

Design for all as a research and education strategy

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ABSTRACT

The biggest challenge for the education of designers lies in the fact that graduates will have to work in a context that is still in a process of definition. To meet this challenge, a collaborative and participatory strategy that develops two fundamental competences for the future is proposed: capacity to research and, therefore, to produce knowledge, and to meet needs other than the traditional ones. This strategy gathers three areas: Research developed by professors; Interaction between theory and practice of integral design and universal design; Research and practice focused on the needs of people with disabilities. The specific objectives of this proposal are: to educate designers based on the perspective of research-action; to pay attention to human rights; to confront students with real situations; to encourage co-design between users and designers. Examples of designs developed by students in final projects are described.

Keywords: design for all, strategy, design education.

Introduction

The impact of design to improve the quality of life and to boost economic growth becomes more relevant everyday. Serious efforts are now being made to confront design students to a highly competitive environment that demands innovation. To face this situation, design projects under the idea of linking the university with firms are developed. Although this trend has many positive aspects, there is a risk of emphasizing a limited point of view in relation to bigger problems that demand a solution. University graduates in the future will face problems that do not exist today and that go beyond the approach of solving the immediate problems faced by enterprises. It is also true that students should be able to get a job, but the goals of education go further: "Education must form citizens, not employees" (Savater, 2016).

"Just when we knew the answers, someone changed all the questions" is a popular phrase that sums up the complexity and uncertainty we face. The world is undergoing a great paradigmatic change. It is a metamorphosis that surpasses sciences and technology, although these are forces that impel this movement, contextual factors should be added such as climatic change, the restructuring of the economy, the disenchantment regarding globalization and economic neoliberalism, migrations around the world, amongst many other factors, that place education in

the face of a serious problem: we must educate professionals with the capacity to face difficulties that we do not yet know therefore their education can not be limited to learn the skills of traditional design (Baynes, 2010). Therefore it is important to develop the capacity to produce knowledge and attitudes that should allow designers to deal with uncertainty, in other words: to educate designer-researchers.

Global change is a great challenge due to the difficulty that arises from the convergence of different areas of knowledge and therefore the need to explore the interdisciplinary approaches that are necessary to face the complexity of the problems that are emerging. At the moment it is essential to stimulate the development of a way of thinking capable of generating strategies of thought, open and flexible, that based on self-criticism make it possible to modify design approaches in real time, instead of learning preset methods. Another element to consider is that of ethics, which is sometimes reduced to moral lessons; in the words of Edgar Morin:

Ethics can not be taught with moral lessons. It must be formed in the minds from the consciousness that humans are at the same time individuals, part of a society and part of a species. We carry in each of us this triple reality. In the same way, all truly human development must include the joint development of individual autonomies, community participation and the conscious-

ness of belonging to the human species (Morin, 1999, p. 3).

Given this context, the education of designers should take a clear approach in order to nurture students capable of producing knowledge based on data and observations, to be able to face needs and problems other than those usually considered within the spectrum of design, framed in an ethical standpoint and that fosters the capacity to work in an interdisciplinary way within an environment of empathy and solidarity.

Context and methods

The focus of design courses at the University is comprehensive and integral, which means that they do not focus on professional specialties such as graphic design or industrial design. Therefore students have a broad perspective and have to develop diverse capabilities. The courses during the last year of studies are aimed at solving a final project and are divided into three major phases as shown in Table 1. It is expected that students will be able to carry out a diagnosis, analyze problems from a broad perspective and propose systemic solutions and not only to offer answers from the standpoint of "specialties" such as product design or visual communication (Rodríguez, 2014).

Within this framework, a teaching-learning strategy is proposed that provides a common space between research, learning and teaching (Drew, 2007), therefore research developed by teachers is used as a central guide and students learn the skills needed for this process, such as observation, gathering of relevant data and its analysis and understanding.

