THE ENVIRONMENTAL DIMENSION IN NEW PRODUCTS DESIGN - EDUCATIONAL TRAINING IN INDUSTRIAL DESIGN

A DIMENSÃO AMBIENTAL NO PROJETO DE NOVOS PRODUTOS – FORMAÇÃO EDUCACIONAL NO DESIGN INDUSTRIAL

LA DIMENSIÓN MEDIOAMBIENTAL EN EL DISEÑO DE NUEVOS PRODUCTOS - FORMACIÓN EDUCATIVA EN DISEÑO INDUSTRIAL

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ABSTRACT

EIndustrial design (product) was one of the most impacted professions by the changes imposed by the insertion of the environmental issue in the project. Initially contemplated in the so-called eco-design, industrial design activities underwent adjustments and improvements. These result in an expanded vision, contemplating the modern vision of sustainability, in its economic, social, and environmental dimensions. The teaching and academic applications of design in the research and extension spheres were consequently altered, demanding complementary visions throughout the process, including the PPCs of the courses and the qualification needs of the faculty. The article presents models of project processes and reflects on the need to insert sustainability issues in project teaching.

KEYWORDS

Product and industrial design; Design methods; Design Education

RESUMO

O design industrial (produto) foi uma das profissões mais impactadas pelas modificações impostas pela inserção da questão ambiental no projeto. Inicialmente contemplada no chamado eco-design, as atividades de design industrial passaram por ajustes e aprimoramentos. Destes, resulta uma visão ampliada, contemplando a visão moderna de sustentabilidade, em suas dimensões econômica, social e ambiental. O ensino e aplicações acadêmicas do design nas esferas de pesquisa e extensão foram consequentemente alterados, demandando visões complementares em todo processo, incluindo os PPCs dos cursos e necessidades de qualificações do corpo docente. O artigo apresenta modelos de processos de projeto e faz uma reflexão para a necessidade da inserção de questões de sustentabilidade no ensino de projeto.

PALAVRAS-CHAVE

Design de produto e industrial; Métodos de design; Ensino de Design

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RESUMEN

El diseño industrial (de productos) ha sido una de las profesiones más afectadas por los cambios impuestos por la inclusión de las cuestiones medioambientales en el diseño. Inicialmente abarcadas por el llamado ecodiseño, las actividades del diseño industrial han experimentado ajustes y mejoras. Éstas han dado lugar a una visión ampliada, que tiene en cuenta la visión moderna de la sostenibilidad en sus dimensiones económica, social y medioambiental. La enseñanza y las aplicaciones académicas del diseño en las esferas de la investigación y la extensión se han visto consecuentemente alteradas, exigiendo visiones complementarias en todo el proceso, incluyendo los PPC de los cursos y las necesidades de cualificación del profesorado. El artículo presenta modelos de procesos de diseño y reflexiona sobre la necesidad de incluir cuestiones de sostenibilidad en la enseñanza del diseño.

PALABRAS CLAVE

Diseño industrial y de productos; Métodos de diseño; Enseñanza del diseño

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1. INTRODUCTION

A project is defined as a complex activity that involves a reflective action of thought (abstract), a creative dimension, and the materialization of the result (concrete), requiring multidisciplinary knowledge to equate all the factors involved in the creation of a product/artifact that aims to meet the needs of users. Starting from the question that there are still conceptual conflicts, in this article, project will be treated as synonymous with design, and product will be addressed broadly, as defined by Kotler and Armstrong (2015), who state that a product is something that can be offered to a market to satisfy a need or desire, and that it can be tangible or intangible, for organizations or consumers.

Although this broader definition is used in the field of administration and business, in the intention of discussion proposed here it is more appropriate, according to the objectives outlined, encompassing sustainability as a guiding factor.

In the 1970s, Papanek (1977) was the precursor who questioned the profession of designer in the way he presented himself and already demanded an environmental, moral, and social responsibility on the part of this professional. He argued that in an era of mass production, design had become a powerful tool in the configuration of man's tools and environments and emphasized the importance of understanding the basic needs of human beings and their relationship with design.

