, researchers and practitioners. Being exactly in between the two worlds, design is more likely to fall into a -man-made rather than existing- cultural gap as something that both sides fail to understand, engage with or even accept it as something of its own (with deep roots on both sides but at the same time culturally autonomous in itself). Scientists, mathematicians, economists and engineers reject design, consider it as an Art rather than Science while artists fail to recognise in design any other value than the technical and functional one. Things get worse when one of these worlds attempt to adopt design merely on its side. Incorporating design within a School of *Visual and Applied Arts* instead of a School of *Art and Design*, may encrypt a perception of design as a lower-class kind of art (applied art), leading to a restrained curriculum where STEM subjects are totally excluded. On the other hand, Schools of Engineering tend to perceive Product Design as synonymous to Product Engineering, thus leaving the other part of the coin (and brain) aside. In this case, education lacks anything associated with the semiotic and symbolic values of the form, the social and cultural implications of design and promotes a *technology-driven* rather than *human-centred* innovation.

A critical issue in this matter is that the division between the STEM subjects and the Arts happens in the very early stages of education. This tends to create an environment in which pupils with more visual or kinaesthetic learning styles begin to reject STEM subjects or, at least, find them difficult to engage with, due to the way they are usually taught (Poleine, 2011). Even if someone wants to engage in both the sciences and the arts, preference choices often force him to choose one path over the

other. This initial experience is carried over to the adult life when students are studying in Higher Education. Subjects related to theory and research immediately smell of science and either fear or boredom set in (Robinson, as quoted in Poleine 2009).

Towards a new paradigm in Design

It is most evident that we are lately shifting towards a new paradigm in design. Long ago, Design has moved away from mere industrial aesthetics to enclose the idea of human-centred innovation. At a time when style and surface had become too superficial for many people, the search for a new theme on design led to a new paradigm. State-of-the-art design today, let's call it "New Design", is almost an inversion of the old model. As Arnold Wasserman puts it, at the core today is human-centred innovation, entailing rigor about human needs, functionality, marketability, usability and sustainability (Wasserman, 2004). External appearance is only one dimension, even though an important one, among many others in the complex interactions of design, now serving not just for making better "stuff", but widely for creating better socio-technical systems, experiences, strategies, organisations, even public policies and programmes (Table 1). New Designers all pursue the same goals: to define people's needs and desires in order to shape products and socio-technical systems that change life for the better (Wasserman, 2004).

Table 1: Old Design vs. New Design (Wasserman, 2004)

OLD DESIGN	NEW DESIGN
Product-Driven	Process-Driven
Product Function	User Experience
Technology Driven Invention	Human-Centred Innovation
Producer-Centric	Customer-Centric
Our Way	Your Way
We Know What You Should Want	What Do You Really Need & Want

Think From Inside the Company	Think From Outside in the World
Outward into the World	Backward into the Company
Experience-Based Judgement	Research-Based Insight / Foresight
Specification Culture	Prototyping Culture
Physical Science, Engineering, Technological Systems, Finance	Social Science, Ecology, Biology, Human Systems, Life-Cycle Economics
Maximise Sharefolder Wealth	Maximise Human Benefit
Think From the Present Forward	Think From the Future Back
Limited Production & Mass Manufacturing	Flexible Manufacturing & Mass Customisation
Mechanical / Electromechanical / Atoms	Digital / Software-Driven / Bits
Resourse & Energy-Intensive	Green, Recyclabe, Sustainable
Big, Slow, Heavy	Small, Fast, Light
Only Designers Design	Everybody Can Use Design Methods & Tools
Only Design Students Should Learn Design	Everybody Should Learn Design As a General Knowledge Subject K-12
Design Is For Making Better "Stuff"	Design Is For Making Better Socio-Technical Systems, Experiences, Strategies, Ventures, Organisations, and Public Policies & Programmes

No other organisation reflects this change of paradigm better, than INDEX: Design to Improve Life. Created by Denmark in 2002, INDEX: Design to Improve Life® promotes the application of designs and design processes to improve vital areas of people's lives worldwide, being in sync with the values and principles of Danish design on humanism, social understanding and democratic thinking (Hvid, 2004).

