

The Innovation Pyramid as the basis of the design process: a didactic methodology proposal for product design education

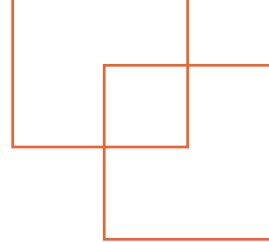
***A Pirâmide da Inovação como base do
processo projetual: uma proposta de
metodologia didática para o ensino de
design de produto***



Ronaldo Martins Glufke

PhD in Design by Università degli Studi di Firenze
- UniFI
Professor of Departamento de Desenho Industrial
of Universidade Federal de Santa Maria - UFSM
rglufke@gmail.com





ABSTRACT

In the current scenario, companies wishing to remain competitive must invest in innovation, not just in a technological and/or procedural way, but providing products that improve experiences for users/ consumers, resulting in a growing demand for design professionals who do not always have in their educational paths the stimulus for the development of required competencies and skills. Supported by concepts of design-driven innovation, this proposal presents a didactic methodology based on Rampino's Innovation Pyramid, having as target professors of product design graduation courses, suggesting resources and didactic strategies to assist the teaching of innovative products development and to promote discussions on this topic.

KEYWORDS

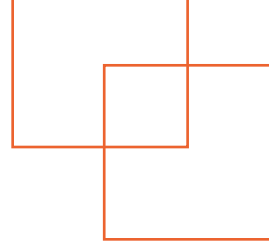
The Innovation Pyramid. Product Design Education. Design-Driven Innovation.

RESUMO

No cenário atual, empresas que desejam manter-se competitivas devem investir em inovação, não apenas tecnológica e/ou processual, mas proporcionando produtos que gerem experiências para os usuários/consumidores, resultando em uma demanda crescente por profissionais de design, que nem sempre têm em seu percurso educacional o estímulo para o desenvolvimento das competências e habilidades requeridas. Pautada em conceitos de inovação guiada pelo design, esta proposta apresenta uma metodologia didática com base na Pirâmide da Inovação de Rampino, considerando como público-alvo professores de projeto de produto de graduação em design, sugerindo recursos e estratégias didáticas para auxiliar no ensino do desenvolvimento de produtos inovadores e promover discussões sobre esta temática.

PALAVRAS-CHAVE

Pirâmide da Inovação. Ensino de Projeto de Produto. Inovação Guiada pelo Design.



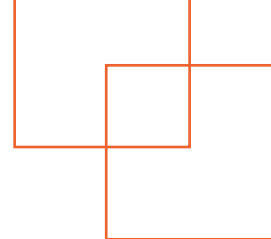
1 Introduction

As product innovation has become the focus of companies from various segments worldwide, seeking to gain the preference of consumers in markets in constant transformation, meeting demands with innovative means and results requires collective effort to transform opportunities, ideas and problems into innovative products (VERGANTI, 2009, 2013).

Gradually companies are realizing that innovation derived from physical attributes and technological applications in the product or production process "[...] is not necessary for future markets. What is necessary are ideas transformed into concepts or unique experiences for the user" (MOZOTA, KLÖPSCH & COSTA, 2011, p.150, our translation), directing their efforts into increasing the participation of design in their practices, understanding that "[...], the search for innovation is often the basic criteria of design, which prioritizes the design of differentiated, special or unusual products" (HSUAN-AN, 2017, p.203, our translation).

Researchers in the field of design and management point out that design practice moves, increasingly, from merely operational contribution to tactical and strategic levels in innovative organizations (MOZOTA, KLÖPSCH & COSTA, 2011), because, "[...] the traditional view of the designer as creative genius or stylist is evolving to a perception of the designer as team member, interpreter of complex systems, communicator and problem solver" (ROTH, 1999 apud LIEM & SIGURJONSSON, 2011, p.197), acting in the "[...] value constellation that surrounds the product, even in the subjective and immaterial scopes [...]" (MORAES, 2010, p.99, our translation).

Because of its direct interference in the structure of products and production processes, the design-driven innovation has been the focus of studies in design education institutions worldwide in recent years. At the Università degli Studi di Firenze - UniFI, when conducting his doctoral studies, the author had his first contact with Verganti's Design-driven Innovation (2009, 2013) and with Rampino's Innovation Pyramid (2011, 2012), when acting as assistant professor in the discipline of Laboratorio di Design dell'Innovazione Tecnica, taught by Professor Vincenzo A. Legnante. Upon returning to his didactic activities in Brazil, in the graduate course of Industrial Design at the Federal University of Santa Maria-RS (UFMS-BRAZIL), he used the Innovation Pyramid in classes of product design as part of the content, identifying hardly explored possibilities of its effective use as a basis for the development of innovative product design, which motivated this research. In order to clearly determine these possibilities, bibliographic research was carried out. The concepts of de-

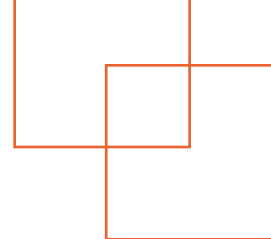


sign-driven innovation, mainly based on Verganti, allowed us to understand the importance of design for product innovation. The dimension of the value of the contribution of design in product innovation was given by the deepening in the studies of Rampino, who categorized the different types of design-driven innovation. The categorization proposed by the author was made by phenomenon occurred study, through analysis of innovative products existing in the market, many awarded in the most prestigious design contests, not having the intention of proposing a practice or project method so that the results of innovation were achieved, although it has listed some starting points of the creative process that can serve as guides for the project definitions.

The Innovation Pyramid is still little explored in studies in Brazil and the world, given its novelty. In Brazil, there are few scientific articles and academic works, both in the area of design and in the area of production engineering that deal with Rampino's Innovation Pyramid, although only as a theoretical foundation in works focused on design-driven innovation.

The literature search also addressed the teaching of product design, given the growing importance of including the development of skills and competencies in the activities of the disciplines of design courses. It was found that the association between design and innovation requires from the designer skills that are not always developed through the educational environment, noticing the urgency of thinking the role of the professor in the development of curriculum content that seeks to adapt to new realities, reorganizing strategies and discussing new models that favor innovation objectives. Therefore, proposals of didactic methodologies for higher education aimed at the development of innovative products and the improvement of the teaching-learning process are relevant contributions. In this scope, didactic methodology is understood as the "[...] set of methods, strategies, techniques, operational resources, criteria, conditioning factors, and even theoretical foundations, applied for the development of works of great complexity, but with clear didactic objectives, focused specifically on teaching and learning" (HSUAN-AN, 2002, p.197, our translation).

