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MOVING FROM CONCEPTUAL TO FORMAL PROPOSAL: A STUDY OF REFERENCES AS AN ANALYTICAL SUPPORT

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ABSTRACT
The methodology employed in industrial design education at the Universidad del Bío-Bío privileges the role of student observation during the research process. The move from observing an object (and its signifier) to developing a proposal, which must be consistent with the value characteristics of the proposed product solution, is key to defining the impact of an idea and its relevance. Here, the leap from conceptual to formal proposal – when ideas are interpreted and translated –is generally approached in an independent and intuitive manner. The present article follows the application of this method in three stages: Reference Map, Attributes Matrix and Semantic Network. It seeks to analyse, identify and isolate desirable attributes found in the natural and artificial world for use in the design proposal. Following the activity, a mixed analysis of participant evaluations was carried out using interviews and surveys. Slides documenting all stages of the process were compared to the final product. The proposed methodology serves as an objective analytical support for formally exploring design proposals, encouraging students to approach design in a more thorough and reflexive manner that ultimately strengthens objectivity and understanding of the decision-making process of conceptual design.

Keywords: Industrial Design, Conceptual Proposal, Formal Development, Design Education, Design Workshop.

1 INTRODUCTION

Industrial design and new product development are key strategies enabling businesses to strengthen differentiation and competition in the marketplace. Nonetheless, developing simple, effective and innovative solutions in order to achieve competition in saturated global markets is an increasingly complex task. It not only implies taking on the complexity of a product [1] during the creative or productive process, but also requires in-depth study of the market and existing products in order to determine the strategic direction of a new design proposal [2]. Preparing designers to better confront these challenges is a difficult undertaking, which necessitates a greater understanding of the socio-cultural context where work is carried out, as well as attention to institutional guidelines and methodologies and the need to make incremental contributions inside the classroom and within the academic community at large. The Industrial Design Program at the Universidad del Bío-Bío (UBB) has incorporated project development aimed at promoting capacity building [3] in the teaching-learning process. Here, a combination of technical skills and cognitive abilities allows students to generate new knowledge for carrying out assigned tasks [4]. Implicit within the learning process is the need to experiment with different levels of interaction with the surrounding environment. By interacting within the field of design, students are able to develop the competencies required to meet emerging needs [5].

2 CONTEXT

2.1 Methodological Context

Design teaching, when approached from the field of engineering, is often concerned with the product development process (PDP). This process seeks to replicate the complexity of user context, yet it too often relies on overly abstract and difficult methods [7].

Industrial design education in Chile, however, is heavily influenced by the Bauhaus School [8] and employs a projectual [9] and reflexive [10] approach that goes beyond engineering to art and architecture. Here, the design process uses *observation* as a transversal methodological tool that, while grounded in scientific investigation [11], has philosophical and phenomenological underpinnings [9] that blur the lines between the observer and object as well as the subjects and their context. This approach allows for greater examination of the relationships and interactions between individuals, objects and their environment [12][13].

The design process proposed by Ulrich & Eppinger (2011)[14] incorporates the following stages: a) Planning; b) Conceptual Design; c) System Level Design; d) Detailed Design; e) Integration and Testing; and f) Release. Conceptual design is the initial stage of synthesis during this process, when conceptual proposals are first developed. Identifying the problem and user needs provides a theoretical basis for new product development.

The Industrial Design School at UBB [15] streamlines conceptual development didactically across two stages: the Conceptual Proposal and the Formal Proposal. In the first stage, designers propose an item or product, its attributes, context of use and application (for example, "Adaptable Endosqueleton" – to display woven knitwear in artisan shop). By exploring all possible configurations of a product, this phase leads to the development of a formal proposal. It involves interpreting and translating theoretical concepts into the practical dimension. Continuous application of this approach shows that "*difficulties faced when moving from conceptual proposal to the formal development of a product are primarily due to the fact that creative exploration is a more informal, intuitive, and less explicit process, largely depending on one's own interpretation of criteria laid out in a written proposal*" [Briede, Rebolledo; 189]. The method presented here builds on the visual model proposed by Briede & Rebolledo (2011)[16], which develops a systematic analysis of references in order to select desirable attributes and design principles for the new product. Three particular contexts serve as a reference point: benchmarking (direct competition), the artificial world and the natural world.