This concept first recognised in the nominations of the INDEX: Awards, has widely spread to embrace other similar events like the Brit Design Awards, where

designs for social change have started to take the place of mere aesthetically pleasing and functional products (Massoud Hassani's Mine Kafon, Hövding Invisible Bike Helmet by Anna Haupt & Terese Alstin, Solar Bottle by Alberto Meda and Francisco Gomez Paz, Free Eyeglasses by Yves Behar and Life Straw by Torben Vestergaard Frandsen, Rob Fleuren and Moshe Frommer to name but a few).

A lot of designers and companies of the private sector have followed suit, looking for social and sustainable approaches to global challenges and realizing, for good, the sizable commercial potential in designs that have the capacity to improve people's lives.

The new paradigm of design is not that new any more. It actually started long before the current economic crisis we are now going through. The dark cloud of recession is, however, a good opportunity to re-examine our collective values and points out the necessity to move towards a new consumer model. As the target group able to pay the additional value of overstyled products talking to our greed and excess will shrink, social and sustainable design for the people's benefit will prove to be a commercially strong, if not the only, viable model.

The difference between Old Design and New Design is really the difference between two "ontologies", i.e. two different ways of looking at the world (Wasserman, 2004). They are the same two different ideologies, the same two –allow me to say- ruling political models, deriving from the two sides of the human brain or the same two idiosyncratic cognitive models: analytical thinking and creative thinking. The contrasting world-views should be thought of not as either-or opposites but as continuums. Design now embraces Social Science as much as Physical Science, Ecology and Biology as much as Engineering, Human Systems as much as Technological Systems and Life-Cycle Economics as much as Finance.

It is about time to re-establish this lost balance between STEM and the ARTS, using Design as a bridge in between. As John Maeda puts it, adding Art and Design to Science Education would put a bit of humanity back into the innovation engine and lead to the most meaningful kind of progress (Maeda, 2010).

Starting from Education

An attempt to bridge the differences between two distinct worlds that meant to be… one, after ages of separation, could not start other than from education. The problem

is, to quote famous Albert Einstein's saying, that *we can't solve problems by using the same kind of thinking we used when we created them*, and today's policy makers are no doubt, the children of the same division between Art and Science Education (being in their majority from a STEM background). What then if we may attempt this change earlier on, before the forthcoming division, to grow a new breed of citizens able to understand, judge and create their world based on the solid grounds of both the STEM (Science, Technology, Engineering, Math) and the IDEA (Intuition, Design, Emotion and Art)? Besides, *the only thing that interferes with our learning is our education*, to go back to Einstein where we started from.

Three years ago, I undertook the commission to teach Industrial Design (as a new module) in the School of Visual & Applied Arts at the Faculty of Fine Arts of the Aristotle University of Thessaloniki (AUTh). Having a background in Architecture as well as in Automotive and Industrial Design, and after having taught design both in the School of Architecture of the AUTh, as well as in the AAS partner College of the University of Central Lancashire (UCLAN), I took the initiative to establish a new Design Lab, which although set in the School of Visual & Applied Arts, would be as open as possible to other Schools of the University (Architecture and Engineering), as well as to prior levels of education and society in general.

My deep belief in creative synergies between fields to bring the best out of design and restore the balance between Art and Science, led to numerous collaborations:

- a synergy of students from the School of Visual & Applied Arts and Architecture to design and construct the fairing of the student Formula SAE (Aristotle Racing Team) engineered by students from the School of Engineering (2010-11).
- An intensive interdisciplinary Workshop with students from both the School of Visual & Applied Arts and the School of Architecture in collaboration with the Municipality of Thessaloniki, on alternative uses for urban parking spaces (designark.blogspot.gr) (2012)
- Design Lab Open Days in the context of the "AUTh on Syndays" programme, organised for the public to visit, be informed on our activities and attend a joint programme of two hands-on activities for children aged 9-11 and adults (2012)

Simultaneously, in close collaboration with the Macedonian Museum of Contemporary Art, Architecture and Industrial Design (MMCA) and Marianna Kaltsa (artist/architect), we organised a lab (design workshop) for primary school pupils, co-ordinated by both, as part of the educational programmes of the museum. The programme runs in three-month cycles (two every year) and includes 2-hour labs on a weekly basis. The project followed an earlier idea to research design pedagogies and their potential benefits in primary education (Liamadis 2003). Active involvement of 9-11 year-old pupils in the design of everyday objects justifies the necessity of the subjects they are taught, promotes their ability to judge the objects around them and builds well-informed consumers: credibility conditions to bring Design Thinking into the agenda of primary and secondary education.

