 DOI: 10.32870/zcr.v8i15.222 ISSN: 2448-8437

Evaluating design products: four categories for their comprehensive analysis and evaluation

Evaluar productos de diseño: cuatro categorías para su análisis y evaluación integral

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Received: November 8, 2023
Approved: February 8, 2024
Published: March 26, 2024

Abstract

Design is present in our daily lives. We live surrounded by a sea of both material and immaterial products that are the result of a design process. Even though these objects have a strong impact on the social, environmental, and individual environments, there are currently no strategies that allow design products to be evaluated in a systematic, objective, and comprehensive manner. In this work, we propose a classification of four categories of analysis for this assignment: evaluate the *design object* in terms of its functionality, performance, efficiency, and innovation; evaluate the *user experience* in terms of usability, aesthetics, and symbolic experience; evaluate your environmental *impact* in terms of the carbon footprint, as well as waste production, energy consumption, and non-renewable resources; and evaluate the *social and cultural impact* of design in terms of its relevance and contribution. The ideas presented arise from the analysis and collective reflection of three sources: academic and personal experience on the problem, a review of specialized literature, and the valuable contribution of anonymous reviewers.

Keywords: User experience, sustainable design, social design, design evaluation, social innovation.

Resumen

El Diseño está presente en nuestra cotidianidad. Vivimos rodeados de un mar de productos materiales e inmateriales que son resultado de un proceso de diseño. Aun cuando dichos objetos tienen un fuerte impacto en el entorno social, ambiental e individual, no existen por ahora estrategias que permitan evaluar los productos de diseño de manera sistemática, objetiva e integral. En este trabajo proponemos una clasificación de cuatro categorías de análisis para dicha encomienda: evaluar el objeto de Diseño en términos de su funcionalidad, desempeño, eficiencia e innovación; evaluar la experiencia de usuario en términos de usabilidad, experiencia estética y simbólica; evaluar su impacto ambiental en términos de la huella de carbono, así como de la producción de desechos, consumo energético y de recursos no renovables y; evaluar el impacto social y cultural del Diseño en términos de su relevancia y aportación. Las ideas presentadas surgen del análisis y reflexión colectiva de tres fuentes: la experiencia académica y personal sobre la problemática, una revisión de literatura especializada y la valiosa aportación de revisores anónimos.

Palabras clave: Experiencia de usuario, diseño sustentable, diseño social, evaluación del Diseño, innovación social

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Introduction

From the emergence of the first civilizations to the present day, man has transformed the world through the design and manufacture of objects. As a result of this, humanity began to gradually transition from the natural world, created by nature, to the artificial world, created by man. Thus, design *objects* were gaining ground, occupying an increasingly greater place in the world and in our lives. However, with the advent of industrial society and the development of the economic model characterized by large-scale production and mass consumption (Sparke, 2013), the transformation of the environment accelerated significantly, and the impact of design became more evident. Man's creations occupy an increasingly larger area and presence in the world. Its impact is considerable, both in the social and cultural environment as well as in the environment, generating diverse effects that demand our immediate attention.

Faced with this scenario, in which design[1] plays a leading role, it is essential to evaluate the exercise of the profession and its consequences. It is therefore essential to adopt a self-critical attitude guided by ethics, reason, and social and environmental responsibility. It is necessary to objectively evaluate design products and their effects from the following four priority categories of analysis:

a) Evaluation of *design object*[2] in relation to its functionality, performance, innovation, etc.

b) Evaluation of *user experience* as a result of the relationship and interaction of the design object with the user.

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[1] As we have stated before, without seeking an exhaustive and precise definition but rather a descriptive delimitation, we consider design to be "the practical activity that aims to develop solution alternatives to the needs (basic, aesthetic, meaning, or of another nature) of a user (individual or collective) through products and services (digital, material or spatial) that are the result of project activity and in which the experience of use and formal and functional characteristics constitute fundamental, distinctive, and defining features" (Herrera Batista, 2018, p. 6). This includes, of course, not only tangible products but also intangible products, such as services, among others.

[2] In this work, we will refer to the design object as the product or service that is the result of the design activity.

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c) Evaluation of the *environmental impact of design,* from the consequences generated by production to the disposal of the design object in terms of its carbon footprint, waste generation, energy consumption, and non-renewable resources.

d) Evaluation of the *social and cultural impact* of design based on the cultural relevance of the object and its contribution to the solution of social problems.

Before exposing and explaining the importance of each of the proposed categories of analysis, as well as their consequences and possibilities, it is necessary to briefly describe the method used in the development of this work and establish certain considerations regarding what we assume here as evaluation.

Work method

The method consisted of a series of weekly meetings to reflect and argue about the social and environmental responsibility of design in the face of current challenges. In this work, the need was raised, as is done in the labeling of processed food products that warn of possible risks to the consumer's health (for example, excess calories, saturated fats, sodium, etc.). Design products should warn the user about their possible impacts on the environment, the user, and society.