This teaching-learning strategy has the following objectives:

- To build and to generate processes: It refers to a sequence of activities that start with the detection of a problem and continues with an analysis that leads to a diagnosis, which in turn is the foundation of research and collection of relevant data, that are fundamental for the generation and development of ideas or proposals to solve the problem. It is important to note that this strategy considers the notion that design problems are built (Protzen and Harris, 2010), as opposed to the traditional stance in which design problems are "defined" by means of a brief that the client delivers to the designer. This process culmi-

nates with the definition of the necessary elements for the materialization of the proposed solution and its evaluation. This process, includes the concept of management, understood as the knowledge necessary to "make things happen"; implies the ability to organize and direct the design process, considering all the variables that intervene throughout it in order to optimize the available resources. Management implies a high degree of proactivity, both to initiate and to drive the process. This attitude is central to the training of integral designers.

- Visualization of scenarios: The notion of construction of scenarios in design refers to the ability to imagine a sequence of events or the course and consequences derived from an action. In the case of the proposed strategy, a scenario is understood as the area in which an action is developed, contemplating the effects for the user, the environment and culture. The scenarios focus on what is about to happen, therefore they demand a prospective attitude, based on the analysis of current factors.
- Generation of strategies: The construction of strategies can be understood as the planning of actions oriented towards the achievement of objectives, making use of available resources.
- Formulate creative and innovative solutions: It is important to distinguish between creative solutions, (which are those that offer some new aspect, either in the aesthetic sense or in the factors related to usability or the application of materials or technology in production) and Innovation, which the OECD defines as "The instrumentation of a new or significantly improved product, good, service or process, a new method of marketing, or a new organizational method in business practice, work space organization or external relations" (OECD, 2005, p. 2). Therefore innovation, although based on creativity, is distinguished by its significance and generation of value, either for the market sector to which the design solution is focused, or for some of those involved in its development, thus asserting the orientation of user-centered design.
- Develop a critical standpoint: The graduate of design, must be able to critically analyze her/his professional performance and the environment in which she/he develops. Although the graduate must possess the professional competences that allow her/him to be a

Table 1. Objectives and activities.

	Phase 1	Phase 2	Phase 3
Objectives	To carry out the diagnosis of the problematic area, needs and definition of the problem.	To develop integrated design strategies that address identified problems and the specific needs of users with a systemic approach.	To define and produce an integral systemic solution. To write (and design) the documented report of the complete process.
Activities	Documentary and field research; first contacts with potential users and stakeholders. Elaboration of the first protocol or preliminary research project.	Evaluation of the first protocol; Formulation of a Design strategy. Development of proposals and first models of elements of the proposed solution.	Iterative evaluations with users. Final design.

part of the labor market, it is not sufficient nor desirable to educate professionals who only reproduce the current conditions. The University must be able to educate citizens capable of criticizing their scope of performance and its complexity in such a way that they are capable of offering new answers in a broad sense; self-criticism is seen as a starting point towards the generation of innovations that seek a true inclusive social development and not just follow the dictates of fashions or processes linked to consumerism.

- Design as interface: The central problem of design lies in the interface between a technology or situation in the context (physical and cultural) and the human being. In Bonsiepe's words:

It should be taken into account that the interface is not an object, but a space in which the interaction between the human body, the tool (artifact, understood as an object or as a communicative artifact) and object of action is articulated. This is the undeniable domain of industrial and graphic design (Bonsiepe, 1993, p. 17).

The final project as research and education strategy

In order to achieve the convergence of research and teaching, the course is taught by two professors who study in their research work the field of Inclusive Design (Martínez de la Peña, 2015) and Strategic Design (Rodríguez, 2015).

In summary, students should be able to:

- (1) Analyze complex situations and identify problems and opportunities for innovation and design.
- (2) Identify a research object.
- (3) Define an objective and to research and analyze data.
- (4) Gather information, considering the user as the main source, as well as secondary sources such as opinions of experts and specialists.
- (5) Evaluate information based on design criteria, user needs, markets, and social, environmental and cultural contexts.
- (6) Formulate a design proposal based on a process of analysis, synthesis and evaluation, which provides a solution to the problem (Martínez de la Peña, 2014).