The bibliographic researches carried out, combined with the experience of didactic practice, resulted in the suggestion of a didactic methodology, aimed at professors of product design disciplines of undergraduate courses in design, configured in an adjustable model of content and procedures for use in teaching of innovative products, to facilitate and enhance the critical understanding of design-driven innovation on



the part of students, having the Innovation Pyramid as the basis of the design process. The proposal here presented suggests the planning of activities, learning scripts and suggestions for evaluation criteria, with their possible variations and adjustments.

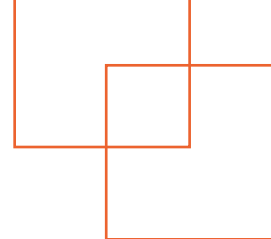
At the end, it is recognized that the proposal may come to assist professors in replicating the didactic methodology through the available resources, besides the very course of construction of this methodology serve as guidance to compose other teaching proposals in product design, as well as to rethink the strategies for the development of skills and competencies crucial to future professionals.

2 Design-Driven Innovation

Mozota points out that the global maxim of the current productive sector is "Innovate to survive" (MOZOTA, KLÖPSCH & COSTA, 2011, p.147, our translation). For Rampino (2011), innovation is usually identified only as of the search for new technological solutions and that "Even today, in most cases, innovation is referred to as introducing new technology into a product or into its manufacturing process in order to improve its performance and usability or to minimize its cost" (BAGLIERI, 2003 apud *ibid.*, p.3). But little by little the world scenario is reacting to the changes of points of view regarding innovation, and the role of design is gaining prominence, attributed by Mozota for having "[...] a conceptual dimension that has the ability to unite all innovators around a common goal focused on the customer" (MOZOTA, KLÖPSCH & COSTA, 2011, p.150, our translation).

Kumar (2012 apud POZATTI, BERNARDES & VAN DER LINDEN, 2016, p.32) clarifies that successful innovations are built through what companies learn by studying the motivations and experiences of users/consumers, because attributes, forms, and technologies can be easily reproduced by competitors, but a new value, experience or meaning, hardly will be, also taking into consideration that there is a shortage of tools and methods for creating truly innovative solutions instead of only providing incremental improvements in products.

The Italian professor Roberto Verganti, researcher of design management and innovation of Politecnico di Milano, published the book "Design-driven innovation: changing the rules of competition by radically innovating what things mean" in 2009, to show managers how they can implement an innovation strategy that generates products and services



with a radically new meaning, able to convey to customers completely different reasons to buy them, in order to redefine the dominant meanings in their sector, before the competition. The author (VERGANTI, 2013) names this strategy design-driven innovation - the process of research and development of meanings "[...] as the word design (from the Latin de-signare) is etymologically related to 'making sense of things'" (HESKETT, 1985 and KRIPPENDORFF, 1989 apud VERGANTI & ÖBERG, 2013, p.88), and design "[...] by definition, includes to bring meaning" (ibid., p.88). For Verganti (2013), even when we buy products for their usefulness, we still seek personal fulfillment, meaning, because it is natural of the human being and different scientific disciplines, from psychology to sociology, from cultural anthropology to semiotics, in studies on consumer behavior corroborate the statement that "every product has a meaning" (ibid., p.22, our translation). The author attests that,

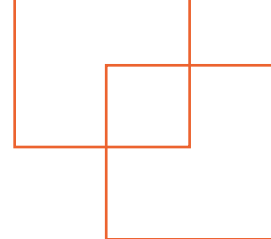
However, many companies do not pay attention to how the meanings of products change or how they can innovate them. They argue that meanings are a matter of marketing and communication, not research and development. They strive to understand, through customer analysis, how people make sense of things, only to discover that this meaning was proposed by the arrival on the market of a new product designed by a competitor. (ibid., p.22, our translation).

Companies do not understand that, like technologies, meanings can also be submitted to research and development processes (ibid.), and,

Companies that develop design-driven innovation move away from customers and take a broader perspective. They explore how the context in which people live evolves, both in the socio-cultural sphere (as the reasons why people buy things change over time) and in the technological sphere (how technologies, products, and services change the context). (ibid., p.12, our translation).

Thus "[...] it is more important to understand 'why' people need a product than know 'what' they need. People buy and use things following deep motivations, often not obvious [...]" (VERGANTI, 2013, p.22, our translation). The author is emphatic in stating that the process that enables meaning innovation in products is design. It is design, by its very nature, that sets it apart from any other type of innovative process, and is a means to create a competitive advantage because it innovates meanings, and meanings make a difference in the marketplace (ibid.). Therefore, Bezerra (2005 apud CASENOTE & VAN DER LINDEN, 2017) asserts that innovation specialists are experts in the design process, which involves both identification and problem-solving skills.

Norman and Verganti (2014) focus on two categories of innovation, Radical Innovation and Incremental Innovation, where Radical Innova-



tion proposes disruptive solutions with high degree of novelty and Incremental Innovation is characterized by small product changes to improve performance, lower costs, enhance the degree of desire or announce the launch of a new model, and even though it is the most common type of innovation, and not as exciting as Radical Innovation, is equally important. Both types are necessary, because Radical Innovation, despite having quite rare success stories, creates potential for the big changes that have their value captured by Incremental Innovation. According to Schumpeter (1997 apud POZATTI, BERNARDES & VAN DER LINDEN, 2016, p.33), "radical innovations bring about major changes in the world, while incremental innovations continually fill the process of change." Verganti (2013) also clarifies that Incremental Innovation does not lead to meaning innovation because it does not lead to a new product experience, different from Radical Innovation.

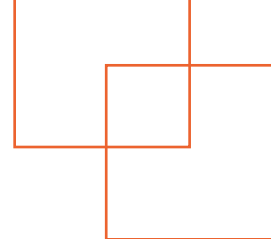
2.1 The Innovation Pyramid

The Innovation Pyramid is part of the research of professor Lucia Rampino, from Politecnico di Milano. Started in 2006, it involved the three main areas related to new product development: management, engineering, and design. The research problem, and also the challenge, was to show effective contribution of industrial design to product innovation to the managers and engineers of the research team, since

The problem of measuring the value generated by design innovation is a direct result of the difficulty in quantifying the meaning and cultural aspects of a product. From the financial aspect, a new product on the market can only be considered an innovation if it generates profit for the firm. The value of design-driven innovation, however, is not always measurable solely in terms of commercial success. (RAMPINO, 2011, p.4).

