SOCIOTECHNICAL
ENVIRONMENTS

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PROCEEDINGS OF THE 6TH STS ITALIA CONFERENCE 2016

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Emotions behind a Sphere.
Experimentations for an Interactive Object
Communicating Brand Values
and Encouraging Behavioural Changes
(or Reactions)

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The line separating visual designer and developer appears to be blurring, and this is not limited to the screen or projected image (Reas, McWilliams and Barendse, 2010). It also affects the design of physical spaces and the empiric field. The increasing accessibility to open technologies allows visual designers to conceptualize and practice new processes and results in the representation of organizations' values and in the design of points of contact.

An experimental project (developed during the third year of the Bachelor in Communication Design) gives rise to a discussion of changes in the fields of Communication, Interaction and Experience Design. The brief was to design visual identities, programming and using open source codes and hardware like Arduino, in order to communicate intangible brand values through an interactive and multisensorial experience in a physical space. This brief led some student groups to design objects that act. One of those results is a communicative machine named Phos Light Experience.

In order to comprehend the actual interaction with the object persona (Cila et al., 2015), the prototype was tested by real potential users, employing specific sensors to collect biometric data. In addition to the predicted results, unexpected forms of relationship and use emerged, generating new levels of discussion.

Keywords: *Visual design; communication design; object's agency; emotional data*

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Visual design and programming: the context

The knowledge, way of thinking and workflow of the visual designer is changing because of the new possibilities offered by programming (Lehni, 2011). But the use of programming in visual design it is not something peculiar only to the so–called Generation Y (those born between 1980 and 1996) designers, for which the use of technology is natural if not obvious (Wicht, 2011).

In visual and graphic design there is a particular field, that is, the design of types and fonts, that has emerged in the last 30 years as extremely suitable to experimentations in this direction. Type designers are used to comparing their designs both to formal and technical meanings. Moreover, because of this inner nature of the design of types, when digital technology arrived in the 1980s, type designers made the accidental a starting point for new ideas. As they became more adept with the new technology, some began to intervene in the underlying computer code (Crow, 2008).

In the design of visual identities interesting evolutions emerged also in the use of code to program devices to produce and generate visual artefacts able to manage variations (e.g. logo–generators). It is possible to name those devices 'toolboxes': visual designers have still to define the set of rules and a framework to shape a visual identity and they can easily manage it automatically or through external parameters.

Visual designers involved in experimental and professional practice are more and more engaged with programming, thus becoming designer–programmers or designer–developers and using their everyday work tools, as computers are, in a more consistent way. Computational design usually requires the designer to write programs and because of that, it is possible to mistake the practice of computational design as a technical skill rather than a way of thinking. Learning to program and engage the computer more directly with code, opens the possibility of not only creating tools, but also systems, environments, and entirely new modes of expression. It is here that, using the McLuhan metaphor, the computer ceases to be a tool and instead becomes a medium (Reas, McWilliams and Barendse, 2010).

Moreover, it is important to consider accessibility to instructions and information related to codes, offered by the global open source culture, as a critical component in this evolutionary process (Lehni, 2011). This culture allows the sharing of knowledge, results as well as codes, making possible a constant upgrade. It becomes knowledge available for all, blurring the borders of a merely professional disciplinary field.

An antidisciplinary experimental practice

Contemporary academic culture organizes disciplinary fields of study with its own particular words, frameworks, and methods. Design, by its inherent nature, is a discipline that is between scientific knowledge, technical competencies and art. It resembles an interdisciplinary field where people from different disciplines work together, share their knowledge and design new things preserving their single fields. But designer knowledge and culture is more and more something that it is difficult to fit into any existing academic discipline. It is becoming an antidisciplinary field, evolving from the design of objects both physical and immaterial, to the design of systems, to the design of complex adaptive–systems. This evolution is bringing about a shift in the role of designers; they are no longer the central planners, but rather participants within the systems they exist in. This is a fundamental shift, one that requires a new set of values (Ito, 2016). In addition, there is a clear shift from the centrality of function to that of meaning (Antonelli, 2011). Just in the past few years, communication has exploded into new fields: responsive objects, ubiquitous data and information, and newly instinctive interfaces. Design itself has become a way of communicating, with the open–source movement and constant connectivity changing how ideas are conceived and products made.

