RESEARCH ARTICLE

Design and health: An interdisciplinary baseline experience of product design for health needs of the Chilean elderly

Juan Carlos Briede Westermeyer[1], Cristhian Perez Villalobos[2], Pablo Olivera Morales[3], Rocio Glaria Lopez[4], Carolina Bustamanete Duran[5]

Abstract

Objective: Describing the results of a User-Centered Design workshop using Challenge Based Learning or CBL, where students from Chilean industrial design and health degrees, developed solutions to resolve health problems among the elderly.

Method: It was a pre-experimental study; 45 university students took part in a workshop: 39 from Industrial Design, 3 from Speech Therapy, 2 from Medical Technology and 1 from Medicine. In this workshop, the students, using CBL in disciplinary heterogeneous groups, faced a 3-week challenge to develop products to overcome a health problem for an elderly person. Once the product was presented, the professors and students assessed the conceptual proposals, using a semantic differential. The students also evaluated the workshop with a perception survey.

Results: Both the students and professors positively evaluated the usefulness and functionality of the conceptual proposals; although, the industrial design students were more critical about these aspects. The originality of proposals evaluated was the worst. Regarding the workshop, all students (100%) felt that instructions were clear as were the three moments of design, with problem definition stage best evaluated.

Conclusions: The CBL is shown to be an educational tool that allows training professionals in product design and in developing health technology that is suitable for the users' needs. Regarding the process, heterogeneous make-up of the groups and clear external guide appear as essential for CBL to work well.

Keywords: challenge-based learning, elderly, interdisciplinary, higher education. (JPMA 71: 449; 2021)

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Introduction

Health professions are responsible for health care, but also for leading innovation in the Health system. For this reason, interdisciplinary approach and deliberate training are required.

There is consensus that health is a human right, with citizens as stakeholders, and the State as guarantor.[1] The State of Chile, assuming this role, has introduced a series of public policies, mainly through the former National Health Service, which have helped produce excellent health indicators that stand out in Latin America and are similar to countries like the United States, despite spending only a seventh of what is spent per person there.[2]

Currently Chile, at a Latin American level, is recognized for having a health system with high coverage and good epidemiological results, despite its segmented architecture. It has increased public health spending and guaranteeing basic rights using mechanisms like AUGE-GES Explicit Health Guarantees.[3] However, Chilean health system still has shortfalls regarding resources and infrastructure,[2] hence science and innovation are the only means for its subsistence and improvement.[4]

It is expected that science offers technological solutions with an economic and social impact.[5] This is why projects like National Health Research Fund (FONIS) have been created. This fund promotes research in applied health, looking to develop public policies and standardize solutions for the area's priority problems. Although it could be expected that doctors are able to detect health needs that necessitates being resolved, their participation as FONIS researchers has fallen.[6]

The complexity is despite of consensus that a biopsychosocial approach and inclusion of other professions in health technology innovation and research has favoured its development; it is undeniable that in the interdisciplinary understanding of these phenomena, participation of health professionals is required.[5,7] In fact, projects like Chilean National Health Survey have shown an opening for other areas to strengthen health planning and improvements, but emphasis in calling upon health professionals has remained.[8]

[1]Department of Design Engineering, Federico Santa Maria Technical University, Chile; [2,5]Department of Medical Education, School of Medicine, University of Concepcion, Chacabuco corner Janequeo s n, Concepcion, Chile; [3]Department of Design Technologies and Art, University of Bio Bio, Concepcion, Chile; [4]Department of Speech Therapy, School of Medicine, University of Concepcion, Chacabuco corner Janequeo s n, Concepcion, Chile.

Correspondence: Juan Carlos Briede Westermeyer. e-mail: juan.briede@usm.cl

The growing number of elderly is one of the issues that require health innovation and research. Nowadays, this is one of the most important social transformations, as ongoing demographic ageing has an impact on economy, on public policy and on development of communities and families.[9] Worldwide, life expectancy could pass the 100 barrier, while in Latin America it should double between 1950 and 2050. By 2050, the average age will rise from 28 to 40 and the population over 60 would triple.[9,10]

Chile, by 2025 will have the highest aging index in the region, hence, will experience a similar scenario. By 2050, elderly would be representing almost one third of the national population.[10]

This means that ageing is becoming a local and global challenge, as well as one of the main health concerns in matters like mental health, infectious or contagious diseases, and chronic illnesses with integrated health in general. It will also have an impact on aspects associated to health resources.[9,11] These problems involve families and the State, especially as the Chilean model sees responsibility for health care fall upon families.[3,10,12]

This makes it necessary that scientific research and health technology innovation addresses elderly, generating a process involving an interdisciplinary needs assessment and development of products that benefit wellbeing of this group.