3 METHODOLOGY

Over the course of the 2015 UBB User-centered Design (UCD) Workshop, participants worked in collaboration with the organizations TPH and *Manos del Bío-Bío* in order to develop real-world solutions to problems faced during the creation, manufacturing and display of artisan crafts. During this process, application of the proposed methodology aimed to support the conceptual design of a product solution. The following three tools were employed: Reference Map (Visual Model), Attributes Matrix and Semantic Network. Tools were applied sequentially and time was allotted for each stage. Finally, feedback was solicited by both professors and students.

I. Reference Map: Students developed a visual model [16] using product concepts and attributes defined in the conceptual proposal. Morphological and analogic references were collected from various sources, including direct competition (products with similar typology and functions on the market), the Artificial World (references, products and artificial elements that embody the desired attributes), and the Natural World (references and natural organisms that possess the basic functionalities or that may serve as a metaphor or analogy [18]).

This tool in particular allowed designers to carry out a structured search of references and concepts for further analysis and review. In addition, it allowed designers to catalogue references, thereby enriching and broadening the search for alternatives in the later stage of formal development.

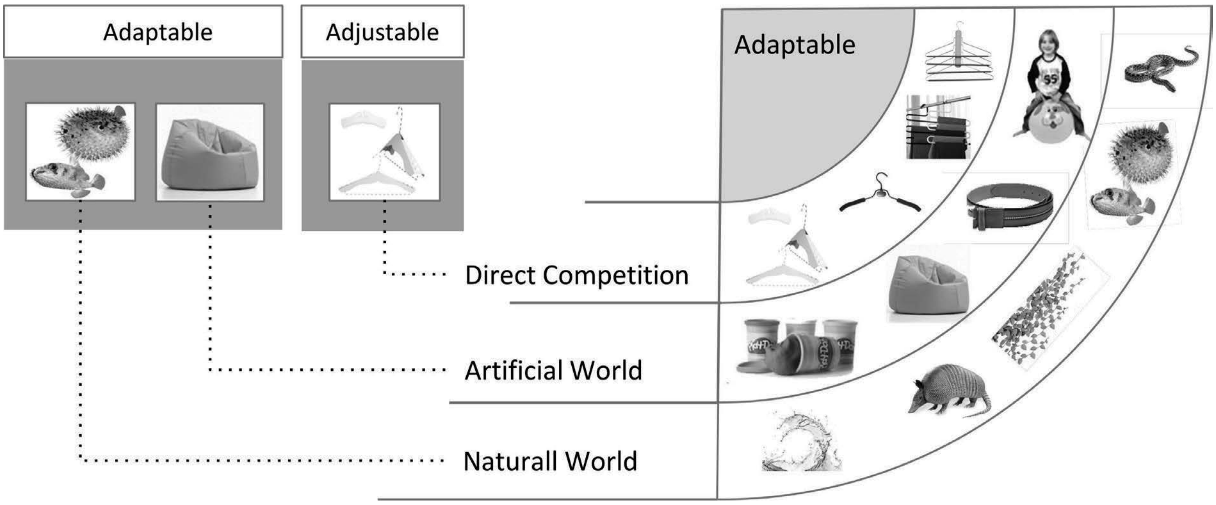

Figure 1. Reference Map. Source: Adapted from Design Team Nº2

II. Attributes Matrix: After selecting appropriate references, student designers created a matrix in order to individually and comparatively analyse product attributes. Desirable attributes were identified and considered for their usefulness in the conceptual proposal and ability to meet user needs. In addition, advantages and disadvantages of each reference were weighed.