This rapidly described context is the background that inspired the teaching and tasks of one of the Visual Communication Design Final Synthesis Studios of the Communication Design Bachelor at Politecnico di Milano over the last four years. The Studio's main theme is to get the students to work on visual and brand identities, which is definitely one of the key areas in the communication design field. However, the approach to this area is unconventional: students are at the same time introduced to programming and open source hardware, to be used during the design process.

Unreal organizations were assumed as subjects of the design; the aim was to allow students to work deeper on the conceptual side and to look for case–histories (to be taken as inspirations) that did not necessarily refer to the assigned organization, as well as to get students used to cross disciplinary borders and to adopt a critical approach to fixed fields. Trigg's (2003) comment on experimentation as a way to find solutions, even in areas that we (as teachers and/or practitioners) or students do not precisely know, is incredibly fitting. A learning by doing approach, aimed to result in prototypes, is the main methodological framework. During project development, students experienced something close to the definition of

thinkering (Antonelli, 2011) in which a final result it is possible through progressive collective refinements.

The applied methodology (fig. 1) can be summarized in a spiral model (Dubberly, 2005), which perfectly represents repeating cycles of design moving away from a central starting point. In each of the 4 main phases students experienced different design steps as they gradually approached, in practical terms, their final solutions. The class is organized in groups of 4 or 5 students each. First, each group has to define the whole concept and the organization of the assigned subject, their aims and values, through targeted research and then design the visual system, defining appropriate communication channels, tools and applications. During last year (2015–16) the class worked on visual identities referring to unreal companies producing everyday objects like umbrellas, light–bulbs, buttons or hangers.

Each group had to design the visual identity in both two and three dimensions. In addition, students had to work on the design of an experience to be contextualized in a fixed area of 4x4x4 meters, by realizing devices ('communication machines') that interpreted companies' values making them accessible to users. 'Communication machines' were objects, installations or interactive devices to be realized as prototypes to be verified and tested. Those 'machines' are intended as a 'object personas': an extension of the design research and educational process arguing for design fiction as an important methodological tool. Design fiction represents a speculative mode of thinking that can open up new questions and unfamiliar opportunities (Cila et al., 2015).
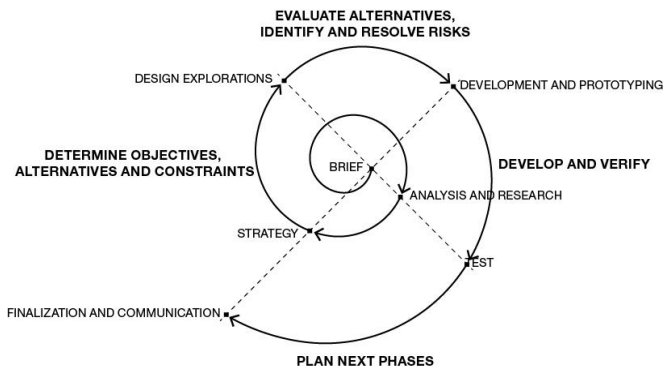
Figure 1   The spiral model of the methodology applied among years in the experimental Visual Communication Design Studio at Politecnico di Milano.

The Phos sphere

Artificial light is one of the symbols of modernity. We use it in our everyday life, it is an obvious presence, and when we have to buy new light bulbs we do not care about the brand: what is relevant is its light–colour, power and consumption. However, Phos, the ideal company adopted for the following experimentation, tries to give new values to the light bulb: light as heat, emotion, shelter, source.

Once the visual identity was defined and possible communicative applications designed, to complete the brand experience, a concept for a 'communicative machine' was developed: an easy–to–use object able to make users react emotionally and/or rationally to it and interact with it.

The installation was called the Phos Light Experience (PLE), and it is based on the interaction with a sphere with a light–bulb inside (fig. 2) which changes its colour depending on the user's hands heat and movements (fig. 3). The user would find this sphere lying on a table inside a dark room pulsating white–light, and would have different possibilities of interaction: picking it up, the colour would change depending on the heat of their hands, rotating it, the colour would blend and finally, shaking it vigorously, the colour would change randomly.
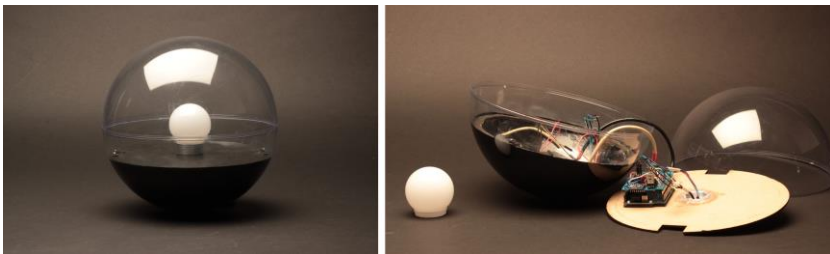
Figure 2   On the left the prototype of the sphere, on the right the technology inside.