To innovate, professionals need to develop expertise that adapts to phenomena, lets them apply their technical knowledge to develop solutions for new problems and that goes against routine expertise, which focuses on developing efficient solutions to usual problems. Although the former is developed through professional experience, it is possible to stimulate it in professional training using specific teaching strategies like Challenge-based learning (CBL).[13]

CBL is a training opportunity where students have to develop products to cover real problems, applying technical knowledge at an implicit rather than explicit level, implementing a cycle between research and conceptual reflection.[14] It has already been used in undergraduate engineering,[13] design[14] and nursing[15] classes as well as in interdisciplinary health and design groups.[16]

This study presents the evaluation of a User-Centered Design (UCD) workshop, involving students from health degree programmmes at the University of Concepción (Chile) and from industrial design programmmes at the University of Bio-Bio (Chile). The workshop, as a training activity, involved developing products to cover health needs of the elderly. It was run within the framework of the process that integrated characteristics, needs and wishes of users that the UCD philosophy proposes. This philosophy has become ever more popular for professionals as an innovation development tool.[16-18] CBL, meanwhile, was used as a didactic strategy.

The decision was made to call upon health and design students from different universities. Health students tend to think that innovation is somewhat outside their comfort zone, while industrial designers, whose work directly involves innovation, have limited possibilities to contribute to health issues because they lack basic knowledge about health. Considering this, both areas combined together would make the design process richer, as well as, helping develop transversal competences among the students and broadening their knowledge.[16]

The learning opportunities of professionals are improved by developing interdisciplinary work,[17] just like in this case, as the development of advanced epistemological beliefs, critical thinking, metacognition and understanding of relationships between different areas is fostered.[18] Interdisciplinary experiences, in this way, allow addressing issues in an unrecognizable and creative way,[19] considering practical implications and adding value.[20]

Given that the University of Concepción does not have industrial design programmmes and the University of Bio-Bio does not have health programmes in the city, both universities came together to run the course.

This kind of learning activity, in universities where different disciplines tend to be trained separately and focus on common professional problems, could be relevant to develop skills such as innovation, creativity and transdisciplinary work. However, it is necessary to provide evidence about their results with students. This is why the research aims to describe the results of a User-Centered Design workshop using Challenge Based Learning or CBL, where students from industrial design and health degrees in Chile, developed solutions to resolve health problems among the elderly.

Material and Method

The UCD workshop was organized based on two CBL activities: a brief educational challenge on a common focal issue (independent elderly person with mobility issues) for all the students, which had to be developed in three weeks, and another empty one that had to be progressively developed over other fourteen weeks in the course, where each group had to choose their focal issue related to a global problem: independent elderly people.

This article presents results of the first activity. It followed the model of previous experiences[16] and was organized based on three moments:

1) "A view of reality": A trained actress represented an independent elderly woman with mobility and vision issues. This representation covered waking up, getting up from her bed, taking some medicine and preparing for breakfast. The performance lasted 10 minutes, with students having to make an open observation of what was being represented, following orientation guidelines, which they had been given beforehand with questions like: What does the elderly woman look to do? What resources does she use? What makes her activity easier? etc. The students, with the observation, had to prepare a graphical organizer, which summarizes key concepts and variables of the situation represented, choosing a focal phenomenon from multiple elements represented.

2) "The problem": After identifying the focal phenomenon, students had to progressively carry out a differentiation process of needs, wishes and difficulties, with support of interdisciplinary team of professors. With this analysis, they built a problem tree, identifying the core problem.[21]

3) "We are all designers": Over three weeks, students had to gradually develop a product, which solved the main problem identified in the previous stage. For this, they started with a brainstorming session[22] and ended by preparing a conceptual proposal[23] as a series of sketches. The last stages were then submitted for expert revision of interdisciplinary team of professors and students. The end product was a presentation of the prototype.