Starting from that triggering idea, the question was posed: in this region, what type of relevant information should be included in design products? The outcome of this was the development of a brainstorming session to explore various possibilities. Subsequently, a selection of the ideas generated was made, from which the axes that we present here emerged. Later, a review of specialized literature on these topics was carried out from a design perspective.

The ideas finally raised in this space are the result of the joint reflection of the authors based on the consultation of selected readings and their own experiences as design teachers, in addition to the incorporation of observations and recommendations about authors kindly suggested by the anonymous reviewers of this article, to whom we thank for their valuable contribution.

Evaluation as a compare-and-contrast process

For the purposes of this work, we assume that evaluating implies measuring *differences* or *discrepancies* between two or more areas of contrast. Regarding design, we notice four fundamental comparison scenarios that complement each other to form a comprehensive analysis vision.

In the first case, what is evaluated is one's own *design object*. The comparison seeks to identify and quantify differences between what was

planned and the result obtained, or between the *design object* and his predecessor, or between the *design object* and other similar items with which it competes.

The second area of contrast focuses on the interaction of the user with the object, that is, on the experience that is derived from the use, possession, or contemplation of the design object by the user. It is about evaluating the *user experience* in a broad and holistic sense.

The following categories arise from the fact that every design object always implies some *impact* on social and environmental conditions. As Manzini (2015) points out, when using or consuming any design product or service, "a reaction occurs in people, their environment, their community, and the Earth" (p. 55).

The reactions produced through design can be oriented from a market logic perspective or from a different perspective. What is demanded now is to explore a "new culture, a new way of looking at the world and at what design can do with and for people living in it" (Manzini, 2015, p. 55).

Thus, the categories of analysis to be considered are: on the one hand, the evaluation of the environmental impact of the design; and, on the other, the evaluation of the social *and cultural impact of the* design. Next, the central objective of this work is specified, and the four categories of analysis proposed here are explained.

Objectives of the article

a) Reflect on the importance of design and its impact on the individual, society, and planet.

b) Highlight the need to evaluate the design from a holistic and integrative perspective.

c) Propose priority categories for the comprehensive analysis of the design that contribute to the discussion and allow progress in this regard.

The proposed categories are shown by the following graph (see Figure 1).

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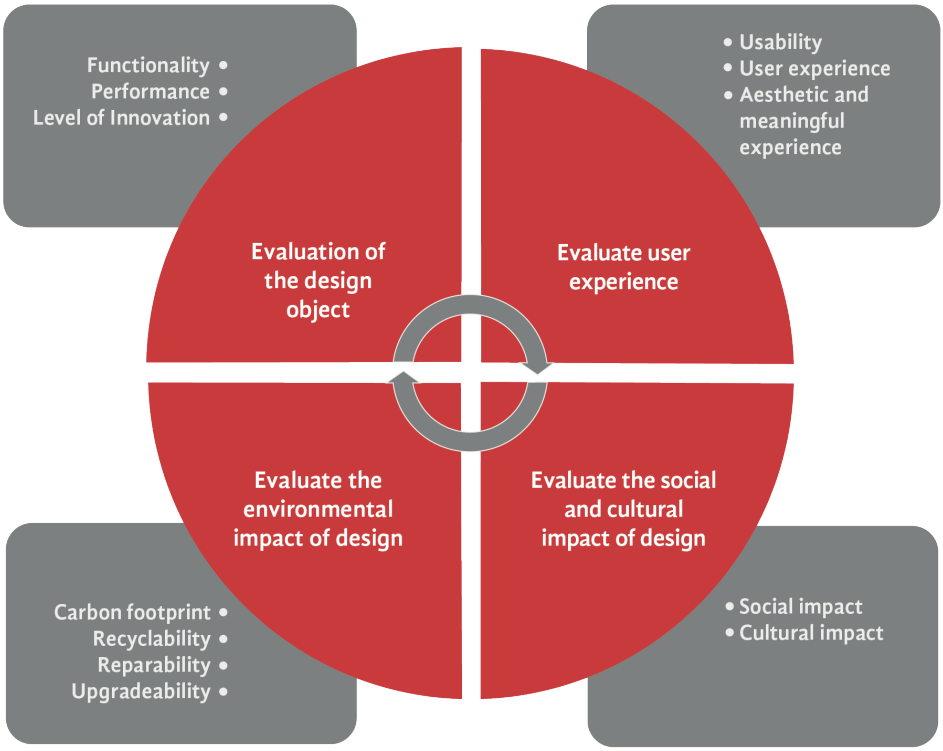

Figure 1. *Priority categories of analysis for the comprehensive evaluation of the design.*
Source: self-made.

Evaluation of the design object

As a scope of analysis, in this category, the design product obtained is compared with what was previously planned, that is, with the original project and what is expected of the object. Also included is the evaluation of the performance of the product obtained compared to other similar products, as well as the contrast with previous versions of the same product. In other words, it is a comparative *evaluation*. *Obenchmarking*, which is defined as "The process of comparing the performance of something (e.g. process, technology, etc.) against a standard or against other equivalent objects" (Levin, Kalal, and Rodin, 2019, p. xliii).