This difficulty in measuring the innovative value of industrial design is also due to the fact design deals with qualitative factors, and that normally innovation in companies is "non-design-driven", where,

[...] even in manufacturing sectors where industrial design is accorded an acknowledged role (for instance, in household appliances and consumer electronics), product innovation is usually managed by other departments in a company: R&D takes on the technological aspects while marketing handles the issues related to satisfying market demands. Industrial design also deals with the same issues (technology and satisfying market demands) but its contribution [...] is harder to demonstrate and to quantify. (ibid., p.4).



Studying innovation from a phenomenological point of view, the team observed and analyzed products to extract the variables that could represent the essential structure of design-driven innovation, based among others, on Verganti's studies. The initial results demonstrated the need to distinguish between the final result obtained by the designer, and the tools used to obtain this result, pointing out then that "[...] each design-driven innovation process can be described by a finite number of levers and results" (ibid., p.5). The author clarifies that the term lever was used metaphorically as "[...] the relationship of the designer, who pushes on it, to the object designed, which is lifted by it; the very discipline of design being the fulcrum" (ibid., p.5).

The final results of the research reached the objectives and resulted in the categorization of the different types of design-driven innovation, where each process can be described by three levers: Form, Mode of Use and Technology, and four results: Aesthetic Innovation, Innovation of Use, Meaning Innovation and Typological Innovation (RAMPINO, 2011, 2012).

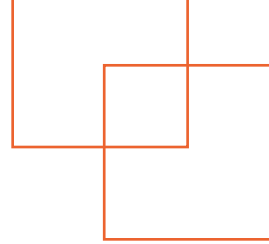
2.1.1 Design-Driven Innovation Process Levers

Form - the starting point of the creative process where the designer projects thinking about morphological issues to identify a new form and a new language for the product. The author also stresses that this lever is not only restricted to morphological attributes, but also all sensory characteristics (RAMPINO, 2012).

Mode of Use - the designer rationalizes the product's mode of use, to identify the needs not fully satisfied, and that may occur through new usage and/or new functions (ibid., 2012). Preliminarily, the author used the term - function - which was replaced by - mode of use - because it does not only represent the operation of the product, but also the cultural importance and the social dimension that comes from the concept of use (RAMPINO, 2011).

Technology - the designer starts the design process thinking about the possibility of applying new technology (product or process) to a product that does not consider it (ibid).

For the author, giving priority to levers is useful because of they usually conflict, for example, an ideal solution for form may not be for technology, or a solution of use mode may hinder from the aesthetic or productive point of view. However, it points out that levers are deeply related and interdependent. Choosing a lever in the design process me-



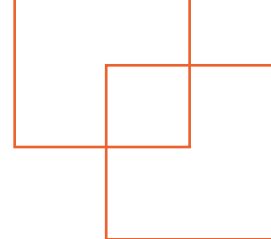
ans defining the guiding priorities of the project, and the designer can decide which has priority, even unconsciously, or it may be the production company that directs the project, by strategic choice. Not defining the clear priority among the levers makes it difficult for the designer to choose in which direction to move (ibid., 2012).

2.1.2 Results of the Design-Driven Innovation Process

Aesthetic Innovation - The objective of aesthetic innovation is to make the product recognizable and attractive (RAMPINO, 2011). It is related to the recognition of products, how they differ from competitors in their external appearance, with attributes (shape, size, the proportion of elements and color) that can be judged at first sight, without the need for interaction or understanding. Eisenmann (2007 apud ibid., p.8) defines the aesthetic innovation as "[...] a series of incremental adjustments to the physical appearance [...] that neither alter the archetype nor influence its performance or technology". It is one of the easiest processes to be understood given the high number of studies, both in the area of design as marketing, application studies, and connection between aesthetics and consumer choice.

Innovation of Use - This refers to how much the product improves or modifies its use, even with the addition of new functions in comparison with the competition. It is worth mentioning that just as the term - function - was replaced by - mode of use -, the expression - functional innovation - became - innovation of use - (ibid.), because the concept of function is concentrated in the operation of the product, in what the product is capable of doing, fitting in the engineering field, while the concept of use adds a cultural importance and social dimension, fitting in the design field. An innovation of use, as understood in the author's study, cannot in any way modify the function of the product, adding that the interaction with the product and the perception of how to use it are linked to the cultural context of users/consumers.

Meaning Innovation - Refers to the emotional and symbolic aspects of a product, what it is able to communicate. It affects the user at a visceral level in the aesthetic plan. Around the product are built stories, brands, status, communities and a sense of belonging (RAMPINO, 2012). For Heskett (2002 apud RAMPINO, 2011), the term - me-

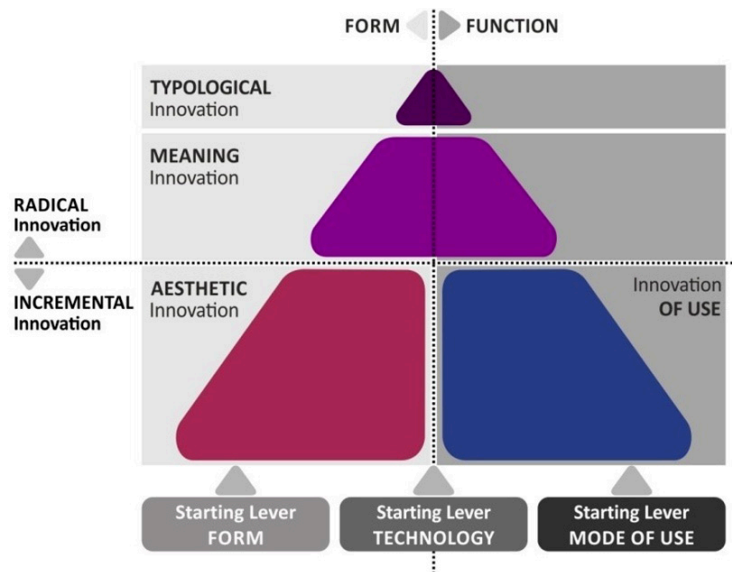


aning - is defined as the meaning that forms acquire depending on how they are used and the role they receive. Ulrich and Eppinger (2003 apud RAMPINO, 2012) refer to the "emotional appeal" that is achieved when working the appearance, color, sound and harmony factors of the product. Norman (2004 apud *ibid.*, p.10) "[...] defines this level of design as 'reflective' since it deals with the meaning of a product and with the memories it evokes and, at the same time, with our self-image and with the messages the product conveys to other people", therefore, is about the satisfaction from possessing, showing and using a product, strongly influenced by individual culture and experiences. The author then defines that to have innovative meaning, the product must be attractive, tell a story and be displayed with pride by the owner. "To obtain this kind of innovation, industrial designers must be able to master all the tools of product semantics, particularly those relating to symbolic functions" (*ibid.*, p.10).