A quantitative methodology was used with pre-experimental and descriptive design to assess this experience.

The workshop was taken by 39 students from Industrial Design undergraduate programme and 6 from health degree programmes (3 from Speech Therapy, 2 from Medical Technology and 1 from Medicine). The first group was studying an obligatory course from University of Bio Bio's curriculum. The rest were in an elective for health degree programmes at the University of Concepción. The only exclusion criterion was participation in a previous version of UCD workshop. A non-probability convenience sampling was used. A minimum sample size of 41 participants was needed for a descriptive study (Confidence interval=95%, Margin of error=5%) according to this formula:[24]

$$n = \frac{Z^2 * p(1-p)}{\left(Z * \sqrt{\frac{p(1-p)}{n}}\right)^2}\left(1 - \frac{n}{N}\right)$$

However 43 students decided to participate in data collection process and they were final sample.

Both courses were coordinated within a single UCD workshop, which was moderated by nine professors from both universities, including 3 industrial designers and 6 health care professionals (3 nurses, 2 psychologists and 1 physician). They were chosen as teachers for this Workshop because of their knowledge regarding UCD and elderly health issues.

The professors and students, upon finishing this first challenge, had to answer the following documents:

Product Assessment Questionnaire: Students and professors used a 14-item semantic differential to assess the final design proposal of each group. This document was an adaptation of Briede et al.[16] to the document proposed by Oman et al[25] and as a semantic differential, it sought to measure general meaning associated to the product through selection of one out of 21 alternatives, which marked a position within a dimension whose extremes were conceptually opposed[26] (e.g. Complex-Simple). Thus, if an alternative that was closer to -10, then a higher affinity to the first term would be indicated (e.g. Complex), while closer to +10 would indicate affinity with the second term (e.g. Simple). A value of 0 indicated a neutral assessment.

Students, in order to evaluate the Workshop, also answered a Likert format 21-item questionnaire with 7 answer options (from 1=completely agree to 7=completely disagree) designed by Briede et al.[16] This was used to evaluate implementation of the activity, learning achieved, group's performance, quality of the product achieved and usefulness of challenge's three stages. These two instruments have previously been used in other studies.[16]

The dynamics of CBL were explained to students in the first session, and they were given orientational guidelines with guiding questions for the three work moments indicated. After this, actor's performance began, and they started to work in seven groups comprising five to six industrial design students and one health-based student. They had 3 weeks to carry out three sections of the challenge.

In the final week, students had to make an oral presentation with results of three CBL moments, with emphasis on the problem and conceptual design. In this moment, students and teaching team evaluated the product with semantic differential and students answered workshop's evaluation survey, all with prior informed consent.

The study had certification of the University of Bio-Bio's Ethics Committee.

A descriptive statistical analysis of questionnaires was made in STATA SE 11.0. The mean, standard deviation, minimum and maximum of each dimension evaluated were calculated for semantic differential, differentiating professors and students. In addition, analysis was repeated, separating students and health and design professors. At each level, absolute difference between areas (Diff|design-health|) was calculated to evaluate the degree of agreement.

In case of workshop assessment questionnaire, this was analyzed with answer frequency analysis. To aid reading, three agreement and three disagreement categories were grouped together.

Inferential statistics were not used as all the participants answered the documents.

Results

The students and professors, when they evaluated conceptual proposals presented by the groups using semantic differential of Oman et al.,[25] obtained results shown in Table 1. These are differentiated by area, reporting absolute difference between design and health (Diff|design-health|).

Here, it is seen that health students considered conceptual proposals were mainly useful (M=5.8), original (M=4.5) and functional (M=4.5). The design students agreed in that they were useful (M=3.6) and functional (M=3.3), although their opinions were not as positive.

In case of health professors, they evaluated proposals as useful (M=7.2), functional (M=6.1) and original (M=5.7), while design teachers mainly value usefulness (M=5.2), logic (M=3.3) and unique character (M=3.3) of the designs.