The author also stated that it was necessary to design within a social context. Its role was to demand greater engagement from designers and, above all, the creation of a design to meet social needs.

Thackara also points out design and its alternatives for a complex world. The author points out that currently many designers are already designing services and systems that are visibly less harmful to the environment and more socially responsible, but emphasizes the need for change, proposing a paradigm shift: 'In this new era of collaborative innovation, designers are having to evolve from individual authors of objects to facilitators of change among large groups of people' (THACKARA, 2008, p. 21).

Thus, it is observed that design for sustainability must be carried out collaboratively and must seek to work under the three levels of sustainable development: be economic, not harmful to the environment, and accessible to all. As already highlighted, much has already been done on this aspect, but it is necessary to consider that we still live in an economy of consumer politics, in a world with enormous social inequalities. With this, the power that design exerts over people can be considered both surprising and shrewd, making us accomplices of this accentuated consumerism.

Manzini and Vezzoli (2008) include the precepts of sustainability in design when they stated that product design should be understood according to its broad and current meaning, not applying only to the physical product (defined by material, form, and function), but extending to the system – product, that is, to the integrated set of product, service, and communication. Within this line of thought, the authors highlighted that the project is the activity that should "link" the technically possible with the ecologically necessary acting within four levels of interference: environmental redesign of existing products; design of new products to replace current ones; design of new products – intrinsically sustainable services; and proposal of new scenarios for a new sustainable lifestyle.

Santos and others (2018) show that even with the conceptual evolution of the period from 2008 to 2018 (date of the two publications mentioned), the professional performance of people related to the project areas still occurs, in most cases, in the first two levels. Although this was relevant to the maturation of the theme in the area, nowadays, it is insufficient to achieve environmental sustainability, guaranteed only by the other two levels (Design for Sustainability). Therefore, there is still a need for behavioral change in the project activity, focusing on paradigm shifts every time a new product is designed.

In this case, the project encompassing the precepts of sustainability becomes the most relevant possible solution for the union between the philosophy of continuous improvement (kaizen) with the increasing need to preserve natural resources, human quality of life, and current capitalism. The understanding of this was so impactful that the UN established, in 2015, the 17 Sustainable Development Goals (SDGs), with measurable effectiveness plans for the year 2030, wherein a reinterpretation of the principles of total quality, something like a PDCA (Plan, Do, Check and Action) will be rotated on each of the SDGs (and its 169 goals).

This article aims to study the evolution of environmental issues in the design process of product and industrial design based on design methodologies traditionally used in undergraduate courses in Product Design and Industrial Design.

2. BACKGROUND /CONCEPTUAL DISCUSSION

The design has undergone many modifications in its design form over the years. As projects become more complex and with several factors to be met, the design processes have also been improved, with the inclusion of new requirements and new concepts. The extremely sequential view of the first methods falls heavily on the very classical definition of the word project, from the Aurélio Dictionary online, and originated from the Latin project, which means "launched ahead" and denotes the "idea that is formed to execute or accomplish something in the future; plan, intent, design".

The study of design methods has become increasingly detailed in design, such as Löback's definition of design (2001, p. 16): "[...] an idea, a project or a plan for the solution of a given problem". The author presents its basis for the configuration of industrial products, and addresses aspects such as categories of industrial products, product functions (practical, aesthetic, and symbolic), and describes the design process in four main phases: problem analysis, generation of alternatives, evaluation of alternatives and solution of the problem.

Munari (1998) is another example of a sequential method widely used in design from the 1990s to 2000s. It presents the advantages of being suitable for beginners and to have a language that is easy to understand. However, it is considered a superficial method and does not conveniently address market, management, ergonomics, strategy, and environmental issues. Figure 1 illustrates the design method of Munari (1998)