The main element of the PLE is a sphere of transparent plexiglass which contains a 3W light–bulb with LED RGB technology capable of playing a wide range of colours while maintaining a strong brightness. The sphere has a dark part that serves as a base and hides all the technological components useful to the device's operation.

In the base is collocated Arduino Uno, which is able to handle and process all the data detected by the sensors, thus acting as the 'brain' of the sphere. In order to detect the heat of the users' hands, an infrared temperature sensor (MLX90614) has been used, because more efficient than a contact sensor and faster in detecting the temperature. The

MPU6050, a sensor which incorporates a three–axis gyroscope and an accelerometer in a single component, detects the movements that the sphere is subjected to.

To identify the rest position a hall sensor has been used, positioned on the bottom of the sphere, which detects the magnetic field of the magnets placed on a fixed base. Lastly, the autonomy of the device is guaranteed by a 13400 mAh battery which has an estimated duration of 8 hours without recharging. The battery also serves for balancing the sphere.

All these sensors, connected to Arduino, work thanks to a specifically encoded program which manages the different conditions in which the sphere can find itself. The main functions of the program manage the LED RGB lighting, the gradient transition between the different colours, and the 'rest' phase (when the hall sensor detects the magnetic field in the base) which reset all the variables in order to provide a clean experience to each user.

Figure 3   Color reactions of the sphere during the interaction.

Once the prototype was ready and firstly tested some questions emerged. If we accept the idea that objects, like human subjects, have agency (Gell, 1998), can we measure this agency somehow? Can we record the user's reactions and the empathy she or he develops with an object? Are all users' reactions and feedback predictable by a designer? Or should the designer accept the idea that some design issues are unpredictable?

The use of emotional data in the testing phase

To search for confirmation it was deemed useful to carry out an experiment: to allow real potential users to interact with the PLE sphere. Therefore the prototype was subjected to a series of tests to investigate and verify if the interaction between this object and the users corresponded to what was expected. The main goal of the test was to assess the strengths

and weaknesses of the sphere, how and what it actually communicates to users, in order, in the end, to discover any problems and/or possible improvements.

To find this information, it was decided to collect emotional data generated by a person in the form of biological parameters, facial expressions, behaviours or words.

Emotional data is quantitative data which is able, at the same time, to capture qualitative elements, such as emotional state. For designers, emotional data is that interesting middle space between the density of ethnographic research and the rigid logic of research based on data, where context can easily be lost (Henry, 2016). This kind of data can help clarify why users act in a certain way, giving a new information channel which is, at the same time, simple to analyse and were collected using three different types of tools: video footage, interviews and biological sensors.
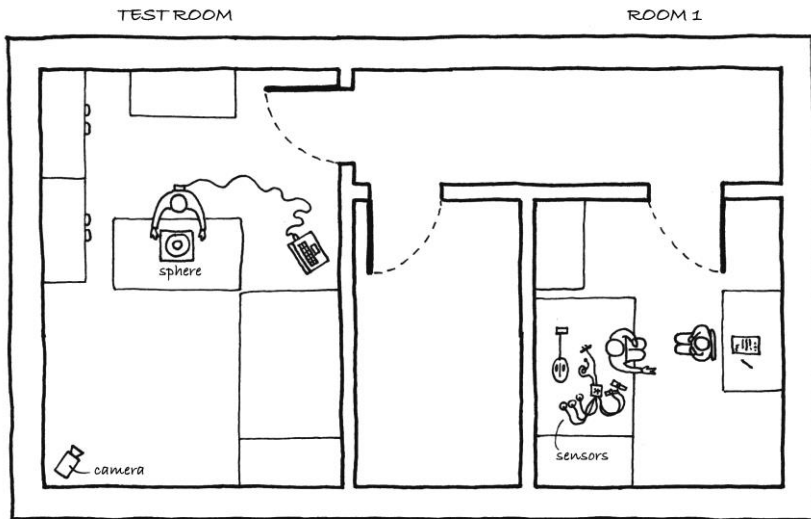
Figure 4   Test environment.