It is worth mentioning that, due to the close link between our discipline and the dominant economic model, concepts and criteria related to production and marketing processes are frequently used to evaluate the design, such as customer satisfaction, commercial competence, product quality, market performance, etc. Here, we have selected only those that we consider fundamental in the design of products and services.

Functionality

As we know, every design product arises with the purpose of meeting a specific user need. In this sense, functionality is the primary factor in the evaluation. It is about assessing to what extent and in what way the product or service fulfills its purpose, that is, if the design object

works for what it was created for and meets the previously established design criteria. When a design is robust, it is guaranteed to function as intended "even under nonideal conditions such as manufacturing process variations or a range of operating situations" (Ulrich, Eppinger, and Yang, 2019, p. 318).

For the purposes of evaluating products or services in general, we can consider the following aspects:

- Performance. It refers to the functional features of the object, i.e., its concerns "to the primary operating characteristics of a product" (Garvín, 1984, p. 30). These are the particularities of the design object responsible for facilitating the achievement of the consumers' objectives. Ulrich *et al.* (2019) say that performance refers to "how well a product implements its intended functions" (p. 195). However, it is desirable that the product design not only perform well but also minimize the effects of noise[3] (Ulrich *et al.*, 2019). In general, performance can be determined objectively using measurement instruments, although qualitative instruments can also be used.

- Efficiency. According to the Royal Spanish Academy (2023), efficiency is the "ability to achieve the desired results with the minimum possible resources" (s. p.). In our context, even though efficiency usually refers to the "effort the user has to put into achieving his goal" (Robier, 2016, p. 18), it is important to comprehensively consider the relationship between the result of the operation or functioning of the product and the consumption of resources (energy, materials, humans, time, etc.). In this sense, the efficiency of a product or service depends on its optimal functioning and the minimum possible consumption of resources. For example, Ulrich *et al.* (2019) suggest the following measures to ensure resource efficiency in the design of objects: implement default shutdown for subsystems that are not in use; use feedback mechanisms to indicate whether too much energy or water is being consumed; and implement intuitive controls for resource-saving functions.

- Reliability. It refers to the guarantee that a product does not present failures within a pre-established period of time. One of the most common tests of the reliability of a product or service is the average time it takes from the product to its first failure. (Garvín, 1984). In other words, we must ask ourselves, "What will wear out before the end of the customer-expected product life, and why?" (Levin *et al.*, 2019, p. 25). In this way, "design changes can be made to improve product performance

[3] Para Ulrich et al. (2019), el término ruido se refiere a "variaciones incontroladas que pueden afectar el rendimiento... [y señalan que] un producto de calidad debe ser resistente a los factores de ruido" (p. 318).

or a maintenance program can be established" (Levinet *et al.*, 2019, p. 25). Even reliability can be determined from objective measurements, it is often also linked to subjective perceptions of the user, such as previous experiences, the brand and price of the product, or recommendations.

- Appearance. Of course, formal characteristics are fundamental in design. They say Ulrich*et al.* (2019) that "An integral architecture facilitates the optimization of holistic performance characteristics and those that are driven by the size, shape, and mass of a product" (p. 195). From a much more subjective perspective, Garvín (1984) points out that appearance refers to how the design product "looks, feels, sounds, tastes, or smells" (p. 32). In this sense, as designers, we know that subjective factors are no less important. It is natural that users always expect a *distinctive or pleasing* "look" [or appearance] from the products they purchase (Kotler and Rath, 1984, p. 18). Kotler and Rath (1984) say that achieving a distinctive style is the best way to stand above competitors. To this end, goods and services sectors usually implement quality programs such as the Quality Function Deployment (QFD), which focuses on "identifying all factors that might affect the ability of the product to satisfy customer needs and requirement" (Levin *et al.*, 2019, p. xlvii).

- Durability. It can be defined as the amount of use you get from a product before it stops working properly. At this point, "replacement is regarded as preferable to continued repair" (Garvín, 1984, p. 31). In short, it is about the useful life of the product. In this regard, Kotler and Rath (1984) say that consumers not only expect a product to function correctly over a period of time of use, but they also expect "visual durability," that is, that the product does not look or feel old or worn excessively. To this end, it is important to note that in product design, materials should be selected "for durability and manufacturability, and to create an attractive appearance" (Urich*et al.*, 2019, p. 231).

- Affordability. It refers to the level at which the product or service is available to the general population. Obviously, the more expensive a product is, the smaller the population with potential access to said product or service will be. Although it is generally assumed that there is a positive correlation between cost and product quality, affordability is aimed at ensuring that quality does not depend on cost. In other words, even when the cost is low, the quality is sought to be optimal. However, from a commercial perspective, it is assumed that "The designer does not aim for optimal quality but affordable quality for that target market" (Kotler and Rath, 1984, p. 17). For the authors, "Effective design calls for a creative balancing of performance, quality,

durability, and appearance variables at a price that the target market can afford" (Kotler and Rath, 1984, p. 18).

