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The role of the designer in mitigating environmental impacts: Building a sustainable future

El papel del diseñador en la mitigación del impacto ambiental: Construir un futuro sostenible

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Abstract: The environmental crisis has profoundly impacted the interaction between man and nature, highlighting the urgent need to rethink our practices and production models to preserve natural resources. This research discusses the ecological crisis and the importance of designers in mitigating environmental effects, highlighting the need to re-evaluate our production methods and systems to help conserve natural resources. Therefore, the main objective of this research is to investigate the role and contribution of design in reducing the environmental effects resulting from the current ecological crisis. To this end, research instruments were used such as the systematic review of academic literature related to sustainable design and bibliometric research with Oasisbr, Scielo and BDTD databases, with a time frame of the years 2020 - 2023. This review will cover studies, relevant theories and practices in the field under study, highlighting the main current trends and challenges. Regarding the results, this research presents some definitions of the main themes covered in the studies, revealing which aspects of the designer's role in mitigating environmental impacts are most discussed in the literature. Finally, it can be concluded that the environmental crisis is a global challenge that requires immediate and effective actions to preserve natural resources, in this sense the role of the designer is crucial in mitigating environmental impacts through innovation in sustainable materials and practices, selection of raw materials, choice of technologies and adoption of new production models, all of these actions have a considerable influence on both the environment and the final cost of the product, highlighting the need for sustainable practices to minimize environmental damage and maintain economic viability.
Keywords: *Sustainable design; Sustainability; Environmental impacts.*

Resumen: La crisis medioambiental ha afectado profundamente a la interacción entre el hombre y la naturaleza, poniendo de relieve la urgente necesidad de replantearnos nuestras prácticas y modelos de producción para preservar los recursos naturales. Esta investigación analiza la crisis ecológica y la importancia de los diseñadores en la mitigación de los efectos medioambientales, destacando la necesidad de reevaluar nuestros métodos y sistemas de producción para ayudar a conservar los recursos naturales. Por lo tanto, el principal objetivo de esta investigación es investigar el papel y la contribución del diseño en la reducción de los efectos medioambientales derivados de la actual crisis ecológica. Para ello, se utilizaron instrumentos de investigación como la revisión sistemática de la literatura académica relacionada con el diseño sostenible y la investigación bibliométrica con las bases de datos Oasisbr, Scielo y BDTD, con un marco temporal de los años 2020 - 2023. Esta revisión abarcará estudios, teorías y prácticas relevantes en el campo en estudio, destacando las principales tendencias y desafíos actuales. En cuanto a los resultados, esta investigación presenta algunas definiciones de los principales temas tratados en los estudios, revelando qué aspectos del papel del diseñador en la mitigación de los impactos ambientales son los más discutidos en la literatura. Finalmente, se puede concluir que la crisis ambiental es un reto global que requiere acciones inmediatas y efectivas para preservar los recursos naturales, en

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este sentido el papel del diseñador es crucial en la mitigación de los impactos ambientales a través de la innovación en materiales y prácticas sostenibles, selección de materias primas, elección de tecnologías y adopción de nuevos modelos de producción, todas estas acciones tienen una influencia considerable tanto en el medio ambiente como en el costo final del producto, destacando la necesidad de prácticas sostenibles para minimizar el daño ambiental y mantener la viabilidad económica.
Palabras clave: *Diseño sostenible; Sostenibilidad; Impactos ambientales.*

INTRODUCTION

The urgent challenge of the global environmental crisis demands a comprehensive and immediate strategy to ensure the survival and quality of life of future generations. The growing concern about issues such as climate change, loss of biodiversity, soil degradation, air and water pollution, among others, highlights the need to rethink our production methods and models. Sustainable development, which seeks to balance economic progress, environmental preservation and social well-being, is a viable long-term solution.

To tackle this crisis, it is essential to encourage the adoption of sustainable practices in all sectors of society, from public policies to consumer behavior, measures such as reducing consumption, energy efficiency, the use of renewable energies, recycling and the preservation of ecosystems are necessary.