Due to its articulation, the test was done in two different locations (fig. 4). One with full light to prepare the user for the experiment, for the application of sensors and to conduct the interviews (Room 1). The other, instead, had to simulate as much as possible the location designed for the PLE, having a size of about 4x4x4 meters, with a table near the entrance, and dark (Test Room). Thanks to this subdivision of the test into two rooms

it was possible to record the initial reaction of the subjects at the sight of the sphere.
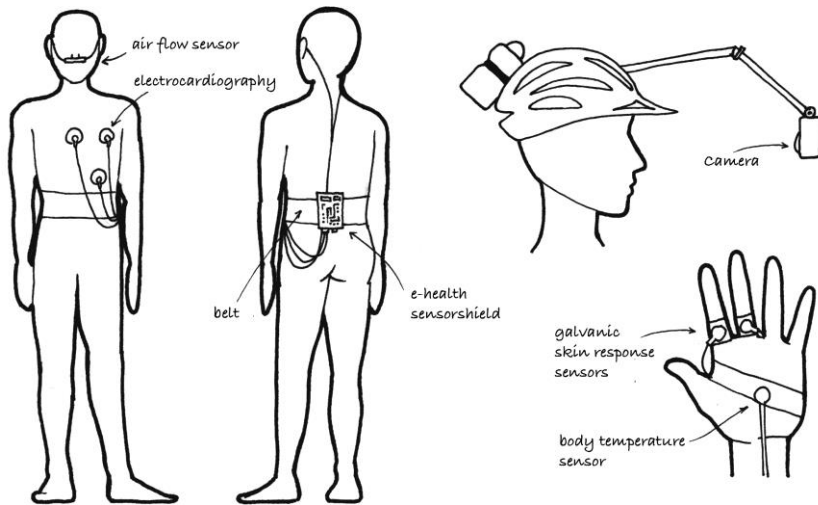
Figure 5 Tools used to collect the emotional data from users.

Video footage was used to record users' behaviours, gestures and facial expressions during their interaction with the PLE. From these data it was possible to highlight the emotions expressed by the user during the experience, if she or he was feeling comfortable or uncomfortable, or if she or he had any difficulties while interacting with the device. Moreover, collecting data on gesture allowed for an understanding of the intuitiveness of the object and observation of the different approaches of the users while interacting. Facial expressions, on the other hand, because they are more difficult to control, permitted an understanding of the emotional state of users. During the test phase two cameras were used: one into the Test Room and the other attached to a helmet worn by the subject.

However, gestures and facial expressions do not always reflect the emotions felt by the subject. Different levels of expressiveness and social and cultural filters (like familiarity with technological and / or digital devices) can mask the visible signs of a change in the emotional state in the individual. This is the reason why it was chosen to collect also biometric parameters. This kind of data allows one to detect the user's emotional states that are invisible to the human eye. For this experiment, the vital parameters – which are signs of a change in the emotional state were

collected through a series of sensors (fig. 5), namely: respiratory rate, heart rate, sweating and body temperature.

Lastly, the sample of users underwent an interview. In this phase, the tool of 'coding and categorization' of words and behaviours was used. The coding part consists in defining labels to summarize responses or behaviours. In transcripts of interviews there are often found many words or phrases with an emotional or sentimental value. These elements can be de–contextualized and condensed into a single word, without losing too much of their individual meaning (e.g.: bizarre, nice, enjoyable, interesting, relaxing, magical). By counting the encoded labels the number of categories is identified, and, subsequently, the number of users belonging to these categories. This is not a technique which is not already used in design research. What is different in this case, is the focus and the connection with the emotions between the coding and the analysis phase (Henry, 2016).

The structured interview with the users was based on seven questions:

- What do you think of the experience that you just had?
- What did you like the most?
- What can be done with the sphere?
- Did you have any problems or difficulties, or something that bothered you?
- Would you change or add something?
- Why does the colour of the sphere change?
- Do you judge this a rational or an emotional experience?

