INTERNATIONAL CONFERENCE ON ENGINEERING AND PRODUCT DESIGN EDUCATION
4 & 5 SEPTEMBER 2014, UNIVERSITY OF TWENTE, THE NETHERLANDS

A PARTICIPATIVE AND SOCIALLY INTERACTIVE APPROACH TO THE TEACHING-LEARNING PROCESS IN INDUSTRIAL DESIGN

Juan Carlos BRIEDE WESTERMEYER[1], Marcela MORA[1], Jorge CARTES[1] and Marcela PÉREZ[2]
[1]Universidad del Bío-Bío, Concepción, Chile
[2]Universidad del Desarrollo. Concepción, Chile

ABSTRACT
Industrial design is concerned with meeting social needs, providing users with products that improve their quality of life. The Industrial Design program at the University of Bío-Bío in Concepción, Chile promotes this aim by offering a "User-centred design" (UCD) workshop for third-year students. The DCU workshop uses project-based learning, and employs a methodology that takes the user as its starting point, shifting the paradigm from "designing for" to "designing with" the user. In 2012, design students joined a collaborative project led by the non-governmental organization "Un Techo para Chile" (TECHO), benefitting low-income families living in state-housing projects in the Nonguén Valley. This initiative focused on developing practical solutions to residents' needs by involving them in product design. Participation in both decision-making and co-creation provided a space of trust and confidence between design students and community members which emphasized the social responsibility of designers. This project culminated in the production of pragmatic design solutions that successfully met local needs and ultimately improved the quality of life for residents.

Keywords: Design Education, Participative approach, social integration

1 INTRODUCTION

Chile, one of the southernmost countries in Latin America, is characterized as a developing economy committed to reducing poverty and improving the quality of life for its citizens. Higher education is one important tool for achieving this change, as it directly impacts the economic and social standing of all members of society. The Biobío region of Chile, where this study was conducted, is an industrial zone with one of the highest levels of poverty in the country. Consequently, a number of governmental initiatives have emerged in order to address persisting inequality and to increase overall social inclusion in the region. Academic institutions have also served this aim by providing an education that fulfils a uniquely social role: enrolling disadvantaged populations and emphasizing the social impact of students' work. The University of Bío-Bío in Concepción, Chile is one such institution that uses this educational model to impact society on multiple fronts.

The relationship between higher education and employment, especially in the field of design, is not well known, and there exists an ongoing need to develop effective strategies that help design students transition to the labour market following graduation. Design education has traditionally used a projective methodology to guide the learning process [1], wherein students are encouraged to reflect on work experiences as moments of situated learning [2]. Project-based learning is also widely employed as a way for students to supplement theoretical knowledge acquired in the classroom [3]. The Industrial Design Program at the University of Bío-Bío incorporates project development into its curriculum. Such activities focus on building competencies [4], where the combination of technical skills and the knowledge needed to perform a given task [5] allows students to generate new applied knowledge [6][7].

This competency-based approach to learning helps with student insertion into the labour market. Throughout the five-year design program, students are exposed to various levels and types of interventions geared towards observation, production, clients and business. Students also develop

social skills relevant to their profession, which allow them to respond appropriately to the needs of their environment [8].
The present study looks at the role of design in solving social housing problems. It analyzes houses provided by the Department of Housing in Chile (MINVU) that are designed to meet the basic needs of residents. Measuring at approximately 40 mts^2, the houses have two bedrooms, one bathroom, a small kitchen and a living space that includes a dining area and living room [9]. Nonetheless, they do not provide optimal conditions for carrying out housework, nor do they offer spaces for storage, clothes drying or waste management, etc. Moreover, furnishing options on the market are not sufficient or accommodating to the small size of these properties. As a result, many residents have turned to creative measures in developing partial and inadequate solutions.
Within this context, students of the University of Bío-Bío conducted a field study, assessing living conditions and evaluating problems in order to develop solutions together with community members. In doing so, students utilized a participatory approach that focused on social interaction, encouraging the participation of community members in the detection, evaluation, selection, co-creation, testing and approval of solutions. Attentive to the complexities of working with vulnerable communities, students joined hands with the Centre for Innovation of TECHO [10] in order to explore the role of design in creating value, and to better understand the role of designers as social agents [11]. The initiative involved beneficiaries of a social living program [12] from the same organization who are based in the Nonguen Valley.
The present intervention was designed to show students how the interplay of factors, such as social behaviours, social systems, cultures and sub-cultures, determine a given client and ultimately shape the ways in which designers should respond. In providing quality solutions to a largely neglected population—low-income communities at the base of the pyramid (BOP)—student efforts not only met the needs of disadvantaged and excluded groups, but also provided these groups with dignity [13].