In this scenario, the importance of the designer is undeniable, as they can help reduce environmental impact by focusing on their ability to review and reformulate *design* practices in harmony with sustainability principles, by exploring substitutes for traditional materials, developing greener and more renewable products, and seeking solutions to environmental impacts. *Design*, in its many forms, influences the built environment, consumer products, communications and services, among others (Muniz, 2022). By taking into account the complete life cycle of the products and systems they create, *designers* have the unique ability to minimize environmental impact, from selecting environmentally friendly materials to creating efficient processes and promoting durable and recyclable products. In addition, the designer acts as an agent of awareness, educating consumers about the importance of sustainable choices (Muniz, 2022; Ambrósio, 2021).

It plays a significant role in sustainability by considering the eco-efficiency of the technologies used, the way in which the metabolism of the production system is able to transform environmental resources into quality of human life. In addition, sustainable *design* seeks to maximize economic objectives, promote social well-being and propose a value of responsibility for not harming the environment. Through inclusive practices and an approach that takes into account the durability of materials, ecological disposal and the use of renewable resources, *design* can make a significant contribution to environmental and social sustainability. In addition, sustainable design can also promote

energy efficiency, reduce waste and encourage recycling, playing a crucial role in the transition to a circular economy (Dos Santos and Hartmann, 2022).

Design for sustainability is a strategy that aims to develop products, services and systems that are environmentally friendly, economically profitable and socially equitable, taking into account the environmental and social impact throughout the life cycle of the product or system, from the extraction of raw materials to final disposal. It is based on fundamental principles such as reducing the use of natural resources, reducing waste production and promoting the use of renewable and recyclable materials (Ambrosio, 2021).

Faced with global environmental challenges such as climate change, the scarcity of natural resources and environmental degradation, *designing* for sustainability is crucial. By adopting this type of design, it is possible to contribute to building a more sustainable future, where products and systems are designed to have a lower environmental and social impact, promoting a balance between human needs and the limits of the planet (Muniz, 2022; Dos Santos and Hartmann, 2022, Ambrosio, 2021; Camelo, Daros and Lucca, 2021).

The main objective of this research is to highlight the role of design in conserving the environment and promoting social justice, seeking solutions that are economically advantageous and improve people's quality of life.

Throughout this article, we will delve into the principles of sustainable *design, the* environmental crisis scenario, the role of the *designer* as a catalyst for change and the obstacles and possibilities that arise in the search for a more sustainable future. Together, in search of innovative and revolutionary solutions, we can reimagine our path towards a future in which harmony between human beings and nature is not only desired, but also achievable.

THEORETICAL BACKGROUND

Currently, topics such as *eco-design*, sustainable development and the environment are being debated extensively in various sectors of society, as ecological awareness is growing progressively, driven by both political and economic reasons. This means that *eco-design* has become a competitive differentiator for conquering markets, especially in the most demanding segments, such as Europe.

It is clear that the relationship between man and nature does not always occur in a harmonious and balanced way, as human action often interferes aggressively, resulting in extensive environmental degradation. Consumerism and the production model are some of the main causes of this degradation, where many companies use the planet's resources without considering the impact this can have, as if these

resources were infinite. In addition, there is a general lack of concern about the waste generated by society.

On the other hand, *designers*, architects and environmentalists are working hard to curb this destruction, giving value not only to natural products, but also to recycled or reused ones. Including environmental criteria in the development of products or projects offers countless advantages for society, the environment and the economy.

Design plays a fundamental role in the ability to transform consumer habits by adopting innovative approaches that are guided by sustainability requirements and that go beyond environmental, social and economic needs. We understand that the development of such innovation becomes possible when there is a deep understanding of the public's routines and preferences in the real world (Camelo, Daros and Lucca, 2021).

Facilitating sustainable consumption requires *design to* encourage and value responsible consumers, promoting transparency, education and customer participation. Its role goes beyond the development of approaches that enable the participation of the client or end user in sustainable and responsible practices, as well as their collaboration in the design process, decision-making, production, implementation and customization of product and service systems with a focus on sustainable and responsible behaviour (Muniz, 2022; Ambrosio, 2021; Camelo, Daros and Lucca, 2021).