To conclude this section, it is worth highlighting the work carried out by Lidwell and Manacsa (2011), who analyze 100 design products based on five evaluation dimensions to determine what they call the merits *of a design,* which are "aesthetic, function, usability, sustainability, and commercial success" (Lidwell and Manacsa, 2011, p. 11).

From a similar perspective, Ulrich*et al.* (2019) state that "to meet the needs of a large number of people using a product, its design needed to address functionality, aesthetics, ergonomics, durability, manufacturability, cost, and marketability" (p. 216).

In this sense, although the *commercial success and product performance*[4] (Lidwell and Manacsa, 2011) as well as manufacturing capacity and marketability (Ulrich *et al.* 2019) could be considered design merits, here we believe that sales success does not necessarily reflect the quality of the design since there are other factors that intervene in consumer habits and other values beyond the economic.

Innovation

In addition to functionality and the other quality factors discussed above, product innovation is another area of evaluation. Although it is clear that "design is related to innovation" (Wolfgang, 2001, p. 66), this factor is not always considered when evaluating the quality of the design. To talk about it, it is necessary to clarify what we mean by innovation.

According to the Organization for Economic Cooperation and Development (OECD)/Eurostat (2018), "A product innovation is a new or improved good or service that differs significantly from the firm's previous goods or services and that has been introduced on the market" (p. 21). Clearly, innovation understood in this way encompasses all types of design products. Accordingly, the assessment of innovation in relation to the design object considers the way in which the new product or service represents an improvement or advancement over similar or previous ones.

Although innovation has been studied for decades, the discourse currently focuses on two levels of innovation: incremental innovation and disruptive innovation, which we will explain later. However, we consider that, with respect to products and services, at least three levels of innovation should be taken into account. To do this, we adopt the proposal of Ryan and Rodríguez (2007), taken up by Brown (2009), in which the following levels of innovation are recognized:

[4] In the analysis and evaluation of the performance of a product or service, commercial success is often considered an indicator, or Key Performance Indicator (KPI), of the quality of the product or service offered.

- Incremental innovation. It is characterized by gradual changes that normally occur to products and services. Most of the advances in design are located at this level. New products and services generally do not represent notable changes but rather small advances. Brown (2009) says that "the vast majority of efforts are focused around incremental innovation –improvements to an existing model or the extension of an existing range" (p. 162).

- Evolutionary innovation. In this case, innovation goes beyond gradual advances since, at this level, features are already incorporated that are not present in previous versions or similar products. According to Brown (2009), evolutionary innovation is vital to expand existing offerings, solve the unmet needs of current customers, or incorporate new customers or markets (p. 162).

- Disruptive innovation. This is the highest level of innovation, since advances do not arise from gradual changes but rather deliberately point in directions that are unprecedented. Disruptive (or radical) innovation involves the generation of unconventional ideas and represents a greater risk to investment. Brown (2009) says that this type of innovation is the most challenging and risky, but it can create completely new markets.

Based on Brown (2009), we can rework the following table to graphically explain the three types of innovation and their relationship with the design of products and services.

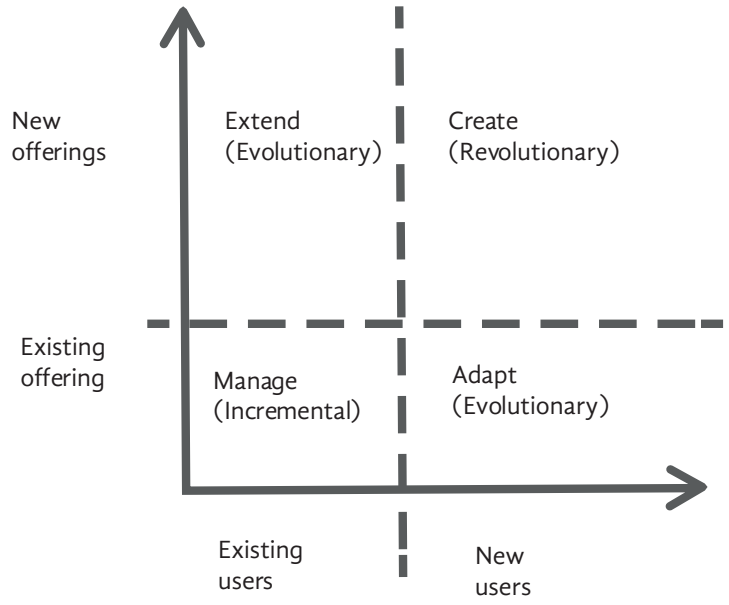

Figure 2. *Relationship between innovation and the design of products and services. Source: Adaptation from Brown, 2019.*

 DOI: 10.32870/zcr.v8i15.222 ISSN: 2448-8437

At the bottom left are the existing products and their users. In this sector, progress in product design is gradual, continuous, and linear. At the next level of innovation, products and services include characteristics that previous models did not have. Here, innovation can focus on extending the scope or functions of products and services or making adaptations to previous models. Finally, in the upper right quadrant, innovation implies an action of greater risk but also of greater impact. In that case, advances are not due to linear or gradual changes, but rather are changes that represent a clear discontinuity from what was being done previously.