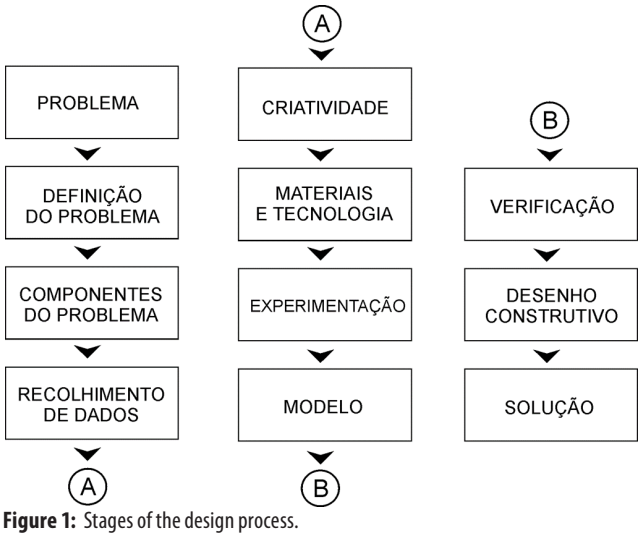

Figure 1: Stages of the design process.
Source: Munari (1998).

When studying the design methods used in the early 2000s in undergraduate design courses, it is noted that in addition to Löbach, several other authors were used. The design process was considered "closed", with the designers initiating a stage only after the completion of the previous stage.

Strunk (2001, p. 15) when referring to the activity of a designer states: "[...] our language is rich, but unfortunately there is no word that translates exactly what we do. Our mission is related to the conception, to the creation of concepts that, once formalized, can make information circulate as effectively as possible, and this without giving up the aesthetic pleasure that is proper to human beings".

Baxter (2000) – another well-known author, stated that the development activities of a new product require research, careful planning, meticulous control, and the use of systematic methods, requiring an interdisciplinary approach (marketing activities, product and process engineering, application of knowledge about aesthetics and style, etc.). Figure 2 illustrates the methodological procedures for the development of Baxter's products (2000).

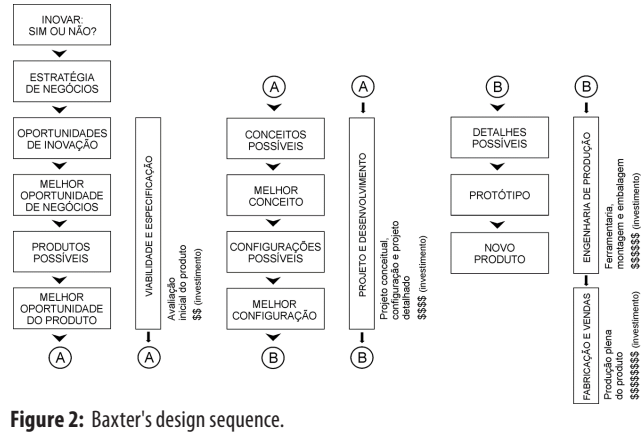

Figure 2: Baxter's design sequence.
Source: Baxter (2000).

It is observed that both also did not address, even superficially, the environmental issue in product development. The concept of conceptual design was widely used in the 1990s-2000s in design schools. It was created by Pahl and Beitz, and through the translation of Baxter's book by Itiro Iida, it came to govern the entire study of project methods in design.

As a broadly interdisciplinary activity, project methods have become the subject of research in fields other than design. Product engineering and production areas have also developed project methods but are still working in a Cartesian way. Two of these methods that can be mentioned here are those developed by Back et al. (2008) and Rosenfeld et al. (2006).

In the case proposed by Back (1983), there are the "phases of the design of industrial products". From this point,

it was already clear that some methods focus more on a given point, others on another; however, with a greater or lesser degree of depth, all encompassed: feasibility study, preliminary design, detailed design, review and testing, production planning, market planning, planning for consumption and maintenance and obsolescence planning. In this last item, some points began to appear very timidly concerning eco-design, very concentrated still only on the issue of component reduction and recycling.

However, although the detailing steps provided very precise technical identifications, there was no step (for instance) that led the designer (or project team) to establish correlations between the environmental, economic, ergonomic, market, manufacturing, and aesthetic variables; in addition to the aforementioned problem of being sequential, inducing non-return to previous steps.

Santos (2005) began the process of transitioning to what is known as the open project method. He concluded, based on applied studies with classes of industrial design students, that the project methods commonly used in design education did not adequately meet the National Curriculum Guidelines. This happened, according to the author, because they did not stimulate the development of certain skills and competencies that a professional in this area should present.