The *designer*'s connection with the formulation of parameters for sustainability is vital and diverse. *Designers play* a crucial role in determining guidelines and criteria that direct the development of environmentally friendly, economically sustainable and socially equitable products, services and systems.

One of the benefits of including these parameters is the prevention of possible damage to the environment. Instead of focusing on recovery actions after damage has already occurred, this approach is preventative. It can be seen that the development of environmentally oriented products and projects, considering environmental parameters from the outset, contributes to reducing environmental impact, optimizing the use of raw materials, reducing production costs and effective waste management. In addition, it is important to note that the incorporation of *eco-design* principles can create a significant advantage in winning markets, as increasingly conscious consumers look for ecologically compatible products (Dos Santos and Hartmann, 2022; Brandão, 2004; Chaves, 2003; Ramos, 2001).

They are the innovative agents who integrate sustainability principles into every stage of the *design* process, taking into account efficiency in the use of resources, waste reduction, the selection of sustainable materials and the promotion of solutions that benefit both the environment and society. Their ability to balance aesthetics, functionality and sustainability plays an essential role in defining parameters

that guide the development of products and systems that respect the limits of the planet and improve people's quality of life.

Design for sustainability aims to create products, services and systems that are ecologically responsible, economically viable and socially just, considering the environmental and social impact throughout the life cycle, which involves reducing resource consumption, minimizing waste, promoting energy efficiency, modularity for repair and reuse, and considering social needs. Its main objective is to preserve the environment and improve quality of life, tackling global challenges such as climate change and resource scarcity. This approach contributes to a sustainable future, balancing human needs with the limits of the planet (Ambrosio, 2021).

In addition to the explicitly known role of the *designer* (developing solutions), there is also the work of promoting education in sustainable *design*, which involves teaching approaches and principles that take into account the environmental, social and economic impact of *design* solutions. By promoting education in *design* for sustainability, professionals acquire the ability to conceive projects that consider the complete life cycle of a product, from obtaining raw materials to correct disposal after use (Ambrosio, 2021).

To do this, it is necessary to think of innovative solutions that consider the entire life cycle of the product and minimize the environmental and social impact at all stages, and design for sustainability can include the creation of solutions that encourage more sustainable behavior on the part of users. Sustainable design has a close relationship with innovation, as it is necessary to create creative and effective solutions that meet human needs in a sustainable way. Through innovation and the adoption of technology, they have the potential to promote substantial changes in the way products are designed, manufactured and used (Dos Santos and Hartmann, 2022; Camelo, Daros and Lucca, 2021).

The concept of "regenerative design" has been investigated in the context of sustainable *design. According to* Brown *et al*. (2021), regenerative design transcends the mere minimization of negative impacts and proactively seeks to generate positive social and environmental benefits. This approach emphasizes the restoration and regeneration of natural systems, promoting resilience and long-term sustainability. Advances in sustainable technologies and materials, along with growing awareness of global environmental challenges, have driven the research and practice of sustainable *design*. Incorporating sustainability principles into *design* is considered crucial to tackling pressing issues such as climate change, biodiversity loss and resource scarcity.

This means recognizing not only sustainability issues, but also how people interact with products and services in their daily lives. Only by understanding these realities and considering the needs and

expectations of the public can we create innovative *design* proposals that are effective in promoting more responsible and sustainable consumption.

Design and its fields have been a means of addressing and promoting positive actions in relation to social and environmental issues, seeking to contribute to the development of new production models, with a focus on creating waste prevention and reduction programs, considering the entire life cycle of the product, from its conception to its final destination. It represents an essential response to the need to reimagine and reformulate the way we live, work and interact with the environment around us.

METHODOLOGY

To achieve the general objective, a literature review was chosen as the methodology, since it plays a crucial role in academic and scientific research, providing the theoretical and contextual basis for a study. It is an essential stage in understanding the current state of knowledge on the subject, identifying gaps in the field and establishing the conceptual basis for the research. The stages of the methodological procedure were: a) defining the scope and objectives; b) defining the keywords; c) identifying sources; d) determining the year of publication; e) collecting data from the literature; f) synthesizing and categorizing; g) writing the review; h) writing the report and discussion; i) communication.