Case study 1: objects that lighten the night

fig.1 "Objects that lighten the night" (2011), project exhibition, MMCA educational programmes, Design Lab for children 9-11 (co-ordination: G.Liamadis, M.Kaltsa)

The project "objects that lighten the night" was carried out over two meetings (of two hours each). An identical project was given to students of the School of Visual and Applied Arts in their 5th semester (module: Industrial Design III). In both cases, the brief addressed a wider question (as design methodology suggests): to make "objects that lighten the night" rather than mere "lamps". Both children and students were

asked to “make” rather than “design” – a natural process of constant dialogue between eye, mind and hand, which pre-existed any other determined methodology of “Design”. This material form of thinking supports learning about the design process through ‘authentic’ learning experiences (Bolt, quoted in Shreeve 2011).
Children, assigned to work with cardboard and were provided all the necessary help to materialise their ideas themselves. During the process, children have started to develop a natural quest for knowledge in the fields of science (physics, geometry, mathematics), realizing the proof of necessity for the STEM subjects they are being taught at school.

Art students on the contrary, having been taught technical drawing out of the context of any particular application earlier in their studies, failed to make use of this pre-existing knowledge, mainly because they had already evaluated the subject as unnecessary in the context of their studies, just as any other STEM subject they happily left behind after school for their choice on Fine Arts.

Following a play game in the dark to discover objects that lighten the night, children came up with a remarkable set of ideas for lamps in symbolic forms: a space rocket at the moment of take-off emitting light from his jet engines, a set of traffic lights (with the figures of Berlin Ampelmann), a TV set, a mobile phone, a bus in the night, a luminescent marker, even a glowing “stop” traffic sign.

There is no greater integrity, no greater goal achieved, than an idea articulately expressed through something made with your hands (Maeda 2010). Leaving the museum with a fully operational lamp for their room, children kept coming back and asking for instructions on how to materialise other similar ideas, while some of them – acoording to parents- brought their thirst for knowledge (to acquire useful information for their handicrafts) to their public school classroom.

The success of this project in terms of the symbolic value of form, led to one more difficult task: introduce children to the idea of conceptual design. This time, the project theme was not based on a physical challenge, but upon an abstract notion: “time”. The outcome was equally impressive, demonstrating a surprising ability of the children to transform abstract concepts into physical objects. Their designs managed to be something far more fully operational clocks: there were objects on the borderline of conceptual art and design, dealing with ideas like the continuity of time, subjective time, stopped or rushing time.

fig.2 "Objects that lighten the night" project (2011), MMCA educational programmes, Design Lab for children 9-11 (G.Liamadis, M.Kaltsa)

fig.3 "Traffic Lights" floor lamp (Maria-Iliana Papanikolaou, 11), cardboard. The Ampelmann figures, a design classic dated back in East Berlin was a concept conceived by Mariliana herself.

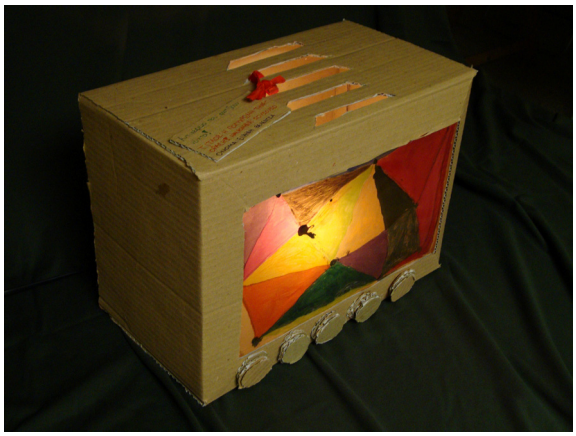

fig.4 "TV set" (Sofronis Prokopiou, 10), table lamp made of cardboad, a lamp of variable brightness according to the projected images. Airvents for heat dissipation.