2 CONTEXT

2.1 Initiatives for Social Integration

The work carried out by TECHO has propelled a number of student collaborations, allowing students to volunteer on housing projects targeted at those most vulnerable—from providing emergency shelter to developing solutions that address thematic challenges for students— and which meet social needs. These projects even extend to popular education workshops which seek to build capacity among residents in establishing income-generating activities. One such workshop led by Social Lab [14], and in collaboration with students, utilizes an online platform to encourage social enterprise. This project seeks to address conditions of extreme poverty by understanding the problems faced by socio-economically vulnerable families, and therefore creating opportunities for social innovation. Overall, the project acts as a motor of social integration, looking beyond the notion of social assistance to provide residents with control over their own communities.
The collaboration between the University of Bío-Bío and TECHO provided students an opportunity to work directly with a local community—not to simply gather information, but to experience, to put into practice, and to value and understand the role of social skills, such as communication and empathy, in carrying out long-term projects [15]. It is ultimately this set of skills that allows students to understand the complexity of working with human beings. Industrial design education should thus respond to the need for a more comprehensive and humanistic perspective, focusing not only on teaching core concepts, but also core behavioural and social skills that allow students to reflect on the human dimension of their work [16].

2.2 Methodological Context

User-centred design locates the user as the centre, beginning and end of the design process [17]. Web applications, for example, consider the user as a key player in the process of evaluating, suggesting, and even designing aspects of applications [18]. If we apply this to product design, we can see a number of methods available for registering, systematizing, and utilizing the perspectives of users [19].
The User-centred design workshop (UCD) at the University of Bío-Bío employs this focus by developing products which respond to the specific needs of users [20]. It considers the design process as an activity carried out “with people,” not only “for people.” In using a participative approach [21]

that involves the user directly and actively in the design process [22], users utilize design representations [23] as models and prototypes in order to develop the most effective solution.
Using a model or mock-up as a means to create a tangible design proposal has a number of benefits [24] that are relevant to the present project:

- It involves and encourages user participation through manual activity.
- It is easy to understand, and there is no confusion between simulation and objective.
- It allows for varying levels of technical skill, and requires basic materials such as scissors, cardboard and glue.
- It is low-cost, which allows for experimentation.
- It is a fun activity that provides recreation and stress relief.

3 METHODOLOGY

The present study uses the DCU workshop objectives as a starting point: it seeks to apply a user-centred design approach to product design, encourage user participation in product design and finally enact strategies for social integration from the standpoint of design.
The project was ultimately a collaborative endeavour, involving the University of Bío-Bío, the Centre for Innovation of TECHO and the community of Nonguén.
A group of professors composed of 2 industrial designers and 1 psychologist designed and coordinated the project. Together with a team from the Centre for Innovation of TECHO (1 industrial designer, 1 industrial engineer and 1 commercial engineer), they presented the project to the community leader in order to make necessary adjustments and coordinate schedules with community members. During the first stage, 12 families signed up to participate. The group of 46 university students thus divided into 12 project groups. The following roles were assigned:
Area coordinator: 1 design professor, 1 member of TECHO, 1 community leader and a student representative.
Design professors from the UCD Workshop (3): Planning and coordination, project follow-up and oversight
Students (46): Leading of the design and planning process with families
TECHO team members (3): Coordination, follow-up, evaluation, and decision-making
Families (12): Definition, evaluation, decision and approval
Project activities were scheduled according to the design program's trimester calendar, and were organized into two areas: 1) main curriculum and 2) core subjects, which provide students with theoretical tools necessary to carry out the project.

Table 2. Timetable of Design Workshop stages

Trimester	**I°**	**II°**	**III°**
Months	March-June	July-September	September-December
Course	**Design Workshop**	Core subjects	**Design Workshop**
Stage	**1,2,3,4, (5-6)**		**(5-6), 7**

The trimester academic schedule (Table 2) results in a temporary break in the design workshop, during which students develop technical skills and procedures in core subjects that are relevant and applicable to the third trimester workshop. Core subjects include "Introduction to Design" (Reverse Engineering), "Computational Design II" (product modelling), "Process and Production 1," "Semiotics of Objects" and "Prototypes."
The project was carried out in the following stages:

1. **Invitation**
   The workshop focused on preparing students for project activities, using an explanatory sheet to guide the process. Hosts presented project goals and expected outcomes of the community intervention, highlighting the use of everyday language specific to women homeowners and caretakers (opposed to specialized language), which would facilitate communication and co-construction. Through direct coordination with the community president, a meeting time was set during monthly assemblies in order to invite families to take part in the project. This allowed for a better understanding of the community structure and participation or rate of involvement of residents. Moreover, a list of interested participants was obtained.