Regarding agreements between areas, in case of students, there was a greater agreement between health and design areas in that the products were cheap (Diff|design-health|=0.5) and simple (Diff|design-health|=0.6). The

Table-1: Descriptive statistics of product evaluations by student opinions separated by area.

	Categories	Industrial Design			Health			Diff
		Mean±SD	Min	Max	Mean±SD	Min	Max	|design-health|
Students	UNORIGINAL – ORIGINAL	1.40±4.40	-10.00	10.00	4.50±4.00	-7.00	10.00	3.10
	CRUDE - WELL MADE	1.60±3.90	-9.00	10.00	4.20±4.00	-8.00	10.00	2.60
	EXPECTED – SURPRISING	-0.20±3.80	-10.00	10.00	2.80±3.00	-5.00	8.00	3.00
	DISORDERED – ORDERED	2.90±4.10	-10.00	10.00	3.90±3.90	-8.00	10.00	1.00
	COMMON – ASTONISHING	-0.10±3.60	-10.00	10.00	1.80±2.80	-6.00	8.00	1.90
	NON-FUNCTIONAL – FUNCTIONAL	3.30±4.00	-10.00	10.00	4.50±3.80	-3.00	10.00	1.20
	ORDINARY – UNIQUE	0.30±4.00	-10.00	10.00	3.80±3.50	-2.00	10.00	3.50
	ILLOGICAL – LOGICAL	2.50±3.80	-10.00	10.00	3.30±3.50	-2.00	10.00	0.80
	UNUSEFUL – USEFUL	3.60±3.20	-4.00	10.00	5.80±3.30	0.00	10.00	2.20
	EXPENSIVE - CHEAP	0.70±4.50	-10.00	10.00	1.20±3.70	-9.00	7.00	0.50
	INVASIVE - FRIENDLY	1.90±5.00	-10.00	10.00	-0.20±4.60	-8.00	9.00	2.10
	UGLY - BEAUTIFUL	1.20±3.90	-10.00	10.00	2.10±3.40	-7.00	9.00	0.90
	IDEALISTIC - REALISTIC	1.70±4.60	-10.00	10.00	2.50±3.50	-3.00	9.00	0.80
	COMPLEX - SIMPLE	0.90±5.00	-10.00	10.00	1.50±4.00	-7.00	9.00	0.60
Professors	UNORIGINAL - ORIGINAL	2.90±3.10	-3.00	6.00	5.70±4.00	-3.00	10.00	2.80
	CRUDE - WELL MADE	2.10±2.40	-3.00	5.00	3.50±4.50	-6.00	10.00	1.40
	EXPECTED - SURPRISING	1.90±4.00	-4.00	8.00	3.70±4.00	-4.00	10.00	1.80
	DISORDERED - ORDERED	2.80±1.90	0.00	6.00	4.80±3.90	-4.00	10.00	2.00
	COMMON - ASTONISHING	1.90±3.10	-4.00	7.00	3.10±3.90	-4.00	10.00	1.20
	NON-FUNCTIONAL - FUNCTIONAL	2.80±3.10	-4.00	7.00	6.10±4.00	-6.00	10.00	3.30
	ORDINARY - UNIQUE	3.30±3.20	-2.00	9.00	3.70±5.00	-5.00	10.00	0.40
	ILLOGICAL - LOGICAL	3.30±2.40	0.00	6.00	5.60±3.80	-4.00	10.00	2.30
	UNUSEFUL - USEFUL	5.20±2.70	0.00	9.00	7.20±2.70	2.00	10.00	2.00
	EXPENSIVE - CHEAP	-0.40±3.80	-8.00	5.00	0.60±5.70	-10.00	10.00	1.00
	INVASIVE - FRIENDLY	-1.50±4.30	-7.00	8.00	-3.50±4.20	-10.00	9.00	2.00
	UGLY - BEAUTIFUL	-1.40±3.90	-8.00	5.00	-3.10±3.30	-10.00	2.00	1.70
	IDEALISTIC - REALISTIC	-1.90±5.50	-8.00	8.00	3.70±4.90	-8.00	10.00	5.60
	COMPLEX - SIMPLE	0.10±4.20	-8.00	7.00	0.70±5.50	-10.00	9.00	0.60

SD: Standard deviation; Min: Minimum score; Max: Maximum score; Diff|design-health|: |Design students mean score-Health students mean score|.

greatest discrepancy was in terms of originality (Diff|design-health|=3.1) and surprising nature of the design (Diff|design-health|=3.00), where health students' average was three points higher than that of design students.