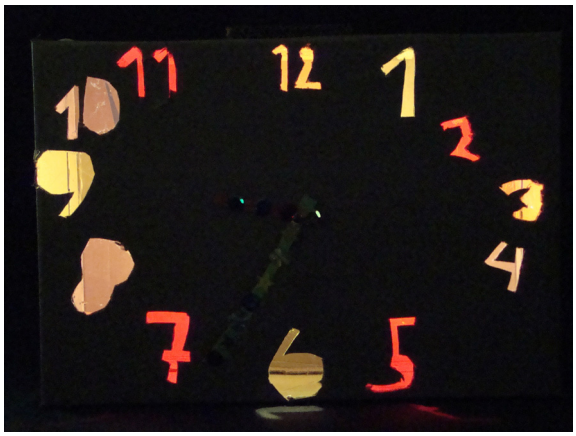

fig.5 "Lighting Clock" (Anna Moumkidou, 8), cardboard. Information over form. Glowing numbers instead of a glowing shape.

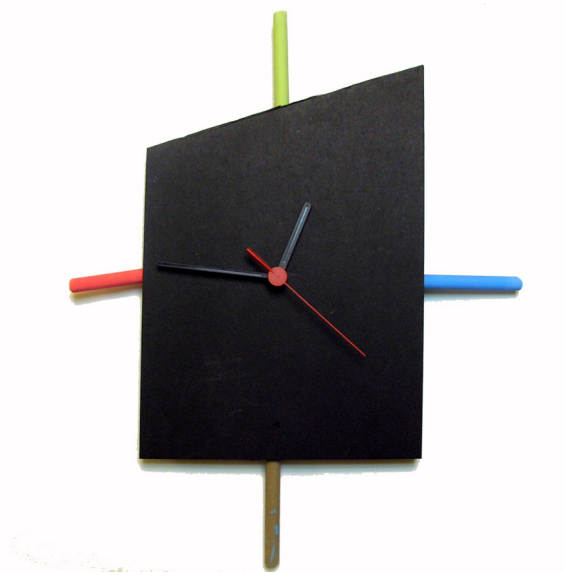

fig.6 "Time" project, clock made of black cardboard and four chalks, concept: clock surface is used as a blackboard to take notes of your activities as *"it is not the hours that matter, but the distribution of activities within the day"* (Ioanna Bakaliou, 8)

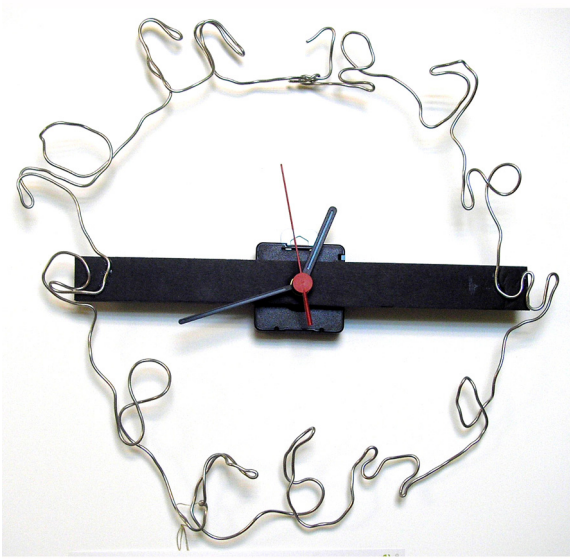

fig.7 "Time" project, clock made of black cardboard and wire, clock numbering made with "one stroke of the pen" from a single piece of wire to underline the conceptual approach on the continuity of time (Petros Topouzelis, 10)

fig.8 "Time" project, clock made of coloured cardboard and markers. Symbolic signalling refering to nature. A tree for "1" o'clock, a snake for "5", an octopus for "8" and a couple of flowers for "11" o'clock (Andromachi Fotiadou, 11)

fig.9 "Time" project, clock in the shape of the "stop" traffic signal made of coloured cardboard. Conceptual approach on the need to stop the time (Antonis Bidernas, 7)

Case study 2: DesignArk – park your ideas on design

fig.10 "Design Ark: 6 alternative uses for parking spaces" Exhibition, Centre of Architecture of the Municipality of Thessaloniki, June 2012, [designark.blogspot.gr]

Both projects mentioned above, showed a remarkable ability of primary school children to deal with the core idea of design, including not only basic functional aspects, but also the deeper values of symbolism and semiotics. What children lacked was the 'easy' part: to turn their imagination into imagineering, in other words to research, try and learn ways to materialize their ideas. And we say 'Easy' as this is the core agenda of their forthcoming education anyway. Facing a physical challenge such as to make things that shape the world can be a strong motivation to quest knowledge on physics, maths, geometry etc.