The interviewees had no time limit nor were they interrupted during their response, so that they could create a continuous stream of thoughts without feeling judged in any way. To collect the responses in a more precise way they were recorded.

Test steps and sample of users

The test was divided into three stages. The first part consisted in the application to the subject of the various sensors in order to record the vital parameters at rest. This record was useful in the case of peculiar or abnormal results during the interaction, because it could verify if the same flaw or error was also found in the data initially taken. Thereafter, the subject was asked a series of questions to collect basic information: age, sex, nationality, mother tongue, employment, level of interaction with technology and any physical characteristics that may have affected the test results (heart problems, motor limitations, asthma, etc.).

In the second stage of the test the subject was conducted into the Test Room, where he was left alone for four minutes to interact with the sphere, having been given no information regarding the object. The interaction was recorded by the two cameras. After four minutes the interaction was interrupted.
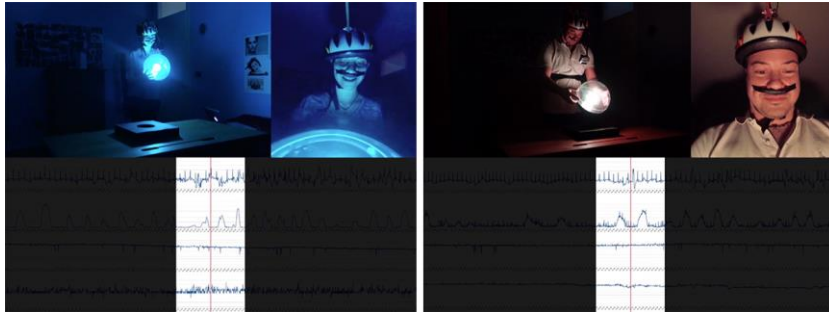
Figure 6   Some phases of the experiment with users' reactions and some measurements.

In the third stage of the experiment, the subject was brought back into the First Room. Here, once the sensors were removed, the interview took place and the user had the opportunity to express his thoughts about the interaction. After the interview the experiment officially ended.

To establish these stages a pilot test was conducted which gave an understanding of whether the test could be done properly and if the information collected was sufficient for the aims of the experiment.

In choosing the subjects to be analysed an attempt was made, as much as possible, to have diversity in every aspect: from age, to origin, to level of interaction with technology. An amount of 15 subjects were analysed, which it is not a substantial sample of users, but because of a diversity of age (between 12 and 76 years), sex and profession, it was assumed as useful reference for the experiment. Of course results cannot be considered as absolutely thoroughs.

Some results of the testing phase

The results of this experiment were surprising, both for the way they verified expected results and for the fact that a multitude of new interaction scenarios emerged.

What emerged, above all, was that a common cognitive path made by all the users during the interaction could be traced. No interaction was only emotional or rational. Considering as emotional all interactions subsequent to feelings like unexpectedness, surprise or affection and rational all interactions consequent or addressed to an understanding of the device functionalities (Branco, 2003; Tuan Pham, 2007). In general, through measurements of biological data, it was found that the subjects passed through 4 different phases, whose duration and intensity varied according to the individual (fig. 7):

- Emotional Moment 1 (EM 1): the interaction begins, the subject is excited to start the experiment and is surprised to be confronted with an unknown object;
- Rational Moment 1 (RM 1): after the first impact with the object, the subject tries to understand the operating principle of the sphere;
- Emotional Moment 2 (EM 2): the sphere does something unexpected (usually it changes colour abruptly), and the subject allows himself to get carried away by the moment;
- Rational Moment 2 (RM 2): the subject has learned more information and has summarily understood the operating principle of the object.
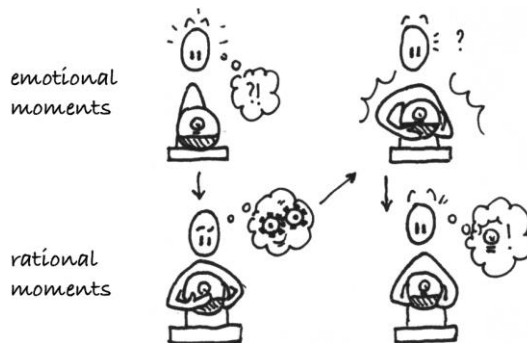
Figure 7   The users' four different phases during the experiment.