Table 1. Section of the Matrix with an Example of a Natural Reference. Source: Design Team Nº2

Reference	Description	Desired Attribute	Reasoning	Advantages	Disadvantages
	Butterfly Cocoon	Intermediary Barrier/Stalk	During metamorphosis, the caterpillar remains dormant inside the protective cocoon	Protection and Resistance	It hangs down or dangles while inactive

III. Semantic Network: In the third stage students created a Semantic Network, using the conceptual proposal to guide the development of the product. In order to do so, they identified possible relationships and interdependencies between desirable attributes from the previous stage, with attention to the objectives of the current proposal. These include relationships of inclusion (A is part of B), exclusion (if A exists, B cannot exist), independent relationships (there is no relation between A and B), compensatory relationships (A makes up for the shortcomings of B), moderating relationships (A affects the level of influence of B) and potentiating relationships (A and B together increase their effect).

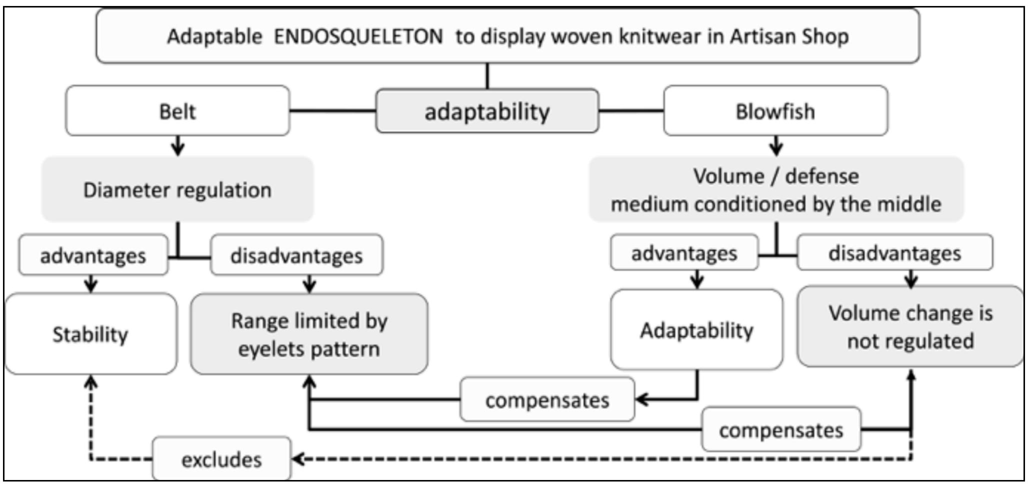

Figure 2. Semantic Network for the product :Endoskeleton. Source: DesignTeam Nº2.

3.1 Assessment

A descriptive and exploratory mixed study [19] was carried out in order to evaluate the application of this methodology. In the quantitative phase, a perception survey of the workshop was administered to students. Out of 34 total students, 28 provided responses (82%). The survey consisted of three sections corresponding to the Reference Map, Attributes Matrix and Semantic Network, all of which were structured as closed questions. In the qualitative phase, interviews with students were carried out in order to better understand their evaluation of the method and its impact on the final proposal. Overall, this study forms part of the methodology of the user-centred design workshop for third-year students in the program, which consisted of groups of 3 to 4 students. Data was analysed using descriptive statistical analysis.

4 RESULTS

Eighty percent of the students surveyed agreed that the three-stage process facilitated constant feedback and was responsive to their engagement with the material as they defined and deepened their understanding of the connections between stages. Seventy-five percent of students agreed that the method had an indirect impact on the final proposal, since many references spurred their conceptual development and were later transformed during the process. Moreover, 90% of students attest to the advantages of this methodology in facilitating a systematic analysis of references, allowing them to engage with the complexity and depth of the topic.