2. **Study of the Context**
   Using the list of participants as a guideline, students were divided into groups of 3 to 4 and assigned to a specific family. Each group worked directly with the family in order to coordinate a time for carrying out research and fieldwork (crucial to understanding the local, lived reality of the family). Certain factors were taken into consideration such as family composition, number of children, type of employment, and even disposition, which influenced the family's investment in the project. Some groups met two consecutive days, and others met during brief intervals throughout the day. These meetings allowed students to familiarize themselves with the specific requirements and needs of the family.
3. **Problem Identification**
   The next step was to order, classify and distinguish problems, needs and desires among the many concerns expressed by families to then orient them towards design problems. A participatory approach involving conversation and reflection was utilized. For example, users took part in card-sorting, which allowed them to define, rank and assign value to their needs in response to priority or urgency—and with attention to available resources. Students were then able to make observations using written notes and sketches, as well as identify elements that contributed to the problem. Moreover, students constructed a small-scale model of the problem context.
4. **Conceptual Design**
   Once defined, the objectives included both a proposal and attributes. This was, in essence, a theoretical commitment to both specifying product typology and classifying attributes or characteristics which would provide solutions to the problem at hand. It also served as a guide with which to carry out a formal exploration of the conceptual design—a representation of the general qualities of the proposal.
5. **Development and Co-creation**
   During this stage, the user was invited to simulate the proposal by interacting with scale models of the design. This process highlighted key factors involved in the design process, such as gestures, space limitations and conditions, and the interaction of multiple objects, among others. More than simply encouraging users to participate in co-creation, they were also inspired to modify and adapt proposals using basic materials such as cardboard and clay. In most cases, user interventions were minor, and as a result students were encouraged to also submit a photographic record and notes taken during the session.
6. **Testing and Approval**
   In this stage, a prototype was constructed in order to finalize design details, taking into consideration the availability and affordability of materials in the region. In addition to testing product usability, products were tested to ensure their functionality.
7. **Implementation**
   Each group took part in pre-production, with a total of 2 to 3 units produced per product. Each group delivered a prototype of the final product to their respective families.
8. **Evaluation**
   After 2 weeks, each group met with their respective families to better understand and evaluate in situ the performance of the prototype. In addition, a questionnaire was handed out to families in order to gather feedback on product functionality, usability, disuse and appearance. Two types of solutions were highlighted: autonomous objects, which were more intuitive and easily utilized, and accessory objects, which, when isolated from their context, did not have a simple and independent function, and thus required a counterpart. (Function: achieved by all products on good terms; Disuse: capable of being stored and/or saves space. When the object takes up space, the user values its functionality; Appearance: it is integrated into the home and combines with other objects, considering user tastes. In some cases, appearance was not successful, however, the object did meet basic needs).

4 RESULTS

Twelve products were approved by users and moved on to pre-production, with 2 to 3 units produced by each group. In addition, each group delivered one functioning prototype to the family with which they carried out the project. The designs, which responded to a series of problems, took the form of various products, including a clothes dryer (outdoor and indoor), dish-drying rack and toy organizer.

In order to achieve this, both designer and user maintained contact throughout the co-creation process, developing analogous tools (archetypes, drawings, models and prototypes) that facilitated dialogue and, as low-cost and low-tech solutions, made for a more informal and relaxed creative endeavour.

5 CONCLUSIONS

Experiences from the activity provided important lessons, particularly on two fronts:
Educational: Visualizing and valuing new design opportunities for a different market segment; Developing low-cost and practical design solutions with materials and processes that are specific to local contexts; Learning to open up a space of dialogue and communication regarding design ideas proposed by users in non-academic contexts; Learning to work with others, taking into consideration and accepting differences in order to deliver a product that responds directly to user needs.
Personal: Strengthening social interaction, specifically with people living in other social contexts, providing a more comprehensive look at the lived realities of residents, and thus developing crucial social skills such as empathy and respect, which help to establish and build trust—both key for developing and sustaining collaborative projects.