The design process developed in the final projects, has an inclusive approach and is related to the research "Inclusive Design for Quality of Life". It is important to mention that in the curriculum of the Design course of the University, unfortunately, there is no subject dedicated specifically to Inclusive Design or Design for All. This exercise is an exceptional case requested by design students who, motivated by an initial experimentation in the Integral Design Laboratory of Interactive Systems with deaf people, maintained their interest to work on design projects for people with disabilities.

Two central themes are developed in this didactic exercise. The first is that of disability, recognized by the United Nations¹ (UN, 2006) as an evolving concept that results from the interaction between people with disabilities and barriers due to attitudes and environment that prevent the full and effective participation in society of disabled persons due to the lack of equal conditions. In the world, according to the World Health Organization (WHO, 2011) there are over one billion people living with some form of disability; almost 200 million experience considerable difficulties in their daily performance.

The Convention of the UN defines our second concept: "universal design" (also understood as inclusive design or design for all) in a broad sense and refers to the design of products, environments, programs and services that can be used by everyone, without the need for adaptation or specialized design. Universal design will not exclude technical aids for particular groups of people with disabilities, when needed. Likewise, subsection (g) of Article 4 from the same Convention, states that research and development must be undertaken or promoted and also to advance the availability and use of new technologies, including information and communication technologies, mobility aids, technical devices and appropriate support technologies for people with disabilities, giving priority to affordable ones.

Quoting the document Curricular Training of Design for All in Design (DfA),² can be defined as the design that takes into account human diversity, social inclusion and equality. This holistic and innovative approach is a creative and ethical challenge for those responsible for planning, designing, management, administration, as well as politicians.

Design for All aims to make it possible for all people to have equal opportunities and to participate in every aspect of society. To achieve this, the built environment, everyday objects, services, culture and information, in short, everything that is designed or done by people for people has to be accessible, and useful for all members of society and consistent with the continuous evolution of human diversity.

In an exercise in congruence with these guidelines, both professors decided to carry out this work together with our students.

Didactic strategy and Problem-Based Learning

As mentioned in the first part of this document, the didactic strategy of the final projects is made up of 3 phases that are addressed in specific academic periods (quarters) of twelve weeks each. It is based primarily on Problem-Based Learning of a social nature.

Phase 1. Diagnosis of needs and definition of the problem: During this phase, the students carried out documentary and field research and had their first approaches with persons with disabilities. They also carried out ethnographic research exercises and developed their first preliminary

¹ The Convention on the Rights of Persons with Disabilities and its Optional Protocol were adopted on 13 December 2006 at United Nations Headquarters in New York. It is the first comprehensive human rights instrument of the twenty-first century and the first human rights convention that opens for signature by regional integration organizations. It points to a "paradigmatic shift" in attitudes and approaches towards people with disabilities.

² IMSERSO, Fundación ONCE and Coordinator of Design for All People in Spain (EIDD - Design for All Europe) (2010).

research project to generate a first approach and diagnosis of possible problems to be solved.

Phase 2. Development of comprehensive design strategies that solve the problems detected and the specific needs of users with a systemic approach: In this phase, the students evaluate their first protocol and establish working teams to define convergent areas of interest. Thus, they propose their first approaches to design strategies for all and begin to materialize models of solution.

Phase 3. Define and produce the integral solution of the System. To write (and design) a documented report of the complete process: In this last stage the students enter a constant process of evaluation and interaction with the users of the design proposals. Collaborative work is most intense in this phase. The iterative process of ideation, elaboration and evaluation optimizes the solution, integrating user's requirements and their contributions to the projects. Likewise the students produce the written report of the project that is the recollection of the research of their work and the development of the solution.

As mentioned before design, as taught in the University, has an integral and systemic approach. This means that students focus on relevant social problems to be solved through an integral proposal based on a system of articulated solutions and not only through a specific object. The problem for this exercise was disability and it was developed throughout three terms. The students worked in teams and through a participatory action-research process, identified specific problems for different groups of people with disabilities, and sought to propose solutions that would provide the most complete response possible based on the principles of Design for All.