Typological Innovation - The typological innovation is related to the deviation of a product from its "dominant design", an expression that means the basic architecture of a product (ABERNATHY & UTTERBACK, 1978 apud *ibid.*, p.11) that has become the accepted market standard in a product category. Utterback (1994 apud *ibid.*) states that a dominant design is a formal archetype that gains market loyalty, and competitors follow it to achieve participation in this market. Thus, industrial design can play the innovative role of offering new radical solutions and putting them into action through previously unthinkable forms, where the most successful become new formal archetypes (*ibid.*). Therefore, products with typological innovation are easily recognizable. The author points out that marketing studies show that, when a product is totally new or highly unusual, the user/consumer struggles to categorize it and tries to map it to an existing product category, concluding that this does not always produce commercial success, but can make the company stand out for being the pioneer in the introduction of a new archetype.

The results were later structured graphically in the form of a pyramid, arranging the Incremental Innovations: Aesthetic and Of use, at the bottom, and the Radical Innovations: Meaning at the top, and the Typological, rarer at the vertex. The so-called Innovation Pyramid (Figure 1) thus represents the categorization of the three possible levers of a design-driven innovation process and the four possible types of result of a design-driven process.

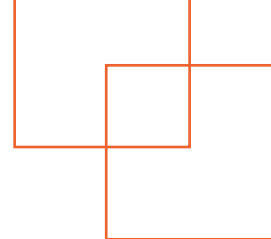
Figure 1 - The Innovation Pyramid.



Source -Adapted from Rampino (2011).

3 The Product Design Teaching

The teaching of industrial design is not only about meeting the needs of the manufacturing sector, but educating for understanding, preparing students for the environment of an ever-changing world (TRATHEN & VARADARAJAN, 2009, apud LIEM & SIGURJONSSON, 2011). This premise is observed by many authors. Dias and Gontijo (2006, p.50, our translation) indicate that there is an evident and definitive "concern, on the part of several Design researchers, in rethinking and reconstructing methodological and epistemological guidelines that contemplate the learning processes and the dynamic transformations that involve and permeate the complex contemporary society". Norman and Klemmer (2014 apud CASENOTE & VAN DER LINDEN, 2017b, p.315, our translation) state that the reason for the need for change in design education derives from the fact that "[...] in general, there is a gap between the current complexity of problems in design, the skills needed to face them, and the average expertise of the designer trained today". The main reason for this, according to Dijon de Moraes (1999, p.135, our translation) is that "[...] part of the problems to be solved were not even mentioned during the years of school education", demonstrating the difficulty of establishing "[...] which teaching plan would be the most appropriate to the schools that teach this craft today, knowing that such activity has been receiving in-



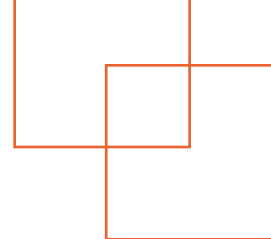
fluences from the constant behavioral, technological and cultural changes of our society" (ibid., p.135, our translation). The author affirms that it is up to the design schools:

"[...] make the students, using previously and strategically established themes, practice a form of projection in which subjective and theoretical approaches prevail as differentiating elements of a project. This should occur until this practice becomes a natural and intrinsic factor of their project process and method. In this way, not only is a feeder of different project factors and aspects being prepared but a thinker for new and different solutions" (ibid., p.155, our translation).

Given the affirmations above, the teaching of product design should seek to be guided towards the construction of knowledge and development of skills and competencies, so that regardless of the type of project, the student can fully and safely fulfill the different steps as, gather and select information in order to understand and interpret the problem and the needs of users/ consumers, generate solutions, and ultimately convert these ideas into products. To this end, Heller and Talarico (2016, apud PEREZ, 2016, p.48) propose that the design teaching that intends to achieve these goals should seek three results: to challenge the student (offering variables and uncertainties to test skills and talents); to educate the student (providing questions to be answered to learn the new, exercising the original); and to elevate the student (confronting success and failure, providing learning in both).

The teaching of product design takes place through disciplines and activities of different content but that complement each other. These distinctions are based on the pedagogical project of each course, on the pedagogical guidelines of the institution and on the methodology employed by the teacher. The Brazilian higher education design institutions are based on the Diretrizes Curriculares Nacionais do Curso de Graduação em Design (National Curriculum Guidelines of the Graduate Course in Design), elaborated by the Câmara de Educação Superior do Conselho Nacional de Educação (Chamber of Higher Education of the National Education Council), to guide the structuring of their curricula. The guidelines also define the competences and skills that the courses should provide, such as creative capacity to propose innovative solutions, systemic vision of the project, mastery of the stages of project development, mastery of the profession's own language, interdisciplinary transit capacity, knowledge of the productive sector and historical and global vision of the activity (BRASIL, 2004).

Tidd et al. (2005 apud POZATTI, BERNARDES & VAN DER LINDEN, 2016, p.33) indicate that "To manage innovation, basic competencies and behaviors are necessary, such as how to plan projects or understand consumer needs" and Casenote and van der Linden (2017b, p.313, our translation),



that "[...] meet demands with radically innovative means and results requires from the current designer's skills to deal with uncertainties and complexities, not always contemplated by their educational path", which shows the need for reflections concerning the definition of approaches in the teaching of product design for the practice of innovation, since "Being at the crossroad of tradition and new possibilities, higher education is challenged to adapt to emerging trends [...]." (ALTBACH, REISBERG & RUMBLEY, 2009 apud LIEM & SIGURJONSSON, 2011, p.194).

4 Proposal of didactic methodology

The objective of this topic is to present the didactic methodology suggested to the educators, which is configured as an adjustable model of contents and procedures for innovative product design classes through the precepts of design-driven innovation and the Innovation Pyramid. To this end, it was based in a basic discipline of Product Design of a graduate course in Design, with 60 total hours per semester, 4 class hours per week, starting from the 3rd period, where the student has completed the study in disciplines that addressed methodologies and processes of product design, and therefore, having the theory of project practice constituted.