Thus, Santos (2005) proposed the MD3E – 3-Step Deployment Method, where the design problem is being treated radially. In this type of deployment, it is no longer necessary for one stage to end to start another, and the design process becomes more inclusive, interdisciplinary, and fast. Figure 3 shows MD3E in its original form (on the left) and in its application form via software (on the right).

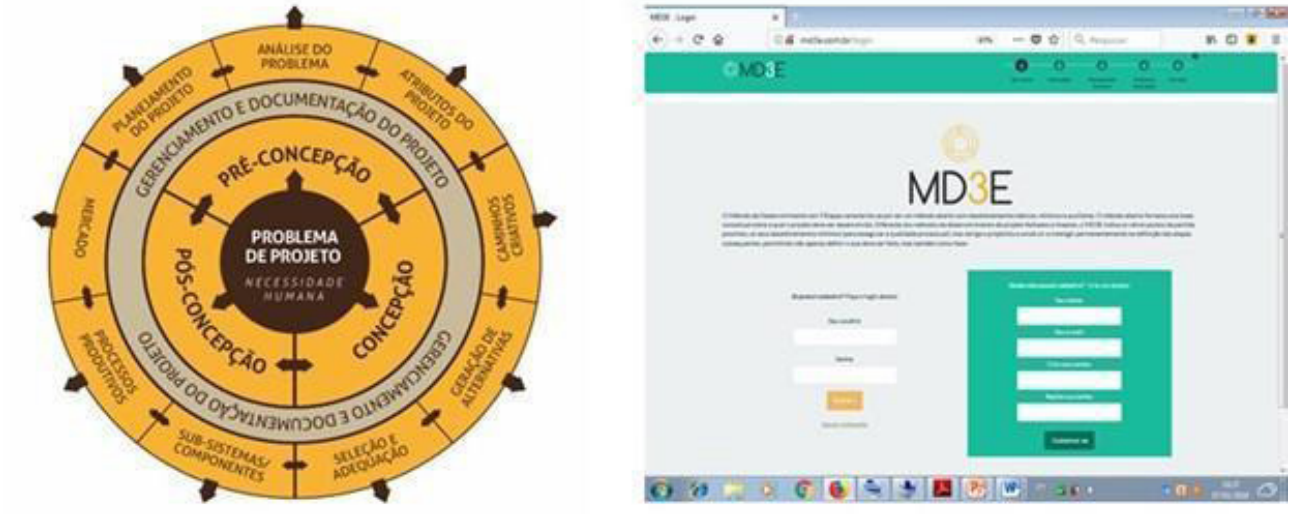

Figure 3: 3-Step Deployment Method.
Source: Santos (2005 and 2017).

In summary, the method of Santos (2017) allows greater freedom for the project team, while other methods, such as those mentioned above, have a more traditional and systematic structure. Due to the current curricular structure of design courses, the choice of an "open" or "semi-open" method allows material choices, for example, to be made in several stages, and the issue of sustainability is linked to materials. Ferroli and Librelotto (2023) use these concepts to show that materials in a design process involve two steps: Choice and Selection of Materials. This does not happen in closed methods, often leading to erroneous choices.

The design student must understand that the project encompassing the precepts of sustainability is the solution to combine continuous improvement with the increasing need to preserve natural resources, human quality of life, and current capitalism. This goes beyond the internal classroom activity.

In 2005, after a case study of the design process in eleven large companies such as Alessi, Sony, and Xerox, among others. The Design Council concluded that designers' processes have common similarities and approaches. Thus, they propose a simple four-step diagram called the double diamond model or double diamond, as shown in Figure 4.

In 2008, in the Harvard Business Review, Tim Brown of IDEO presented the term "design thinking" not as a project process but as a thinking attitude towards innovation.

The design thinking process has three phases: 1. Inspiration, where a problem or a need is analyzed by observing extreme target audiences (children, adults) identifying an opportunity, the data collected is synthesized

through insights, tell stories; 2. Ideation, which has stages of creativity, production of drawings, models, and tests. At this stage, the author recommends internal communication between the team; 3. Implementation, which covers the production and placing on the market of the product or service. Figure 5 shows the design thinking scheme that has become widely disseminated in several bibliographies.