A brief analysis of five students projects

One team addressed the problem of mobility of visually impaired people in public transportation in Mexico City. The case study was a modal transfer center, a place where different transport systems converge simultaneously, called "CETRAM El Rosario". Because of the complexity of the space, the students of this team³ addressed the problem of how a blind person could move in this place independently, safely and autonomously. To solve this problem the students proposed five design elements, which in an interrelated way support the mobility of blind people. This system includes: a haptic guide that is placed on the walls and that the users can touch while walking. This guide accompanies them during their displacements and ends up in mini haptic maps that provide specific information to the blind about the space, especially if it is a crossing and warns them about what they may encounter there. On the other hand, the students developed braille informative signs that would be placed on the stair railings, since the space has three levels the users need to know when they go down or up and where they arrive. Information modules containing general haptic space maps (with high and low relief codes, movement indicators, haptic pictograms and

braille code information) were also proposed so users are able to generate a complete cognitive map of the Transfer Center and thus move independently, safely and autonomously. Finally the system is complemented with an app that instructs the users audibly about the complete mode of operation of the system.

A second team "SD21"⁴, faced the problem of sex education for young people with Down Syndrome (DS). This team studied the topic of sexuality in people with disabilities, discovering the enormous misinformation and the widespread prejudices that exist on this subject thus disrupting the sexual life of people with disabilities, especially intellectual, that translates into poor quality of life, making them vulnerable to situations such as discrimination, harassment, abuse and rape. There is no support material to help parents, teachers and tutors to approach this issue in order to avoid inappropriate behavior and risky sexual practices. This team was supported by Dr. José Luis Carrasco Nuñez, a researcher who published a manual addressing this issue. In this context, the students developed a new publication they called "Guide for sex education for people with Down Syndrome", edited the texts and generated specific illustrations for each of the topics of the publication. Especial care was taken during the generation of the illustrated characters in order to produce a high degree of empathy with the young people with DS. Through the process of illustration aspects of composition, color management, approval of a graphic style and editorial design were taken care of, in order to generate a quality product. The evaluation process of this project was complex. The students generated several stages of validation with young people with DS, parents, guardians and relatives.

The third proposal aimed to create a reminder system for children with Attention Deficit Hyperactivity Disorder (ADHD) so they can perform specific tasks in a concentrated and successful way, during a given time. The central problem is that children with ADHD are easily distracted, which prevents them from completing tasks and duties at school and at home. The aim of the "AION" system designed by these students⁵ is to encourage the creation of habits through the development of concentration in children with ADHD from 6 to 10 years, also this system reinforces self-esteem and improves behavior and concentration. The system consists of a watch with an interactive screen composed of different interfaces and pictograms that incorporate the activities to be performed. The programming of these elements is the responsibility of the parent or guardian. For the personalization of the watch four animal characters were created to promote empathy with the child. Likewise, the programmed activities are synchronized with an app so that parents can check if the child executes each task and finishes it in a desirable time. For each activity performed, a series of points are generated which in turn are recorded on a board and can be used to give rewards based on performance. The child can visualize her/his performance and achievements. To give identity to the system, the design of a brand was generated, as well

³ This project was developed by Nancy Lemus, Isaac Millán, Raziel Oviedo and Isaac Pérez (2015-2016).

⁴ The members of this project are Carlos Colín, Diana Flores, Nadia Orozco and Rebeca Ortiz (2015-2016).

⁵ The students of this project are Adriana Fabián, Alondra Velasco, Diana Aguilar and Paulina Rivera (2015-2016).

as the packaging and operating instructions. Throughout the project, iconography, typography, chromatic range, the development of all the information architecture and the programming for an adequate interaction of this type of users were taken care of, constantly observing the usability requirements of Design for All.