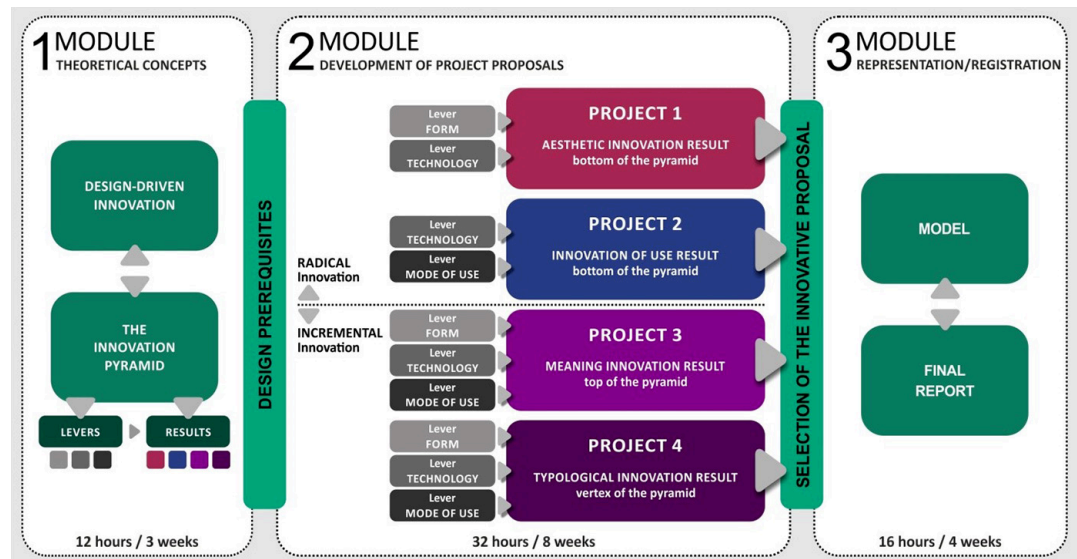
Aiming at the teaching of innovation-oriented product design, the main objective of the discipline should be to stimulate the capacity for innovation, promoting critical design project thinking, by the more articulated understanding of its value in the development of innovative products, contributing to the development of skills and competencies needed. The discipline will approach theoretical and practical contents of design disciplines, with emphasis on understanding the needs of users/consumers and the construction of the model, guided by the concepts of this proposal, such as the development of innovative projects, study of innovative products, and technical principles and applied innovative technologies, through lectures and practices, with presentation and discussion of results.

It is observed, however, that when adapting this model to the activities of a discipline, one must seek coherence through the observation of the capacities, interests, and difficulties of students, verification of time and duration of the activities to achieve the objectives, adaptation of the activities to the available resources, adjustment of the evaluations to the purposes of the teacher and institution and the verification of the possibility of aligning the activities to other disciplines, contributing the most to the student's development and the purposes of the course's pedagogic project.

4.1 Suggested model

The didactic contents and procedures of the discipline were distributed in a structure divided into three modules, interrelated, with the proposition of workload (Figure 2):

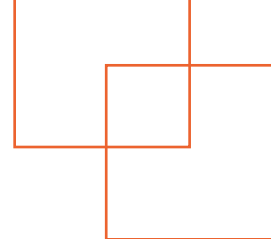
Figure 2: Modules of the suggested application model.



Source: Author.

Module 1: The first meetings will be addressed, by the expository method with the explanation of the content, the concepts of design-driven innovation (VERGANTI, 2013) and the presentation of levers and results of Rampino's studies (2011, 2012), represented in the Innovation Pyramid. This module also addresses the defining elements of projects, requirements, markets, materials and production processes. The participation of students should be stimulated by questions, interpretation, and discussion. Then, students will be presented to products that represent design innovation within the context of levers and results. The discussion of why each product is positioned in each category tends to make the student rationalize on the conceptual constructions. Theoretical support material and product models should be made available to students for further research.

In the next step, students conduct targeted research, seeking examples of products of each result of the Innovation Pyramid, to provide an effective understanding of the concepts, seeking to instigate their curiosity, creativity and investigative capacity. As Rampino's research indicates, the choice should not just be for contemporary products, especially considering products categorized at the top of the pyramid (Meaning and Typological Inno-