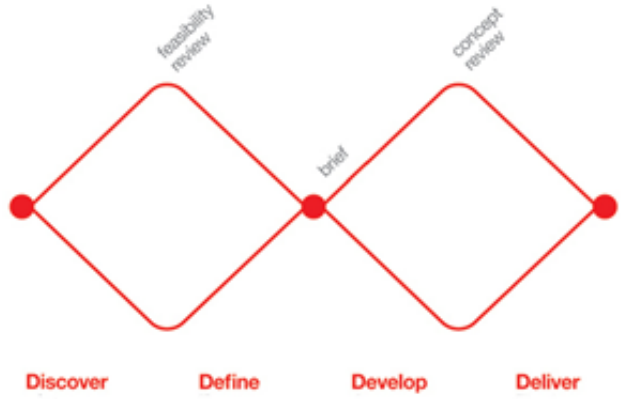

Figure 4: Double Diamond Model.
Source: Adapted from Design Council 2005.

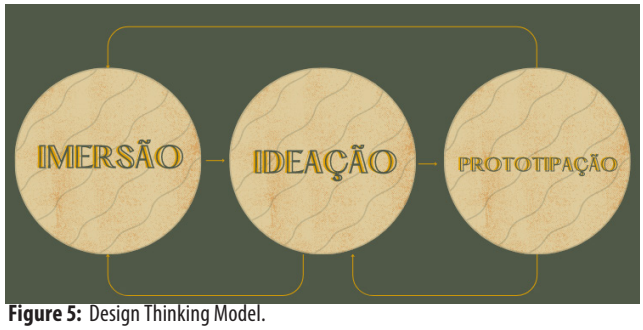

Figure 5: Design Thinking Model.
Source: Adapted from Brown (2008).

Pazmino (2013) presents a mixed project structure relating to a cyclical process planning, informational design, conceptual design, preliminary design, and detailed design, as illustrated in Figure 6.

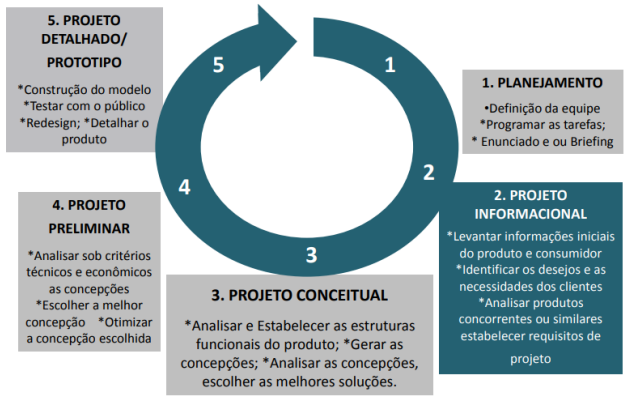

Figure 6: Mixed Project Structure.
Source: Pazmino (2013).

According to Pazmino (2013), the environmental issue is addressed in this proposal in the definition of project requirements, that is, in the informational or immersion project. This detail shows the main difference between traditional and new (open) methods. Both Santos (2017) and Pazmino (2013) provided the inclusion of environmental issues more clearly, taking as a precursor what was proposed by Rosenfeld and others (2016), specifically in what the authors called PDP - Product Development Process. As can be seen in Figure 7, it can be noted that the system is sequential, but unlike the closed methods, it allows a return to the previous steps to correct or modify decisions previously made.

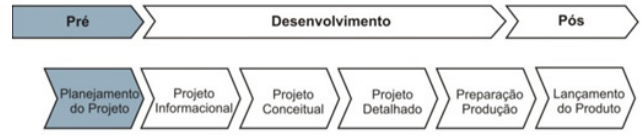

Figure 7: PDP - Product Development Process.
Source: Adapted from Rosenfeld et al (2006).