A third project commisioned to both school children and university students was DesignArk. Design Ark: park your ideas on design started as an intensive interdisciplinary Workshop organised by the Design Lab in February 2012, with students from both the School of Visual & Applied Arts and the School of Architecture working on the idea to propose alternative uses for urban parking spaces.

Later that year, the out comes were exhibited in collaboration with the Mayoralty of Urban design, Planning and Networks, in the Centre of Architecture of the Municipality of Thessaloniki.

The same task to visualise new concepts on how a single parking slot (2x5 metres) could be granted back to urban citizens as a public space, was commissioned to the 9-11 year-old children in the MMCA programme, but also to the visitors of the exhibition through a hands-on activity.

Although original ideas come up from all parts (visitors, children and students), the workshop itself revealed some useful findings regarding the strengths and weaknesses formed by higher education in three areas relevant to industrial design: Visual and Applied arts (VAA), Architecture and Engineering. Students of VAA and Architecture worked in mixed teams of four members each. Students of the School of Architecture proved predictably familiar with the conceptual approach of the design subject, while being also in possess of design tools, both traditional and digital, ie. CAD software, model construction technics etc., demonstrating most of the skills (both STEM and artistic) required in Product Design. However, they seemed to be less familiarised with the problems and challenges of making something with their hands, skill more in possess of the Artists, specially ones from the Lab of Sculpture. What students of the Visual and Applied Arts showed to lack, was the STEM part of the design process. Not only had they left these subjects long ago, but furthermore, did not seem willing to catch up with them (something that small children were seeking with great pleasure, before the STEM – Arts separation).

Having close collaboration with students and collegues from the School of Engineering at that time, I had invited some of them to attend the workshop process and the final exhibition. It would not be surprising to point out their difficulty to understand the essence of the matter of designing something else on place of a parked car. The same appeared to some of the journalists who covered the event, that tended to perceive the project as a potential problem leading to the reduction of parking spaces (five in total hundreds of thousands), rather than an a challenge to create a deeper awareness in the use of public space. This was no surprise either: technocrats with STEM background were equally unwilling to catch up with the other part -that of the Arts, the conceptual, the uncertain- a side of the coin they left long ago in their education.

Case study 3: designing objects of tomorrow

Design is about shaping the world of tomorrow, today. In this effort designers adopt forecasting methodology and form future scenarios, in order to trace trends of the future and propose/create utilitarian objects that will effectively meet tomorrow's needs and desires. Despite it's epistemological content, this technique –in children hands- transform into a game with references to the technology and society of the future.

The project "objects of tomorrow" was carried out over two meetings (of two hours each), focusing on the same theme as the annual design project (over two semesters) given to final year students of Industrial and Interior Design of the AAS College, partner of UCLAN (instructor: G.Liamadis).

Children aged 9-11 were first shown research material on conceptual design projects and selected scenes of science fiction movies, for inspiration. A short discussion followed, touching upon the factors (technological, financial, social and emotional) that shape the context of the future. Finally, right after a short brainstorming session, children were asked to make their own future scenario and design/draw original objects serving needs of this new world.

Beyond the dystopian scenarios of our time, children envisioned a world where, people will record and reproduce their memories through not only images and sounds, but also odors (a multi-sense camera by Sofia Zioga), every home will meet the nutritional needs of its members through one single polycarp (multigerm) tree (Andromachi Fotiadou) and finally, sailing boat-labs will desalt seawater and shoot the salt into the sky to disperse the clouds (a cloud purifier by Nikos Kourtis)...