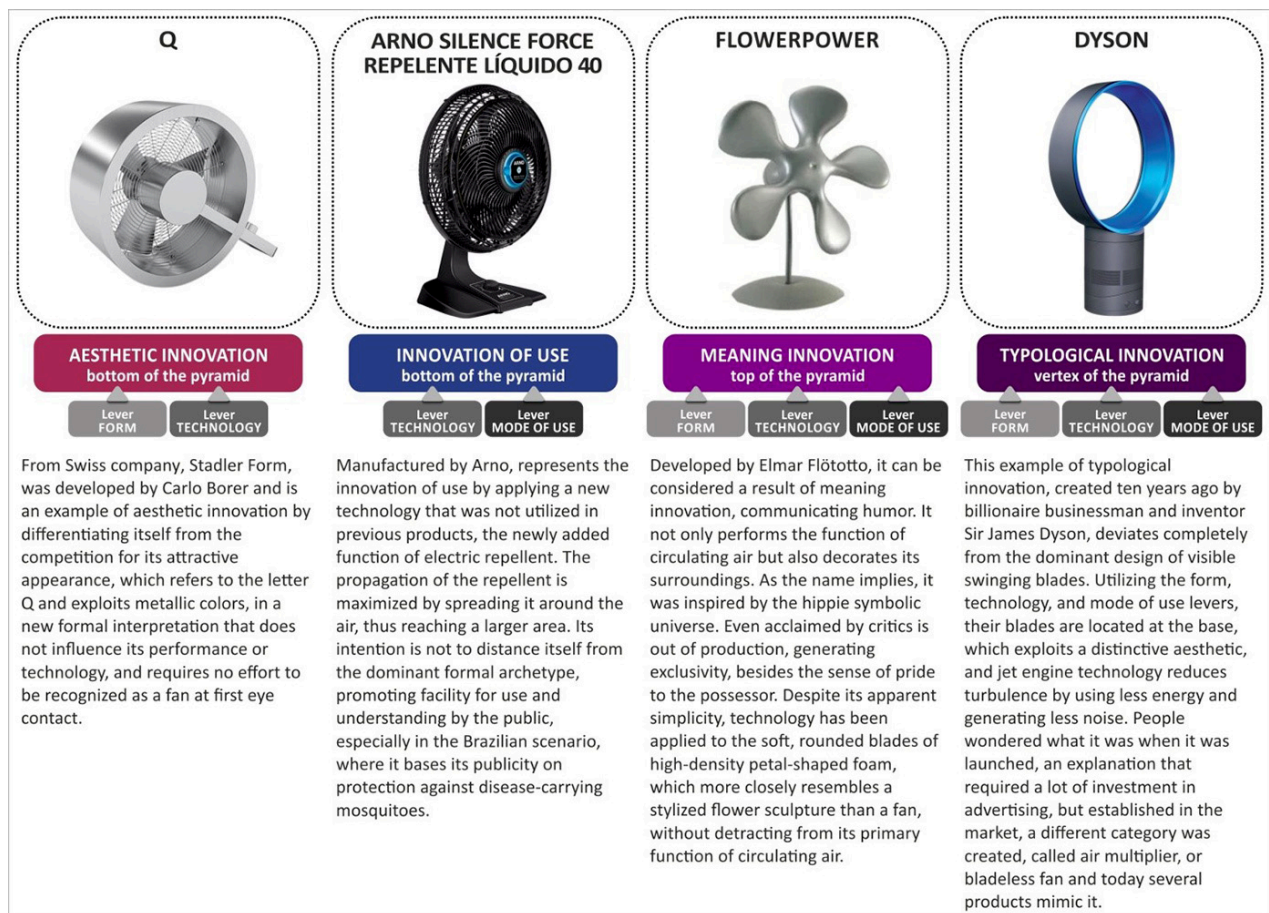
vations), therefore, students can search products that make part of design history. The professor has the opportunity to guide the student to careful exploratory research, so that the acquisition of information is relevant and reliable. The number of products should be evaluated by the professor, but a minimum of eight per student is suggested, two for each innovation result. For better visualization and manipulation, the student should deliver the selected products in printed images, presenting to the group, explaining the reason for each categorization. The group's task will be to evaluate if each product was correctly categorized, and at the end, after correctly grouping the images, it is discussed which pyramid results were more easily found in the market, and which levers were used by the designer to achieve each result, exercising the capacity of organization, investigation, and reflection. Here it is sought the sharing of the perspectives of students and interaction from the exchange of ideas, facilitating the understanding of concepts, making the classes more attractive and stimulating. Another important step to be performed in this module, with the help of the students' examples, is to establish the type of user/consumer profile of each one of the innovation results, where keywords can be established. This can help learners gather the information that will address the design prerequisites in Module 2. But for the research and analysis of products and target costumers to be done within a logical framework, the teacher should provide instructions and guidance in the identification and critical discussion of reference examples, and their users/consumers, precisely because a broad understanding of the levers and results on the part of students should be sought so that the performance of subsequent activities is satisfactory.

Module 2: After the consolidation of the concepts of Module 1, it is proposed that students be asked to choose a product to work on. Learners choose a single product to develop using the levers, deriving four results. The choice of product can be made following the principles of design methodologies or tools, or a specific theme may be suggested, such as ceramics or furniture, depending on the orientation of the discipline. This is the most exciting and demanding stage on the part of the students and the professor. Alternatives can be developed individually or in teams if the number of students permits and/or is the purpose of the discipline. In this module, the student exercises their ability to identify design possibilities, based on user/consumer profile, and the creative ability to propose innovative solutions by consolidating the mastery of the different stages of the development of a project. The project methodology to be used in the discipline should be adapted to the proposal and may be defined by the teacher, or student, according to the objectives.

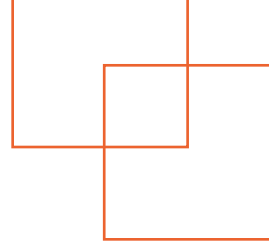
When choosing the product to be developed, the student applies the le-

vers of the Innovation Pyramid, developing a product for each result of the design-driven innovation process, totaling four (Aesthetic, Of Use, Meaning and Typological Innovations), experiencing the concepts presented and discussed in Module 1. Rampino (2012) points out that defining levers as a priority supports design students to define the priorities that the project should seek, and the knowledge they should master to obtain innovation. For these purposes, it is of fundamental importance that the teacher presents the real possibility that the same product category can be developed from the levers and result in four different projects. For didactic purposes, a presentation guide was set (Figure 3), using the table fan category as an example:

Figure 3: Suggested examples of result of the design-driven innovation process, observed in the same product category.



Source: Elaborated by the author, with the products information from the companies websites and images of -
 Q - <https://www.stadlerform.com/en-ch/products/fan/q/information/>;
 Arno Silence Force Repellent Liquid 40 - <https://www.arno.com.br/Ventila%C3%A7%C3%A3o/Ventiladores-repelentes/Silence-Force/Ventilador-Arno-Silence-Force-Repelente-L%C3%ADquido-40cm-Preto-VF55/p/2720011351>;
 Flowerpower - <https://ifworlddesignguide.com/entry/20756-flowerpower>;
 Dyson - <https://www.theguardian.com/technology/2009/oct/13/dyson-fan-green-airblade>



For each result of the design-driven innovation process, it is suggested that the professor instructs the student to evaluate his project alternatives by answering open-ended questions, which will also be useful in evaluating the work of colleagues. We suggest the following questions (Table 1), adapted from Rampino (2011, 2012):

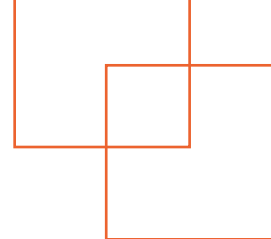
Table 1: Open-ended project questions for each result of design-driven innovation.

Aesthetic Innovation	<p>.....</p> <p>In terms of product appearance, is it near to the dominant morphological archetype?</p> <p>Is the product easily recognizable?</p> <p>How do you evaluate the appearance of this product in terms of attractiveness?</p>
Innovation of Use	<p>.....</p> <p>Is the product intuitive to use?</p> <p>Are functions and mode of use explicit?</p> <p>Does the product introduce new functions that improve or modify its use compared to others in the same category?</p>
Meaning Innovation	<p>.....</p> <p>Does the product have emotional appeal?</p> <p>Can the product be defined as a status-symbol?</p> <p>Does the product tell a story, communicate something?</p>
Typological Innovation	<p>.....</p> <p>At what level is the product far from the dominant morphological archetype?</p> <p>Can it be considered highly unusual?</p> <p>Would the user/consumer struggle to map it in the existing category for which it was projected?</p>

Source: Prepared by the author adapted from Rampino (2011, 2012).