Among professors, on comparing by area, there was a greater agreement in unique character (Diff|design-health|=0.4) and in simplicity (Diff|design-health|=0.6) of proposals, but there was a greater discrepancy in realistic character (Diff|design-health|=5.6) and in the functionality (Diff|design-health|=3.3) of designs, which were given higher marks by health area.

Figure helps compare evaluations, illustrating means of each group studied.

Finally, evaluation that students made of the workshop was analyzed, finding that the best evaluated aspect was clarity of the instructions provided. This scored 100% agreement. It was followed by contribution of the scenic representation to understand the complexity of the context represented (96% agreement), usefulness of the guidelines for activity (95% agreement) and usefulness of activity, "The Problem", in project's development (95% agreement). The value of activity in developing participants' creativity,

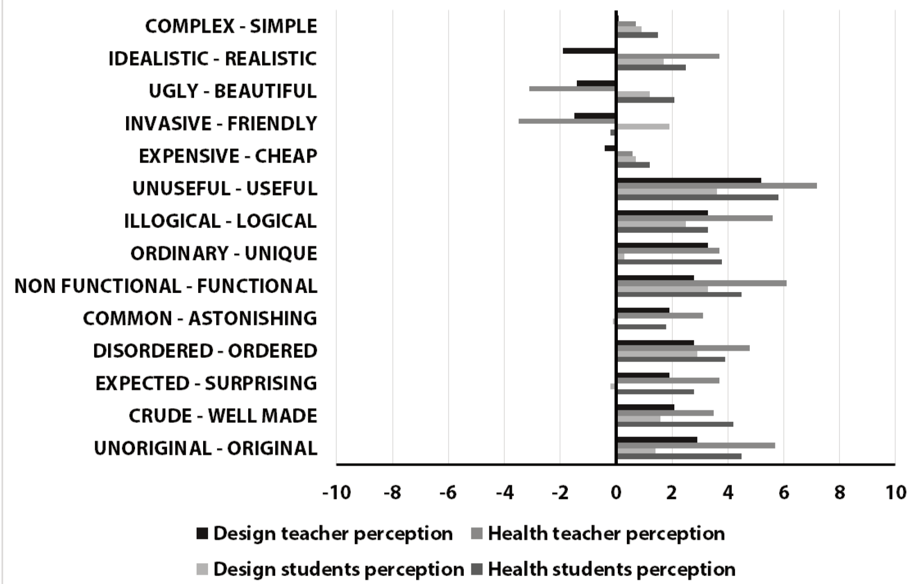

Figure: Average score by dimension of the students and professor's evaluation regarding the participating groups' conceptual proposals.

Table-2: Descriptions of the students' assessment about the different aspects of the workshop held.

Indicator	Omission n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Total n (%)
The instructions given were clear	0 (0)	0 (0)	0 (0)	43 (100)	43 (100)
The guidelines helped me with the activity	0 (0)	0 (0)	2 (5)	41 (95)	43 (100)
What was expected at the end of the activity was clear	0 (0)	1 (2)	6 (14)	36 (84)	43 (100)
The type of activity was motivating for me	1 (2)	2 (5)	10 (23)	30 (70)	43 (100)
The whole activity helped me understand elements in product design	0 (0)	2 (5)	7 (16)	34 (79)	43 (100)
The activity helped me develop my creativity	0 (0)	3 (7)	1 (2)	39 (91)	43 (100)
Being able to work with other areas was a motivation and key to fully understanding the situation being analyzed	0 (0)	2 (5)	5 (12)	36 (83)	43 (100)
The activity "A view of reality" was useful for the project	1 (2)	1 (2)	2 (5)	39 (91)	43 (100)
The activity "A view of reality" was motivating	0 (0)	3 (7)	11 (26)	29 (67)	43 (100)
The activity "A view of reality" helped me learn about product design	0 (0)	3 (7)	5 (12)	35 (81)	43 (100)
The scenic representation contributed towards understanding the complexity of the context being represented	0 (0)	1 (2)	1 (2)	41 (96)	43 (100)
The activity "The Problem" was useful for the project	0 (0)	0 (0)	2 (5)	41 (95)	43 (100)
The activity "The Problem" was motivating	2 (5)	2 (5)	5 (12)	34 (78)	43 (100)
The activity "The Problem" helped me learn about product design	0 (0)	1 (3)	4 (9)	38 (88)	43 (100)
The activity "We are all Designers" was useful for the project	0 (0)	0 (0)	5 (12)	38 (88)	43 (100)
The activity "We are all Designers" was motivating	0 (0)	1 (2)	9 (21)	33 (77)	43 (100)
The activity "We are all Designers" helped me learn about product design	1 (2)	0 (0)	8 (19)	34 (79)	43 (100)
The online forum and group were useful in the activity	0 (0)	6 (14)	7 (16)	30 (70)	43 (100)
It was easy to work with my groupmates	0 (0)	2 (5)	2 (5)	39 (91)	43 (100)
The time allocated for the activity was appropriate	0 (0)	1 (2)	4 (9)	38 (88)	43 (100
)The product developed was innovative	0 (0)	1 (2)	3 (7)	39 (91)	43 (100)