Holistic user experience evaluation

It is a fact that the user's interaction with the design creates experiences—positive or negative—which, in turn, motivate emotions. Donald Norman (2005) has already explained and documented the way in which design objects can produce emotions in the user. Precisely, this second category of design evaluation focuses on the *holistic experience that* the product or service generates in the user.

Here we approach the topic from the standpoint of usability, the user *experience* (ux) itself, and the aesthetic *experience* and symbolism, which are not necessarily derived from the interaction or use of the design object but from contemplation or possession of it.

Usability

Among the characteristics attributable to the object that have a direct impact on the user experience is the ease with which it is possible to carry out the previously determined activity. We talk about what is known as the as *usability level*. According to Nielsen (2012), "Usability is a quality attribute that assesses how easy user interfaces are to use". The objects must be intuitive in their design; that is, they must allow easy understanding of their operation. In other words, usability refers to how easy, fast, and enjoyable it is to use a product or service. Nielsen (2012) identifies five attributes related to usability:

- Learnability: It is the ease with which the user can perform basic functions successfully on the first occasion of use.
- Efficiency: It is the speed with which a user can carry out their activities once they know the interface.
- Memorability: It consists of the ease with which users remember the use of the interface or recover their ability to use it after a period of time without using it.
- Errors: refers to the potential of the object to cause errors in the user as a consequence of the design.

- Satisfaction: It is the user's subjective assessment of the ease of use of the design.

Even though Nielsen's (2012) contributions emerged in the field of *Human-Computer Interaction (HCI)*, usability currently ensures that products and services are "efficiently, effectively and to the highest satisfaction of the customer" (Robier, 2016, p. 13). Regarding the concept of satisfaction, it is important to note that this is usually measured through usability tests aimed at determining "whether the product frustrates users or not" (Blythe, Overbeeke, Monk, and Wright, 2004, p. xvi). However, this is limited since it is about measuring user satisfaction in its entirety and not only in terms of the possible frustration that may be generated in the user.

In short, the interest in the usability of design objects is evident and has led various authors and researchers to develop very different techniques and tools to evaluate them. Although it is clear that a deeper exploration of the topic is important, our objective here is only to highlight usability as one of the determining factors in evaluating the user experience.

User experience (UX)

The user experience (UX) is, along with sustainability, one of the most relevant design evaluation categories today. According to Soares, *et al.*, (2022), "User experience (UX) refers to a person's thoughts, feelings, and behavior when using interactive systems" (p. xiii).

Many companies and developers of products and services focus their attention on this factor because, in the competition for the market, the final decision corresponds precisely to the consumer. A favorable user experience often becomes "the main reason why products are bought, services are used and why customers are turned into loyal brand evangelists" (Robier, 2016, p. v)

It is important to highlight that the final user experience is not limited only to the moment in which the user uses the product but also includes the periods before and after said action. Robier (2016) says that products and services must provide the user with a positive emotional experience "before, during and after any interaction with the product or service" (p. 14).

Although usability occurs during the user's interaction with the object, the user experience considers the entire process as a whole, "from product search to the actual product arrival at its final destination including, as well, the transportation and packaging process" (Robier, 2016, p. 14).

The importance of the user as a consumer and potential agent promoting products and services has awakened interest in research and has led developers to move from the paradigm of "designing for the user"

to "designing with the user". In this regard, Westerink and colleagues (2008) say that evaluating the user experience is not only useful during the design process but also during the entire process of using the product.

To understand the meaning of user experience in a broader way, it is necessary to start from the fact that every user is, at the same time, a human *being* and *a* social and *individual* individual, so it has characteristics that it shares, both with other human beings and with a social and cultural community, and, of course, it also has particular traits that are its own and distinguish it from the other members of the community (Herrera Batista, 2018).

To conclude this section, we just want to reaffirm that the user experience is holistic and integral. On the one hand, user interaction does not begin with the use or manipulation of the design object but rather covers the periods before and after said manipulation. And, on the other hand, it is important that, when evaluating the user experience, we do not fail to consider the user in its three dimensions: the human, the social, and the individual.

Aesthetic and meaning experience

Regardless of their practical usefulness, objects have important attributes for the user that are relevant to their relationship with the object. Two of the potentially strong areas that link the user with design objects are, on the one hand, the aesthetic experience[5] and, on the other hand, a possible association of the object with meanings specific to the user.

Aesthetic enjoyment

They say Blythe *et al*. (2004) that "traditional usability approaches are too limited and must be extended to encompass enjoyment" (p. xvi), and they are right. Beyond the usefulness of a design object, there are factors capable of producing experiences and sensations in the user. Within the set of positive experiences is the aesthetic enjoyment derived from contemplation or other forms of sensory perception. An object, simply by looking at it, can produce aesthetic pleasure. The aesthetic experience has its own existence and may or may not be linked to the use of the object or the meanings associated with it. Faimon and Weigand (2004) assume that there are certain qualities of design "that make an object beautiful (or less beautiful) [and these aesthetics qualities] transcend it" (p. 8).