After analysing the outcomes from both sides (children and students), we may point out the following:

- children came up with original ideas in considerable shorter time than students. A considerable amount of time in the case of the students, was spent trying to disengage them from norms and pre-existing knowledge. Children showed a rather expected flexibility, as their imagination did not have to encounter previous knowledge on what is feasible in terms of technology and construction.
- children designs engaged both concepts of technology-driven as well as human-centred innovation, even if not consciously documented as such. In fact, for them future in both cases is one. Students on the contrary, given the hegemony of STEM

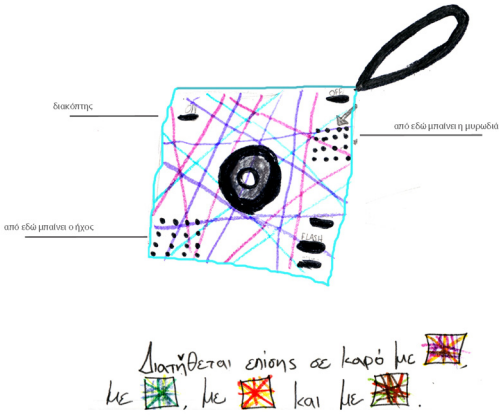

fig.11 "Odjects of Tomorrow" project, a Multi-Sensory Camera-Projector (Sofia Zioga, 9).

"...keeps in memory the smells of the area where the photo was taken from. When it projects the pictures on the wall, you can listen to the sounds and voices of the environment and smell the fragrances of each scene..."

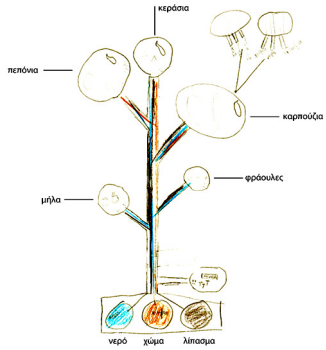

fig.12 "Odjects of Tomorrow" project, a Polycarp Tree (Andromachi Fotiadou, 11).

"... the Polycarp tree goes against the laws of nature, can be placed inside or out and it produces whatever kind of fruit or vegetable you need any time of the year. Each capsule has unique temperature and humidity conditions. You put the seeds in it, fill with soil, water and fertilizer the basis of the tree, which feeds the capsules automatically..."

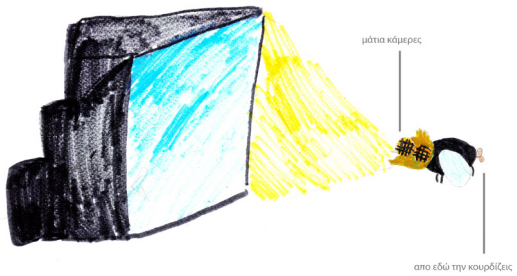

fig.13 "Odjects of Tomorrow" project, a Spy-Fly (Afrodity Keramea, 9).

"...the fly spy goes where you program it to go, records what it sees and then projects it to a screen. It's an easy way to exchange messages with friends from far away. Withstands beaters and spray because as it's made of durable rubber. It fits anywhere..."

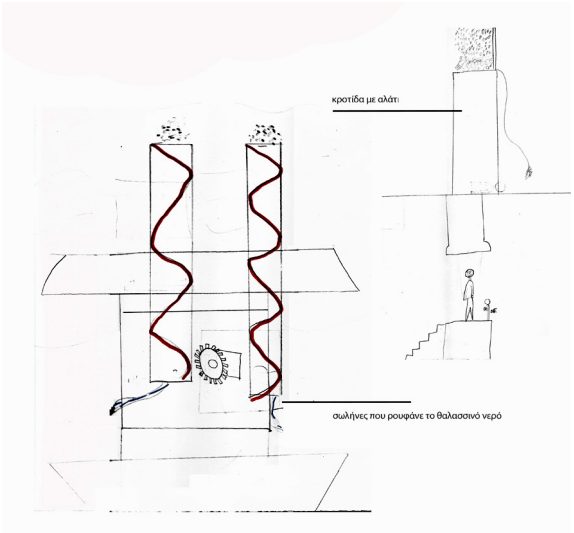

fig.14 "Odjects of Tomorrow" project, a Cloud Purifier (Nikos Kourtis, 8)

"...this device can whiten the dark clouds to avoid rain, by using salt crackers. The device is on a sailing boat, it sucks sea water with pipes, keeps the salt and then throws it to the black clouds with crackers..."

subjects in their general education, consider future scenarios as guided by technology rather than social or cultural issues. In other words, for them, technology leads the way, while society follows (a pre-determined inbalance between design factors, deriving from the old model of Design).