At the revelation of the sphere (EM 1), in 8 subjects a significant variation in the biometric parameters occurred: in everyone the heartbeat increased and in 2 also the respiratory rate increased and the conductivity changed. Moreover, all subjects had changes in their vital parameters at the first contact with the sphere. Regardless of the action carried out, when the sphere changed colour abruptly (80% of the interactions) the users' heart

rate increased. The same happened for the subjects who performed the planned and designed action to shake the sphere (40%, EM 2).

In general, it can be said that the experience was positively perceived and evaluated by the users. Furthermore, comparing the biometric data and the interviews, it can be affirmed that, in most cases, the colour changes of the sphere were not perceived as random but depending on specific actions by users.

From the analysis of the actions it seems that the subjects attributed to the object features that do not belong to it. In fact, initially, many users moved their fingers and hands over the sphere's surface, expecting a reaction from it . This may have been because they were comparing it to the electrostatic sphere. The interaction of the subjects was essentially shaped around the understanding of the sphere's operating principle and its use (RM 1). In fact, no one lived the experience as end in itself, but every person used the interaction in order to understand what the sphere was and how it worked.

The sphere intrigues and never gives the idea of a static object (RM 2). Everyone interacts with it to some extent in a dynamic way. Moreover, the sphere creates a strong empathic relationship with most of the subjects, as confirmed by recorded emotional data. This is clearly evident in the interview responses, where the users declared that they perceived the sphere as a living being, a 'sort of animal' whose 'colours correspond to its emotions.' And colours were precisely the most appreciated part of the object, especially when they changed abruptly. This is clear from the biometric parameters, particularly from the heart rate increase when the colours change, but it equally shines through the subjects' facial expressions when they let slip a slight smile or a laugh. Many people highlighted how the combination of colours and darkness created a magical atmosphere, moving strong emotions. Equally appreciated was also the spherical shape of the object, both for the endless possibilities of interaction and for a simple aesthetic issue.

Conclusions

As expected, and hoped, no one had particular problems or difficulties during the interaction, but some users were bothered or felt frustrated at not being able to fully understand the operating principle of the sphere. Many subjects suggested additional elements to the experience and the one

proposed by most was to add sound to the sphere or the location, a proposition that was evaluated during the design phase of the PLE.

All in all, these considerations lead to the conclusion that the interaction designed meets the expectations, because it realizes the main goal of the project: users are touched and create an empathic relationship with the sphere. The object has no specific function, if light changes are not considered, and his meaning is to communicate values referred to light bulbs in order to intrigue the user and interacting with it. Here there is the shift from the centrality of function to the one of meaning and the relevance of uselessness as a design principle (Kaplan, 2000).

Nevertheless, it is clear that it is not possible to accurately measure the empathy between subject and object. It is only possible to analyse the dialogue or part of the relationship through the emotional data that helps to understand these dynamics, measuring them and providing useful information on the functionality of the object. Users react emotionally at a first interaction with the Sphere and again when they understand (rational interaction), that changes can be determined by some specific actions.

Designing an object like the sphere for the PLE was an excuse to design a process (the experience) and to define the activator (the object). What was interesting from our point of view, is that this object could be of interest for users both in the context it was conceived for (a brand exhibition) as well as out of his original context as it was during the experiment. During the experiment, users were surprised, excited to use the sphere and to determine changes with the hands once they understood the device mode of operation.

Some aspects of the experience are unpredictable (e.g. when something could exactly happen through user interactions); it is not possible to have everything under control, only some general guidelines can be predicted (functionalities, shape, general goal). From the designer's point of view this is a difficult aspect to manage, but when designing an experience there is always a possibility that a user can experience it in an individual way, through a personal interpretation, and this has to be accepted.

Another interesting aspect was to have introduced, in a teaching context, an approach that did not consider the acquisition of skills and knowledge in a fragmented manner, but in an evolutionary way. The use of programming to start processes and develop applications was adopted as a key element of the designer toolset (Lehni, 2011). This approach allowed the customization of some applications both at the development stage (and prototyping stage) as well as in the verification and testing stage. From an

educational point of view, this made it possible, in a practical way, to liken the typical design process to a scientific methodology.

It is our firm belief that this way of working and designing should be encouraged, especially during students' education, in order to make possible the use of digital tools in a more consistent and appropriate way.

Acknowledgements

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