usefulness of activity, "A view of reality", the ease with which group work was done and the degree of innovation of developed products also stood out (91% agreement), Table 2.

Discussion

The results showed that the proposals developed in CBL would allow suitably facing the problems studied, since the best evaluated aspects for both professors and students are usefulness and functionality of solutions. This would support the importance of CBL in innovation competences and design learning.

This is of note, as students started CBL with a complex representation of an elderly person with multiple age-related difficulties,[9] where they had to decide which way they would focus the design on. The fact is that suitable solutions could be generated, even from an unstructured situation, reinforcing idea of promoting innovation and interdisciplinary work[5,7] to face high priority health problems like this, especially due to the positive impact that professionals, capable of developing technological solutions, would have on the health system.[5,6]

Despite this, it is necessary to highlight that design students and professors were more critical about level of creativity in the proposals, considering them to be less original and surprising. This could be evidenced of a more limited education for health professionals in terms of innovation and a greater value for routine expertise in their education.[13,16] But it can also show potential support of working with areas that receive a structured training in innovation[5,7,16] and that strengthen adaptative expertise.[13,16]

Finally, the students, despite the complexity of educational processes like CBL, which require implementing creative, innovative processes, focused on needs of a specific user profile,[13,16] positively valued clarity of the process, which showed that clarity of instructions at the beginning and giving support material as guidelines, could be useful to reduce anxiety and channel efforts in learning processes like these, ones which are less structured than traditional education.

Although the three moments were, in general, positively evaluated regarding their motivational nature, their usefulness for the project and their impact on students' learning, the best evaluated was, "The Problem", and the worst, "A view of reality". In a previous experience, it was also documented that the first stage of the design was the least valued,[16] which might be a result of students being less trained in relatively unstructured observation processes, where a global view of the situations is needed. They felt more comfortable in stages where they are focused on the users' needs and problems. Therefore, it is recommendable to give some sense and usefulness to the first stages of the design, that this is given more time and a more professor-focused guide that provides specific tools to make the most out of this stage.[16]

The intention, using general findings, is to continue the research along three lines:

1) Determining which aspects of each discipline and each individual profile favour or complicate the interdisciplinary work dynamic and quality of the proposal.

2) Establishing work strategies that could be replicated in local and foreign universities to develop interdisciplinary innovation competences in health, while considering other issues, not just the elderly.

3) Identifying processes which favor the initial processes of reflection in interdisciplinary design.

As limitations to the study, this article only reports outcomes from a 3-week activity, so it is necessary to investigate outcomes from longer training processes. Also, it is necessary to acknowledge the non-probabilistic nature of the sample and that the complexity of co-creation processes requires qualitative strategies to complement the collection of quantitative data.

Conclusion

In health contexts marked by lack of resources and emergence of multifactor issues like population aging, training of interprofessional teams in technological development and innovation competences is essential to uphold the system's efficiency. CBL is shown as being a suitable tool for this purpose, as long as it promotes working in teams that are internally diverse and with a clear external guide.

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