For the conception stage, as a way of making the classes more productive, the preliminary results can be shared with the team, thus increasing the perceptions, verifying if the product can really be characterized in the proposed innovation result, helping in the choice of alternatives. This collaborative practice of evaluation makes the students realize that evaluating and being evaluated is part of the learning process, and the critical involvement of students in the presentation and evaluation should be sought, to provide interaction and exchange of experiences, socialization, confrontation between proposals and consolidation of the understanding of concepts in a more meaningful way, fostering cooperative learning, simulating to students discussions that in the future will be held in teams, companies or design offices, increasing their confidence, autonomy, leadership capacity, and enrichment of their technical vocabulary.

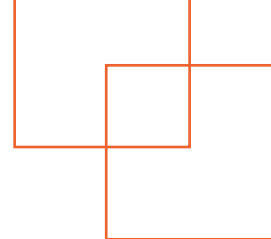
In this module, the main objective is to conceptually develop innovative products, therefore criteria such as technical and economic feasibility are not going to be analyzed, being left to the next module. It is suggested that 2 weeks/8 hours be used for the development of each of the four projects, adjusting the assessment activities according to the teacher's intention, at the end of the 32 hours, or also at the conception phase. Aiming at mini-



mizing the degree of complexity, given the little time available to achieve the objectives of the module, students can finish their proposals only with clear graphic representations, through sketches, exploratory and schematic drawings, that help them to communicate the results to the group, providing the development of one of the types of skills of the designer, according to Mozota, Klöpsch and Costa (2011), of synthesis of concepts, visualization, analysis, and prioritization. The presentation of these proposals should become the assessment component in this module in a discipline of 60 hours, however, if the discipline to be applied has more time, it is suggested that students explore more technical drawings. The student can be evaluated by the presentation of the proposals and their suitability to the theme, by constructive involvement in the evaluation of the proposals of colleagues and also, if necessary, through a descriptive report of each project, where the student should justify their proposals based on the levers and results of innovation.

Module 3: In the last stage, students should choose, among the proposals they presented for each result of the pyramid, one to apply the knowledge and techniques of model building, through the materialization of the product defined, serving to verify if the solution meets the objectives. Choosing a type of three-dimensional representation, such as mock-up, presentation model, shape model, experimental prototype or test (BAXTER, 2000), requires the teacher to evaluate the available resources like time and structure for manufacturing. The choice of the representation should also be based on the degree of complexity of the products and the objectives of the discipline. In this module, the teacher has the opportunity to teach about the fundamentals of materials, technologies, and components. Barbosa Filho (2009, p.75) stresses its importance given that "[...] for each function to be performed by a part or component we will have an associated concept and that, thus, the set of these concepts will configure the achievement of the macro concept of the product under development".

For evaluation purposes at the end of the discipline, in addition to the model, the students must prepare a report of registration of their project proposal. The report must detail the development process and the representation of the alternative in technical and constructive details, seeking to identify the positive and negative points with suggestions for improvement, with the pedagogical objective of promoting the ability to interpret and represent the design projects, developing capacity for critical argumentation and evaluation, and the ability to synthesize ideas through writing and drawing. Within the scope of the application of this study, it is essential that in this final report the students elucidates which levers were used to arrive at the



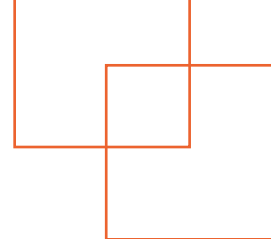
result, in which category of result of the design-driven innovation process the product fits, and why. Depending on the available time, methodology and didactic evaluation, the teacher may request that each student present the product to the group, that may evaluate the proposal together with the teacher, as oriented in Module 2.

5 Conclusion and developments

This article reinforced the statement that the constant challenge of design educators is to provide a comprehensive understanding of the social transformations that are reflected in design problems, so that the student is open and safe to consider different profiles and contemporary scenarios, and proves to be fundamental discussions about the education of the future designer that inquire whether they are being capacitated for innovation. It is also clear that the incorporation of approaches to design-driven innovation can contribute to broader perspectives throughout design practice. In this sense, if the teacher proposes to assist in the development of the skills and competences of students with a focus on innovation, it is clear the need to reorganize didactic methodology strategies that offer students an environment of experimentation, motivation, stimulation of creativity and divergent thinking, offering concrete possibilities for the practical application of theoretical concepts.

Throughout the development of the proposal, it became evident the potential for use of Rampino's research for teaching design focused on the development of innovative products. The great challenge proposed, however, was to synthesize its application in a 60 total hours per semester discipline, where normally only one product is developed, to reach its full potential, applying the concepts of levers and results in four different products from the same product category. The result reaches its objectives, foreseeing the possibility of application, in a way that does not damage the development of the discipline and educational objectives yet bringing new perspectives.

This approach aimed at providing teachers means to support students in understanding the concepts of design-driven innovation and the Innovation Pyramid, in parallel to the development of skills and competencies that provide the basis for project decisions in the exercise of their profession. And although this didactic methodology has been proposed for a specific discipline, it is expected that through its use, students will transfer this knowledge to future activities, strengthening the ability to face problems in design situations. It is expected, therefore, that the detailing of the proposal helps in the performance of teachers, as well as favoring the discussion of studies on



the relationships between innovation and product development in design education, and new didactic methodologies with objectives of innovation, giving a basis for the deepen and expansion of research.

The subsequent step to this work will be the study of the application of this didactic methodology in the discipline Laboratório de Equipamentos (Equipment Laboratory), of the course of Industrial Design of UFSM through a case study to validate the proposal. The discipline in question has 120 total hours per semester, and it is intended to apply the proposal in the first 60 hours, and in the rest, it will be addressed the content that involves the acquisition of new specific technical knowledge.

REFERENCES

BARBOSA FILHO, Antonio Nunes. **Projeto e desenvolvimento de produtos**. São Paulo: Atlas, 2009.

BRASIL. Ministério da Educação. Conselho Nacional de Educação Câmara de Educação Superior. **Resolução CNE/CES nº 5, de 8 de março de 2004**. Disponível em: http://portal.mec.gov.br/cne/arquivos/pdf/rces05_04.pdf. Acesso em: 20 set. 2019.