A fourth project dealt with the lack of a device for the dissemination and incorporation of recently created signs to enrich the system of sign language for deaf or hearing impaired people (HIP). A lack of cohesion of these new signs in the Mexican Language of Signs (MLS) was also identified, this fact produces various problems of communication, education and isolation for this community. It is important to mention that sign language is both an instrument of communication and an identity symbol for the HIP since it is an important defining feature and therefore the core of the cultural expressions of this community. The objective of the project⁶ was to develop a virtual and digital system that favored the integration of the HIP and to document, collect, catalog and disseminate the cultural expressions of the deaf community, to propose a system for the collective construction of the MLS in order to facilitate the social encounter and the cohesion of the members of this community. The name of the system is "We are Deaf". It consists of a graphic identity and a web platform through which members of the deaf community can ask for some specific signal then other members respond and it is validated collectively. Some of the sections contemplated on the solution are "We", "What is Hearing Disability?", "Deaf worldview", "Calendar" – of cultural activities –, "Signals" and "Shop". In this way the system stimulates a dynamic interaction between the HIP. The proposals were constantly evaluated with specific users to check the effectiveness of the system. For this project, the interface, the icons or pictograms, the sections and the appropriate programming were designed in an integral way. In addition an app was developed with the same characteristics of the platform, adapting it for users of smartphones.

The fifth and final project called "Mati Mati"⁷ is a multi-sensory system for children with visual impairment that confronts learning problems related to the development of analytical thinking. It is centered in a sensory learning strategy that reduces the alterations of reception of information due to the lack of the sense of sight. The solution provides information specific to each of the senses, of auditory, tactile, haptic and olfactory type. The axis of the project is formed by two stories written by the same students that portray stories of Mexican animals in danger of extinction: an *ajolote* that lives in the area of Xochimilco and a quetzal that comes from the jungle of Chiapas. The system consists of two stories, disassembled stuffed animals and 3D puzzles. The stories have visual information (printed in ink) for which the editorial design was developed (considering the needs of the visually impaired children) and the illustrations made in watercolor and which are complementary to each story. The publications integrate haptic illustrations a braille system and each story has its

own audiobook so that children can listen to the narrated story with the characters and hear sounds that enrich the narrative. Disassembling stuffed dolls and 3D puzzles reinforce analytical thinking so that blind children can disarm each animal in its parts and then assemble them autonomously. Stuffed animals are volumetric, have textures and materials that simulate the actual texture of living animals and also have odors that match the story of the story. The puzzles were laser cut and have geometric shapes easy to identify by touch and have specific textures so blind children can identify each part of the animal. As in previous projects, constant collaboration, interaction and evaluation with blind children was the central phase of this project.

Final considerations

The model described for design courses during the last quarters of our university's career has shown positive results in terms of training graduates in the action-research process and also in the understanding of design not as an established path, but as a construction process based on complex problems. When designers engage collaboratively in the search for diverse knowledge with users and specialists, it is possible to develop interdisciplinary and flexible attitudes, which allow to face new challenges for which – sometimes – the experiences and knowledge acquired are insufficient. Also the constant process of evaluation with the users, develops attitudes of empathy and skills for the co-design. Design for All is an approach that represents a valuable tool in the paradigmatic evolution of the way of thinking, observing and acting.

The model of Design for All detonates a participative action-research practice, but achieves its objectives only with committed teams, with a clear course and with the active participation of everyone involved, especially of people with disabilities, who enrich the process and the results.

Planning and designing for human diversity in a context of experiences opens up a wide range of possibilities, challenges and wealth. Graduates who have participated in this process have expressed their interest in seeking their professional performance in areas where their work can enrich the quality of life based on research and not only focused on the application of traditional skills of the trade.

Based on the experiences described, it is still necessary to rigorously follow the performance of the graduates, to explore new pedagogical positions that will consolidate the proposals of Design for All. However the results to date provide a firm starting point that offers good possibilities for the next generations of designers.

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⁶ The project "We are deaf" was developed by Citlalli Espinoza, Andrea López and Viridiana Salgado (2015-2016).

⁷ Mati Mati is made up of three students, Sergio Acuña, Yareni Valencia and Sandra Ameyalli Sánchez (2015-2016).

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