REFERENCES

[1] Mabardi J.F. (2012) *Maestría del Proyecto. Apuntes para la práctica de la enseñanza del proyecto*, Ediciones Universidad del Bío-Bío, Concepción, Chile.
[2] Schön, D.A. (1983) *The Reflective Practitioner: How Professionals Think in Action*, New York: Harper Collins.
[3] Dym, C., Agogino, A., Eris, O., Frey, D. and Leifer, L. (2005) "Engineering Design Thinking, Teaching, and Learning," *Journal of Engineering Education,* 103-120.
[4] Ballerini, A., Castro F., Contreras W., Salazar M., Lazo C., Letelier P.Vázquez G., Cáceres H.Vidal J.,Ramis F.,Araneda G., Parra J.C.,Hasse V.,Valenzuela H.,Corrales J.,Gómez G., San Juan L., Valassina F., Laso P., Grandón E., Cifuentes M.T. (2009) *Modelo Educativo de la Universidad del Bio-Bio. Comisión de renovación curricular*, Vicerrectoría académica 2008, Universidad del Bío-Bío, Ediciones Universidad del Bío-Bío.
[5] USDE, U.S. Department of Education, National Center for Education Statistics (2001) *Defining and Assessing Learning: Exploring Competency-Based Initiatives*, Washington, D.C., USA.
[6] Voorhees Richard A. (2001) "Competency-Based Learning Models: A Necessary Future," *New Directions for Institutional Research* 110, 5-13.
[7] Walter D. (2000) "Competency-based on-the-job training for aviation maintenance and inspection – a human factors approach," *Int. J. of Ind. Ergonomics* 26, 249-259.
[8] Barberà, E.; Mas, X.; Guàrdia, L y Vall-Llovera, M. (2008) "El e-transfolio: la evaluación de competencias desde una perspectiva de aprendizaje. 2.0.," V. Congreso Iberoamericano de Docencia Universitaria (CIDU), Valencia.
[9] Tapia R. (2011) "Vivienda social en Santiago de Chile. Análisis de su comportamiento locacional, período 1980- 2002," *Revista INVI* No 73 Volumen No 26, 105-131.
[10] Centro de Innovación Techo….
[11] Good, T., Levin, J. (2001) "Educational Psychology Yesterday, Today, and Tomorrow: Debate and Direction in an Evolving Field," *Educational Psychologist* vol. 36, no. 2, 69 -72.
[12] Habilitación Social TECHO http://www.techo.org/paises/chile/wp-content/uploads/2012/06/HS-2013-2015.pdf
[13] Prahalad, C.K. *Fortune at the Bottom of the Pyramid: Eradicating Poverty through Profits*, Wharton School Publishing, 2004.
[14] Social Lab ¿Que es? http://www.socialab.com
[15] Briede , J.C.; Cartes, J.; Bustamante, A. & Perez, M. (2011) "Shaping the individual designer: participatory design in emergency context," Proceedings of the 18th International Conference on Engineering Design ICED11, Copenhagen Denmark, 15-18 Aug. vol.8, 173-183.
[16] Sonneveld M. (2013) "Humanistic Perspectives on Design Education: Tools for Reflection," International Conference on Engineering and Product Design Education, 5&6 September 2013, Dublin Institute of Technology, EPDE 2013.
[17] Krippendorf K. (2006) *The semantic turn: a new foundation for design*. Boca Raton: CRC/Taylor & Francis Group.
[18] Chauncey, W., (2010) *Handbook of User-Centred Design Methods*. USA: Morgan Kaufmann.

[19] Page, A., R. Pocar, M.J. Such, J. Solaz, V., Blasco (2001) “Nuevas técnicas para el desarrollo de productos innovadores orientados al usuario,” *1a edición*, 4-124. Valencia, España: Editorial Instituto de Biomecánica de Valencia y ADCV.
[20] Lim, Z. , Anderson, C., y S. McGrath, (2012) “Professional Skills Development in a Resource-Poor Setting: The Case of Pharmacy in Malawi,” *International Journal of Educational Development* vol.32, no. 5, 654-664.
[21] Shuler D., Namioka A., (1993) “Participatory design – principles and practices,” Lawrence Erlbaum Associates, publishers, Hillsdale New Jersey: Hove & London.
[22] Sanders L., Stappers P. (2008) “Co-creation and the new landscapes of design,” *CoDesign* vol. 4, no. 1, 5 – 18.
[23] Goldschmidt, G. & Porter,W. (2004) *Design Representation*. Springer-Verlag London Limited.
[24] Ehn P., Kyng M. (1991) “Cardboard computers. Mocking-it-up or hands-on the future,” In J. Greenbaum & M. Kyng (Eds.), *Design at work*. Hillsdale, NJ: Lawrence Erlbaum Associates. 169-195.