Figure 8 better explains this moment of transition. Part A shows the PDCA cycle, a tool commonly used in the 1980s in the industrial/manufacturing context to meet the growth of interest in the search for total quality, which served as a conceptual basis to demonstrate the need to become more "open" to project methods. Rosenfeld et al. (2006) explain this throughout the details of the phases that follow: informational design, conceptual design, detailed design, production preparation, and product launch, explaining, as can be seen in part B of the figure, that as the degree of uncertainty decreases, and consequently also causes a reduction in the number of choices, on the other hand, there is a large increase in the cost part, as time passes. Evidently, the exchange of materials and all the change that comes with it (machines, manufacturing processes, molds, productivity, etc.) is the crux of this problem.

Seraphim et al. (2019) deliver a study presenting the BIOS method, a tool for developing sustainable biomimetic products. With the natural union of Design with Biology, working in an integrated approach to the Product Development Process, the authors concluded that the application of the tool and the technological innovations resulting from this application may contribute to the reduction of negative impacts on the environment when compared to similar products on the market.

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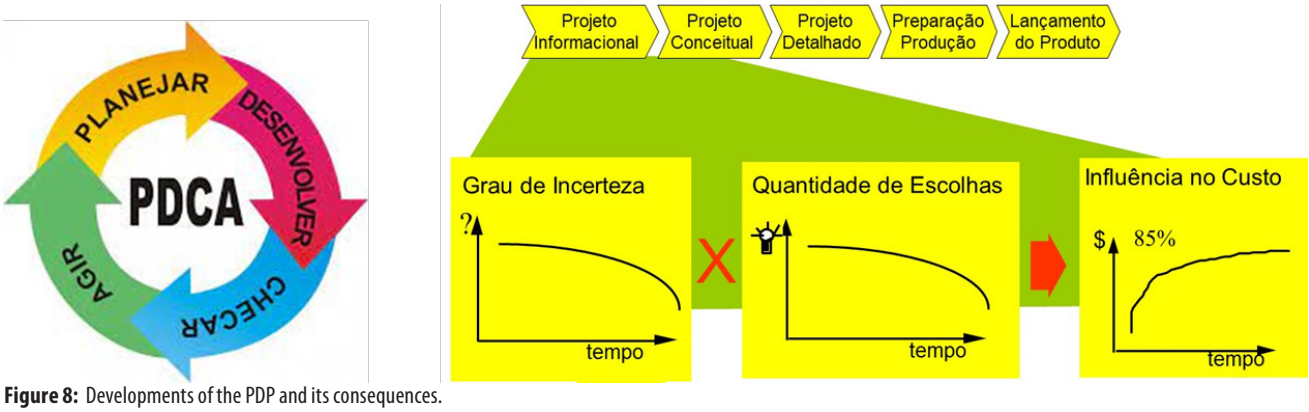

Figure 8: Developments of the PDP and its consequences.
Source: Adapted from Rosenfeld et al (2006).

When relating the proposal to that proposed by Rozenfeld et al. (2006), the structure is presented as shown in Figure 9. The proposed method can apply the biomimetic concepts to the Integrated Product Development Process (IPDP) and, according to the authors, it allowed to achieve promising results within the precepts of sustainability, assisting Engineering and Design professionals in the generation of ideas through the concepts of Biomimetics, contributing to the development of environmentally friendly products. In this way, the BIOS can serve as an easy guidance tool for generating viable solutions and alternatives, enabling the understanding of the universe of biomimicry and its paths to bioinspiration.