Thus, not only is the designed object potentially capable of provoking an aesthetic experience, but, in reality, designers often strive to have their work considered beautiful. Fátima Pombo (in Calvera, 2007)

[5] Appropriate aesthetics occur when the form of the design relates appropriately to its use or function and the colors, materials, and finishes used are suitable for its purpose (Industrial Designers Society of America, 2022).

points out that "design has the responsibility and versatility of designing with meaning and offering beauty through everyday things" (p. 85). In this sense, both the practical and functional usefulness of the object as well as its aesthetic characteristics are fundamental requirements for an effective design of the user experience (Soareset *et al.*, 2022, p. xiii).

The meanings of objects

Like the experience of use and the aesthetic experience, the social or individual-level meanings related to the object can produce emotions and evoke fond memories in users.

In addition to the functional and formal attributes of objects, there is another important dimension applicable to them: meanings. Csikszentmihalyi and Rochberg-Halton (2002) have already documented the way in which people often give deep meanings to objects. These meanings can be located at two scales: a social one, where the codes are built and shared by a community, and another in which the meanings come from the experience and life history of their owner—although they can also be shared with the family. immediate.

In the first case, the codes are objectified by society itself. In this way, objects express belonging to a certain social sector, a lifestyle, a way of life, etc. On a personal level, objects have meanings associated with action or contemplation. In both cases, the objects become important because they constitute a manifestation of the being as an individual, as a human being with a particular life story.

Assessment of the environmental impact of the design

The evaluation of the impact of the design on the environment is another of the priority categories of analysis. Given the linkage of design to the economic model based on mass production and mass consumption, its environmental impact is relevant. Berman (2009) warns that "The largest threats to our world today are rooted in overconsumption, spurred on by rapid advances in the psychology, speed, sophistication, and reach of communications technology" (p. 22), which is why, for the author, "designers are at the core of the most effcient, most destructive pattern of deception in human history" (Berman, 2009, p. 22).

Beyond agreeing or not with the above, the truth is that design plays a fundamental role in the generation of waste of all types linked to the production of objects and services. Here, decisions regarding the type of materials to be used, the way in which they are produced, the possibilities of reuse, the logistics of operation and distribution, etc., have relevant consequences for the environment.

It is important to keep in mind that the environmental impact of the design is not reduced to the selection phase of the materials with which

the products will be made or those that will be used for their packaging and storage, but includes the entire process, from the conception, development, production, storage, distribution, delivery, use, and disposal of the object. This applies to both material and immaterial design objects.

To measure the final impact of the design on the environment, it is necessary to consider some indicators or concepts such as the *carbon footprint,* the level of recycling of the materials used, the level of repairability, the possibility of updating that can prolong the useful life of the object, and some others that may arise.

Carbon footprint

A carbon footprint is known as "the totality of greenhouse gases emitted by a direct or indirect effect by an individual, organization, event, or product" (Ministerio para la Transición Ecológica, 2018, p. 1). Greenhouse Gases (GHG) are responsible for global warming. A large part of the emission of these gases is linked to human activity.

According to the Ministry for the Ecological Transition of Spain (2018), to determine the carbon footprint of a product, it is necessary to consider the GHG issued "during the entire life cycle of a product: from the extraction of raw materials, through processing, manufacturing, and distribution, to the use stage and end of useful life (deposit, reuse, or recycling)" (Ministry for the Ecological Transition, 2018, p. 1). In this sense, it is clear that the design of a material or immaterial object always involves a series of activities that generate energy, directly or indirectly, and that must be considered within the final impact on the environment.

Recyclability in design

The current productive model not only generates material and immaterial goods; it also generates large volumes of solid waste and gases linked to the design, many of which are highly aggressive to the environment or difficult to degrade. Escobar (2018) points out that "To be sure, much of what goes on under the guise of design at present involves intensive resource use and vast material destruction" (p. 1).

One of the most polluting solid wastes today is, without a doubt, plastic. Within the plastics linked to design, there are obviously those products or components that give shape and support to most of the objects that surround us. However, the biggest problem is found in those plastics that serve as packaging, or packaging for the articles.

Part of the problem is due to what we could call the disposable *culture*. Today, most consumer items are usually packaged in disposable containers made of plastic or other non-biodegradable materials. Furthermore, generally, new products are currently accompanied by a large amount

of plastics whose useful life cycle is too short, while their decomposition process is very long. In this sense, although the cost of packaging plastic may be economically low, the environmental cost is usually very high.

As if that were not enough, there is also a wide variety of single-use products on the market, most of which are non-biodegradable and difficult to recycle or reusable materials.

In this regard, it is necessary that, in the evaluation of the environmental impact of the design, the biodegradability of the materials or their real potential to be recycled be considered. It is advisable to avoid combining materials that complicate the recovery and recycling process.