Table 2. Student Assessment of Tools for Analysing and Isolating References Used in the Formal Proposal

	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Reference Map					
Using this tool to study artificial references was an easy task.	0 (0%)	4 (14%)	3 (11%)	**15 (54%)**	6 (21%)
Using this tool allowed me to compare and contrast references to the desired attributes defined in the conceptual proposal.	0 (0%)	2 (7%)	6 (21%)	**14 (50%)**	6 (21%)
Attributes Matrix					
Using this matrix to analyse references allowed me to evaluate multiple attributes.	0 (0%)	2 (7%)	6 (21%)	**18 (64%)**	2 (7%)
Using this matrix to analyse references allowed me to identify the most desirable attributes for each reference.	0 (0%)	1 (4%)	5 (18%)	**17 (61%)**	5 (18%)
Semantic Network					
Once attributes were defined, it was easy to use the semantic network.	0 (0%)	6 (21%)	7 (25%)	**14 (50%)**	1 (4%)
It was easy to identify independent relationships using the semantic network.	1 (4%)	2 (7%)	**16 (57%)**	8 (29%)	1 (4%)
The semantic network helped me to identify relations between attributes.	1 (4%)	1 (4%)	4 (14%)	**19 (68%)**	3 (11%)

Student evaluations for each of the three tools are presented in Table 2. Students agree that using the tool to study artificial references was an easy task, and it allowed them to compare and contrast references to the desired attributes defined in the conceptual proposal. In addition, students agree that analysing references using the matrix allowed them to evaluate multiple isolated attributes. As for the Semantic Network, it is important to note the number of students who were impartial when asked if

the tool helped them to identify relations of inclusion and exclusion, as well as independent and compensatory relationships between attributes. This may be reflective of, or may even hide, the fact that the process was neither simple nor direct. The smaller majority of students, however, agreed that it was easy to identify relationships using the tool.
Qualitative data collected from student evaluations is summarized in Table 3. Overall, students gave a positive assessment of the tools, despite the fact that they increased the workload associated with product design.

Table 3. Student evaluations during the qualitative phase of research

Feature	Opinion
Overall usefulness of design tools	The tools allow students to broaden their understanding and strengthen their analysis of the conceptual proposal, as well as the market where their products will be sold. Nonetheless, the complexity of work increases when students are required to gather information.
Reference Map	This tool allows students to identify, analyse and compare attributes, thereby providing a wide range of concepts that help to spur project development. It also eases the process of gathering information about existing products on the market.
Attributes Matrix	This tool allows students to identify the best attribute of each product reference, helping to streamline data and highlight the advantages and disadvantages of each attribute. These concepts ultimately help students improve their proposal.
Semantic Network	The semantic network helps students to summarize relationships between products despite their obvious differences. Students are thus able to organize their ideas and strengthen the conceptual proposal.

5 CONCLUSIONS

The method proposed here provides a concrete strategy for visualizing and engaging with the creative process – a largely covert task, even for designers. In this way, it provides students with the necessary tools for reflecting on their design proposal, and it supports feedback and encourages creativity by embracing non-lineal thinking. The successful application of this methodology is supported by the opinions of student participants, who overwhelmingly agreed with its benefits. Nonetheless, while the tools are useful in supporting the design process, students experienced moderate difficulty with the Semantic Network, which may necessitate higher-level cognitive processes than previous steps. It may also require a conscious and systematic evaluation of decisions taken earlier in the process.
These same challenges may allow us to understand why students struggle with common design processes that are typically intuitive, informal and less explicit, often resulting in weak or underdeveloped proposals. In this way, semantic networks and previous tools guide students towards a more detailed reflexive process that requires students to defend their design proposal. This may typically be ignored or bypassed as part of an intuitive leap from conceptual to formal proposal.
As a result, the three distinct stages explored in the present study provide students with tools for reflection that guide and shape the reflexive process of the UBB designer. However, one of the biggest risks is the tendency to adopt a technical and one-dimensional outlook, using the method as a structured course rather than guidelines for the projectual process. Therefore, the role of the teacher is key in facilitating and guiding this process, ensuring that students are actively involved in making decisions and continually reflecting on their own thoughts and actions. Only then will these tools fulfil their main purpose in supporting and motivating, rather than inhibiting, reflexivity.

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