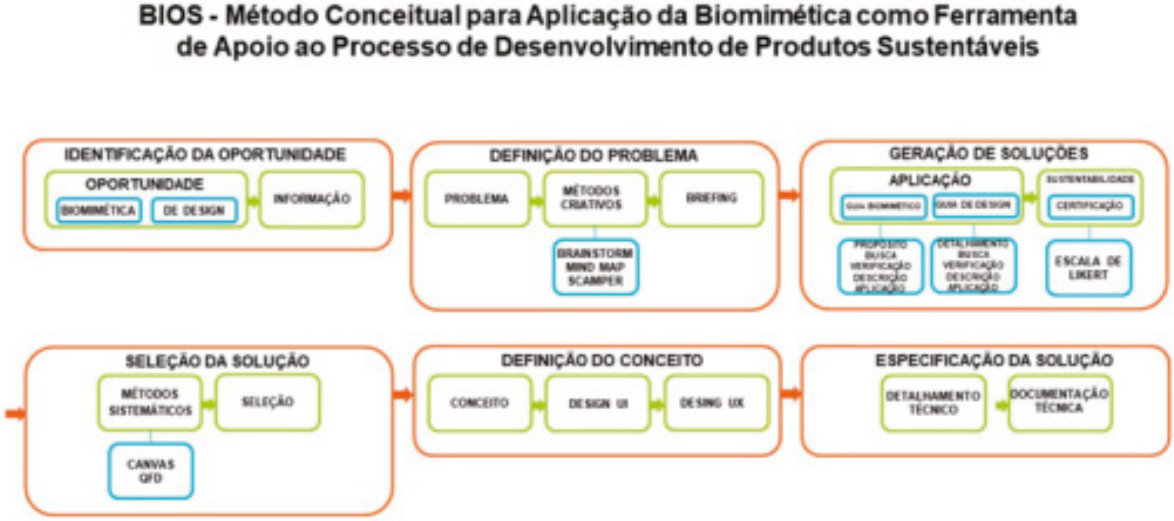

Figure 9: Developments of the PDP and its consequences.
Source: Adapted from Rosenfeld et al (2006).

The methods presented show the variety of design processes used in the teaching and practice of product design development. Environmental and social concern could be inserted in any of them. For this, as mentioned by Pazmino and Santos (2017) in design courses, it is necessary that the cross-cutting theme of sustainability integrates content from the course subjects, allowing the student to develop a broad view of the relationship between environment, user, and product and a holistic view of current problems that affect society, sensitizing them to the most relevant issues regarding ethical and socio-environmental responsibility in the development of their professional activities. It will also allow one to form a code of conduct to be a critical, active, and reflective citizen on topics regarding different dimensions of sustainability.

In the project subjects, it is up to the teacher to direct related themes and throughout the project to apply environmental guidelines that consider the life cycle so that the subjects of the curriculum matrix can insert into their contents the low-impact materials, the references of bionics and biomimicry. Adapt project models to social and environmental approach.

Balbio et al. (2019) associate biomimicry with initiatives to reduce or even replace the consumption of petroleum-derived plastics in various industrial segments, especially with the incorporation of biopolymers (bioplastics),

which, unlike synthetic polymers, derived from petrochemical hydrocarbons, are generated from renewable raw materials.

Despite the significant advances in recent years, and their increasing connection with design, specifically with studies focused on biomimicry, biopolymers still have certain considerations regarding their use, which require studies. Among these, we can emphasize the use of certain foods (potatoes and corn mainly) and the cost that this implies, even using the soil for generating raw materials. These two factors combined create resistance in the food (supply) sector and concern about food generation for an increasing population. There is also some technological resistance to the transformation of these materials.

3. CONCLUSION

Reflections on the relationship between design action and project processes, as well as sustainability issues, should be present in design education from the early stages and permeate the curriculum of the courses, as well as for more open, flexible processes to be used in design disciplines, allowing the insertion of environmental and social criteria.

Throughout the history of designing and industrial design, the concern has been to reduce costs, maximize profits, and improve quality. However, both the increase in products as well as the projected and perceived obsolescence have created an amount of polymer, electronic, non-recyclable waste that has given its name to this era of Anthropocene.

It is necessary to question and insert knowledge in the training of future designers so that they are responsible and creators of appropriate solutions for society and the environment.

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CRediT Taxonomy (http://credit.niso.org/)

PCMF: conceituação, análise formal, aquisição de financiamento, investigação, metodologia, administração de projetos, visualização, escrita - rascunho original, escrita - revisão & edição.

LIL: conceituação, análise formal, aquisição de financiamento, investigação, metodologia, administração de projetos, visualização, escrita - rascunho original, escrita - revisão & edição.

AVP: conceituação, análise formal, investigação, metodologia, escrita- revisão & edição.

LLOP: escrita - revisão & edição.

Conflict declaration: nothing has been declared.