On the other hand, it is necessary to accept that a large part of the ideas disseminated to reduce environmental impact do not imply drastic changes in production processes or materials and are only disseminated to continue privileging economic benefit over environmental benefit. For example, whether a container is reusable or recyclable does not necessarily make it environmentally friendly; it only "extends" its lifespan, but it will inevitably end up deposited as solid waste.

Finally, even though there are currently companies[6] that reprocess materials such as PET[7] to reuse them in the design and manufacturing of their products, it is necessary to review the energy and environmental costs that result from said processing, in addition to considering the unavoidable: at the end of their useful lives, they will inevitably end up as solid waste.

Product Repairability

Another aspect of disposable culture is the production of objects that are difficult to repair or that become obsolete in a few years. Unfortunately, establishments that in the past were responsible for repairing commonly used objects, such as clothing, footwear, televisions, radios, etc., disappear every day. The problem is not the lack of technicians but the planned obsolescence of design products. In this way, products tend to have a much shorter lifespan than in the past, when things seemed to be made "to last." Today, the lifespan of objects is becoming shorter, generating larger volumes of solid waste, some of which is highly toxic.

This situation is a matter of design, engineering, and marketing. Therefore, it is urgent to design objects with greater durability and functionality that allow their use for longer periods. One measure to achieve this would be to facilitate its repair or update.

[6] An example is the Italian company TUCANO, based in Milan and founded in 1085, which currently designs and manufactures suitcases, backpacks, and accessories made from 100% recycled PET fiber material.

[7] It is commonly known as PET Polyethylene Terephthalate, which is a plastic polymer that is made from a polymerization process of terephthalic acid and monoethylene glycol (Station Service, 2023).

The ecodesigns

To conclude this section, we should not underestimate the various efforts and proposals that, from the design point of view, have been made to address the environmental problem. Concepts like ecodesign *(EcoDesign), sustainable design (Sustainable Design), bioclimatic design (Bioclimatic Design),* etc. That is, all types of designs that seek to make energy use efficient, reduce pollution, seek alternative energy sources, etc.

Unfortunately, under these concepts, practices are carried out that do not have a significant impact on reducing the environmental problem. Many times, they are strategies that involve high energy and resource consumption, or they are actions that only postpone the disposal of products, but that will ultimately end up in garbage deposits.

In this regard, a contribution worth mentioning is what is known as biomimetic *design*, which seeks to imitate nature's systems, that is, how nature manages energy, the life cycle of organisms, and how they interact. Benyus (2014a), says that it is about "learning from and then emulating natural forms, processes, and ecosystems to create more sustainable designs" (p. 8). *This is innovation inspired by nature (Benyus, 2002).*

Biomimicry is defined as "a tool for attaining sustainable products, prosses, and systems in the human world" (Benyus, 2014b, p. 159). According to the author, "We are natural beings, we belong here, we have a role to play, and we are connected to the rest of the natural world" (Benyus, 2014b, p. 160).

From this approach, we seek to copy the designs and processes of nature; it is "the conscious emulation of life's genius" (Benyus, 2002, p. 10). "

In a society accustomed to dominating or "improving" nature, this respectful imitation is a radically new approach, a revolution really. Unlike the Industrial Revolution, the Biomimicry Revolution introduces an era based not on what we can extract from nature, but on what we can learn from her (Benyus, 2002, p. 10).

Evaluation of the social and cultural impact of the design

In addition to the effects on the environment, the model based on large-scale production and mass consumption has generated other evident phenomena in the social and cultural environment.

The social

Unfortunately, the prevailing economic model, *the agenda* of design, orients the activity, in principle, to the market represented by the most economically favored social sectors. As a consequence, social groups that do not represent an economically important market have been neglected.

Polak (2008) says that "The problem is that 90 percent of the world's designers spend all their time working on solutions to the problems of the richest 10 percent of the world's customers" (p. 64).

Faced with this reality, design cannot continue ignoring the needs of the poorest sector of the population, often forgotten. Although the market has driven competition and innovation, economic growth has not necessarily translated into a reduction in social inequality.

Even though design does not have the fundamental function of reducing social inequality, it must assume the commitment to improve the quality of life of every human being, regardless of their economic level, social and cultural condition, or religious orientation. In this sense, it is clear to us that "design has all the potentialities to play a major role in triggering and supporting social change" (Manzini, 2015, p. 55).

This is not, of course, about belittling design based on commercial competition, but about strengthening the social meaning of the profession and thus turning it into a "design for social innovation" (Manzini, 2015, p. 55).

The cultural

Although in our field "design culture embraces the networks and interactions that configure the production and consumption of the artificial world, both material and immaterial ... [but it also] extends to more complex exchange systems" (Julier, 2014, p. xiii), what we want to highlight in this section is the impact that design with a commercial focus has on the culture of social conglomerates. That is, we are not referring to the culture of design itself, but to the effects that design with a commercial focus produces on society from a cultural point of view.

We must accept that the economic model has generated a clear tendency towards standardization in the use and adoption of products, devices, fashions, etc., in society worldwide. It is a form of cultural colonization that is reflected through the propagation of foreign lifestyles. This process of transculturation is manifested, among other things, through universal design models that tend to overshadow the cultural diversity of indigenous peoples and other minority groups. As a result of this process, there is a clear impoverishment of cultural wealth in the world.