Conclusion

Only the deep understanding and the attempt to retrieve what's lost on the way from Primary to Higher Education may help to bridge the gap between STEM subjects and the Arts.

Design programmes in the MMCA aim to:

- built up Design Thinking not only as a professional skill, but as a skill for life, i.e. helping to address the right questions, built a wider picture and produce holistic solutions for a better future
- educate a generation of better, more rounded, conscientious consumers
- create the foundations of a more effective, sustainable model of consumption for the future
- help to export design methodologies to other disciplines as useful tools to deal with problems
- establish design pedagogic models that may benefit other disciplines currently struggling to equip studetns for a future of chronic uncertainty (Shreeve, 2011)

Projects incorporating design and construction skills, help primary school pupils develop a natural quest for knowledge in the fields of science and provide them with the proof of necessity for the STEM subjects they are being taught (physics, geometry, mathematics etc).

Design in the early stages of education is the only way to educate designers that will be able to research and propose ways to improve life and not designers that will only execute a design-policy produced and imposed by others. Incorporating design thinking in the agenda of primary and secondary education will prove valuable not only for potential designers, but also for a new breed of citizens and among them potential decision makers. This is a fact of great importance for a wide acceptance of a new holistic design agenda.

Only by connecting the dots between different levels and fields of Education and by looking beyond the ideological boundaries of science and con-science, we may re-define Design as a unity and move towards a new ideology in the Agenda of Design Education.

Higher Education is responsible to research what the role of designer should be and not accept a pre-determined role of design-executor or merely train him for the job. Even if part of our educational duties is to offer job-training services, our academic profile exceeds by far this role to include a continuous research on what the role of each subject should be within the academia, the market and society as a whole. In this context, design education research is not only a critical step of significance, it is a necessity.

Design as a field laying in between the two worlds of Science and the Arts can either fall into the cultural gap between them, or take a giant step to bridge these parts of a false dichotomy into one balanced and thus brave new world.

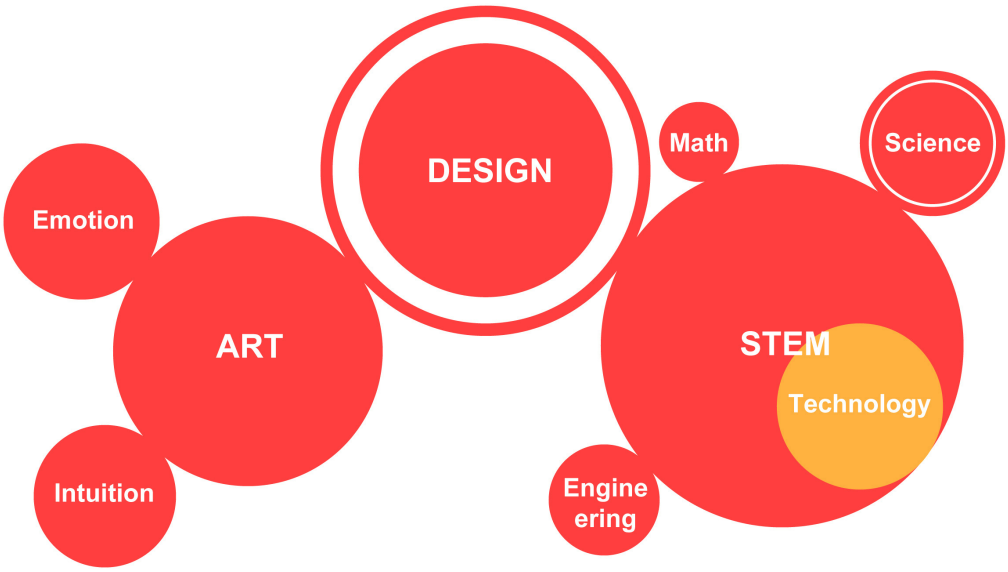

fig.15 Design as a bridge between STEM and the ARTs [Diagram inspired by the graphics of the 6th International Student Triennial]

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