BAXTER, Mike. **Projeto de produto: guia prático para o design de novos produtos**. 2.ed. São Paulo: Blücher, 2000.

CASENOTE, Igor Escalante; VAN DER LINDEN, Júlio Carlos de Souza. Front-end em três etapas: proposta de modelo para estruturação do processo de captação de oportunidades no design de novos produtos orientados para a inovação. p.194-214. In: **Estudos em Design**. v.25, n.2, 2017a. Disponível em: <https://estudosemdesign.emnuvens.com.br/design/article/view/491>. Acesso em: 18 set. 2019.

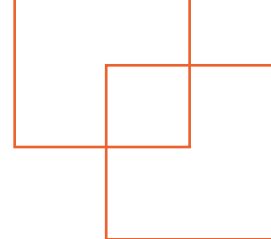
CASENOTE, Igor Escalante; VAN DER LINDEN, Júlio Carlos de Souza. Desenvolvimento de competências em design para inovação: um modelo conceitual para a educação de novos designers. p.313-329. In: **Educação Gráfica**. v. 21, n. 2, 2017b. Disponível em: <https://www.lume.ufrgs.br/bitstream/handle/10183/168905/001048938.pdf?sequence=1>. Acesso em: 18 set. 2019.

DIAS, Maria Regina Á. C.; GONTIJO, Leila Amaral. Interdisciplinaridade no Ensino do Design. p.49-66. In: **Revista Design em Foco**, Salvador: EDUNEB, v.3, n.2, 2006.

HSUAN-AN, Tai. **Sementes do cerrado e design contemporâneo**. Goiânia: Ed. da UCG, 2002.

HSUAN-AN, Tai. **Design: conceitos e métodos**. São Paulo: Blucher, 2017.

LIEM, André; SIGURJONSSON, Johannes B. Adapting industrial design education to future challenges of higher education. p.194-204, 2011, Lyngby



/Copenhagen. In: **Proceedings of the 18th International Conference on Engineering Design (ICED 11)**, v.8.

MORAES, Dijon de. **Limites do design**. 2.ed. São Paulo: Studio Nobel, 1999.

MORAES, Dijon de. **Metaprojeto: o design do design**. São Paulo: Blücher, 2010.

MOZOTA, Brigitte Borja de; KLÖPSCH, Cássia; COSTA, Felipe C. Xavier da. **Gestão do design: usando o design para construir valor de marca e inovação corporativa**. Porto Alegre: Bookman, 2011.

NORMAN, Donald A.; VERGANTI, Roberto. Incremental and radical innovation: design research versus technology and meaning change. p.78-96. In: **Design Issues**, v.30, n.1, 2014. Disponível em: https://www.mitpressjournals.org/doi/10.1162/DESI_a_00250. Acesso em: 15 set. 2019.

PEREZ, Iana Uliana. Projetos de aprendizagem no ensino de design. p.43-51, 2016, Curitiba. In: BECCARI, Marcos N.; MACHADO, Carolina Calomeno (Eds.). **Seminários sobre ensino em design**, v.2 n.10. São Paulo: Blücher, 2016. Disponível em: <https://www.proceedings.blucher.com.br/article-details/projetos-de-aprendizagem-no-ensino-de-design-24230>. Acesso em: 20 set. 2019.

POZATTI, Melissa; BERNARDES, Maurício M. S.; VAN DER LINDEN, Júlio C. de S. Avaliação de soluções geradas a partir de métodos de design voltados para a inovação. p.31-43, 2016, Porto Alegre. In: **Design e Tecnologia**. v.6, n.12. Disponível em: <https://www.ufrgs.br/det/index.php/det/article/view/382/179>. Acesso em: 20 set. 2019.

RAMPINO, Lucia. The innovation pyramid: a categorization of the innovation phenomenon in the product-design field. p.3-16. In: **International Journal of Design**, v.5, n.1, 2011. Disponível em: <http://www.ijdesign.org/index.php/IJDesign/article/view/645/325>. Acesso em: 15 set. 2019.

RAMPINO, Lucia. **Dare forma e senso ai prodotti: il contributo del design ai processi d'innovazione**. Milano: Francoangeli, 2012.

VERGANTI, Roberto. **Design-driven innovation: changing the rules of competition by radically innovating what things mean**. Boston: Harvard Business School Publishing, 2009.

VERGANTI, Roberto. **Design-driven Innovation: cambiare le regole della competizione innovando radicalmente il significato dei prodotti e dei servizi**. Traduzione di Francesca Piccinali. Parma: Rizzoli Etas, 2013.

VERGANTI, Roberto; ÖBERG, Åsa. Interpreting and envisioning: a hermeneutic framework to look at radical innovation of meanings. p.86-95. In: **Industrial Marketing Management**, v.42, n.1, 2013. Disponível em: <https://asaoberg.se/wp-content/uploads/2019/02/4-Interpreting-and-envisioning-%C3%96berg-Verganti-2013-IMM.pdf>. Acesso em 15 set. 2019.

Ronaldo Martins Glufke

Ronaldo Martins Glufke é professor titular do curso de graduação em Desenho Industrial da Universidade Federal de Santa Maria - UFSM, desde 2009. É chefe do Departamento de Desenho Industrial e professor do Curso de Especialização em Design de Superfície - PGDS, da mesma universidade. Possui título de PhD em Design pela Università degli Studi di Firenze - UniFI, Florença, Itália (2017), onde realizou pesquisa sobre modelos de formação e capacitação de designers para setores produtivos, com aplicação nos territórios do Brasil e da Itália, com foco em design-driven.

Possui mestrado em Design e Expressão Gráfica pela Universidade Federal de Santa Catarina - UFSC (2008), especialização em Design Gráfico e Estratégia Corporativa pela Universidade do Vale do Itajaí - UNIVALI (2004) e graduação em Design Industrial pela mesma instituição (2003). Antes de ingressar na UFSM, foi por 11 anos designer da Portobello/SA, indústria de revestimentos cerâmicos localizada em Tijucas, SC, onde atuou como coordenador da equipe de design, tendo um produto premiado em 2008 no iF Design Award, em Hannover. Tem experiência nas áreas de Design de Produto, Design-driven Innovation, Design e Formação, Design de Superfície e Design de Revestimentos Cerâmicos.

Recebido em: novembro, 2019.

Aceito em: dezembro, 2019.