Therefore, it is necessary to approach design from a new perspective that puts an end to the hegemony of the single and standardized world imposed by the neoliberal model. It is about moving towards design for the plural and fostering the conservation and understanding of the multiple worlds that still coexist in society to effectively confront "the interrelated crises of climate, food, energy, poverty, and meaning" (Escobar, 2018, p. 10).

The social and cultural impact of design is about assessing in what sense it responds to the cultural and social diversity of the user, that is, to what extent the design response truly serves the user in their human, social, and individual dimensions. At what level does the design take into consideration the worldview of the sector to which the product and service are directed and how much it responds to a cultural vision constructed by history or assigned by an imposed or induced lifestyle?

Discussion

What is presented in this document has sought to contribute to the debate about a new emerging culture in terms of understanding and practicing design. In the words of Clive Dilnot, it is about "the aim is to push the boundaries of both design and thought, to make each more capable of opening genuine possibilities for thinking and acting otherwise and thus of better facing, and facing down, the myriad failures of the present" (in Manzini, 2019, p.VII).

It is clear that the development of design as an academic discipline and professional practice was strongly marked by industrial society. That is why, even in the face of new challenges, design academics and professionals continue to think and work only from an economic and market perspective. From that perspective, academics such as Campi (2020) consider that designers in the private labor sector "must adapt to their economic role, since they are helping to define a product that will obey the laws of the market" (Campi, 2020, p. 20).

Therefore, here we emphasize the need to explore the possibilities that design offers when assuming a practice that puts social benefit and care for the environment before the commercial inertia of the market-based economic model. That is, the aim is to expand the perspective of design to conceive it as "a contribution to the wider necessities of dealing with a vulnerable precarious world, of establishing project not profit as the basis of action, and of building the bases for wide-ranging emancipatory politics" (Manzini, 2019, p. vii). It is about "re-thinking the relation between justice and making, and between material human needs and the means and modes of how these can be realized" (Manzini, 2019, p. vii).

Let us remember that the exercise of design is not only practice and action but also theory and thought. In the words of Campi (2020), "The designer is not only responsible for putting theory into practice; he also acts the other way around, that is, he reflects theoretically based on habitual practice" (p. 30).

Finally, the main motivation for this work was to promote a holistic, comprehensive, and systematic evaluation of products and design practices. The most important contribution is, without a doubt, to present a possibility in this regard based on the four axes described here. We are aware that it is an unfinished work in the sense that we cannot provide

complete and precise indicators at this time, but it is a first approximation, a reflection exercise that seeks to contribute to the debate.

Conclusions

Every design activity has obvious repercussions in economic, practical, social, cultural, and environmental terms. However, despite its relevance, its evaluation is not usually done in a comprehensive and systematic manner. As those responsible for the design, it is everyone's duty to permanently evaluate the quality of the design and the consequences that arise from it.

Here we have explored four categories of analysis for an integrative evaluation of design. In relation to the product, it is necessary to monitor each of the indicated factors, since these in turn have an impact on other categories of analysis. For example, the performance of the design object clearly has an impact on the environmental impact, since optimal performance reduces energy consumption and other resources, which will implicitly reduce the carbon footprint of the product.

In relation to the environmental impact, it is urgent to design products with greater energy efficiency, use less energy in the production of goods and services, reduce resources allocated to the transportation and distribution of products, and reduce the effects that waste produces on the environment. It is essential to look at the environmental problem in its entirety and with all its implications. To do this, a first step is to evaluate the design.

An alternative to improving design practices would consist of including labeling on products and services with information regarding the level of recyclability of the product and its materials, its level of reparability, and its impact on the carbon footprint. This would give the user the possibility of promoting more environmentally responsible design.

On the other hand, the linking of design to the economic model has been, at the same time, a lever for its development and a brake on exploring many other of its motivations. An obvious example of this is that the evaluation of design is usually done from the perspective of economic success. The Delta Awards, for example, conceive of it as a "privileged tool to generate wealth in an industrial economy and its fundamental role as an expression of our social and cultural values" (Association of Industrial Design of the Fad, 2023, s. p.). Ideas like these are present in various academics who continue to consider the market as an essential factor in design without considering the environment.

However, we should not only focus on conquering a market; it is necessary to "design for people" (Martín Juez, 2014, p. 11). Martín Juez (2014) says that "at the center of the purposes of any design is the human

in its physical and psychological dimension, in its cultural diversity, in the understanding of its emotions" (p. 9).

Fortunately, there are also sectors interested in promoting the practice of our discipline with a more social approach. The If Design Awards, for example, encourage the practice of design with a "positive impact on the world" (iF International Forum Design GmbH, 2023, n.p.). Its philosophy is based on the idea that design can "change the world for the better", that is, approaching design "with a social focus... because our common future is the responsibility of all of us" (iF International Forum Design GmbH, 2023, s.p.).

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