A systematic literature review was initially proposed and a bibliometric analysis was carried out based on the publications available in the main journal indexing databases used in Brazil: *Oasisbr, Scielo* (*Scientific Electronic Library Online*), BDTD (Brazilian Digital Library of Theses and Dissertations). The search strategy used was to filter publications in the databases from January 1, 2020 to November 8, 2023, using the keywords: sustainable design; design management; ecodesign; regenerative design. Works in all research formats (dissertations, theses, articles, book chapters, among others) were included.

RESULTS AND DISCUSSION

With a solid foundation in sustainable *design* literature and environmental crisis theory, this research seeks to demonstrate how *design* is not just an aesthetic tool, but a catalyzing force in the transition to a more sustainable world. This data is fundamental to the bibliometric analysis and is presented in Table 01.

TABLE 01: Selected descriptors and number of publications found.

KEY WORDS	UNIVERSE	OASISBR	SCIELO	BDTD	TOTAL BY KEYWORD
Sustainable design	*Total*	5.060	232	1.671	**6.963**
	Clipping	1.523	83	427	**2.033**
Design management	*Total*	13.767	914	4.612	**19.293**

	Clipping	3.863	291	1.139	**5.293**
Ecodesign	*Total*	482	18	111	**611**
	Clipping	74	4	13	**91**
Regenerative design	*Total*	317	6	142	**465**
	Clipping	98	1	38	**137**
TOTAL PER DATABASE	***Total***	**19.626**	**1.170**	**6.536**	**27.332**
	Clipping	**5.558**	**379**	**1.617**	**7.554**

SOURCE: Prepared by the authors (2023).

The methodological approach employed makes it possible to analyze and quantify scientific production in a specific field of knowledge. This methodology is based on the collection and analysis of bibliographic data, covering scientific articles, theses, dissertations, books and others, with the aim of identifying patterns, trends and interconnections present in the publications. It was possible to identify a total of **27,332** publications (according to the descriptors), of which **7,554** were published in the period presented (January 1, 2020 to November 8, 2023).

Following this bibliometry, a systematic literature review was carried out to list some concepts of the relationship between design and sustainability, which can be seen in Table 02.

TABLE 02: Introducing concepts.

THEME	CONCEPTS	OBJECTIVE	FOCUS
Sustainable design	It is a comprehensive strategy that aims to reduce the environmental impact throughout the life cycle of a product or system, achieved by considering efficiency in the use of resources, recyclability, durability and waste minimization. In addition, sustainable design is a practice that incorporates environmental, social and economic considerations at all stages of the design process.	Developing products that meet society's current needs without compromising the ability of future generations to meet their own needs.	Incorporating sustainability principles into all stages of the design process, from conception to the end of the product's useful life.
Design management	It is a complete process that encompasses the planning, coordination and supervision of all design-related activities within an organization.	Maximize the use of resources and achieve the company's strategic goals through the effective integration of design activities at all levels of the organization.	Management of design practices, including the allocation of resources, the definition of objectives and the evaluation of performance, to ensure design excellence throughout the company's operations.

Ecodesign	It refers to an integral approach that incorporates environmental principles into the design and development of products, systems and services, with the fundamental purpose of minimizing the environmental impact throughout their life cycle.	Propose solutions that are environmentally responsible, resource-efficient and socially conscious, in order to minimize environmental impacts.	Designing products, systems and services in such a way as to minimize their environmental impact throughout their entire life cycle.
Regenerative design	It relates to the reduction of negative impacts, focusing on the active creation of positive environmental and social benefits	Creating products and services focused on the restoration and regeneration of natural systems, with a view to promoting long-term sustainability.	Restoration, renovation and revitalization in the creation of solutions that promote sustainability and positive environmental and social benefits.

SOURCE: Adapted from Brandão e Silva, 2023; Dos Santos and Hartmann, 2022; Muniz, 2022; Ambrosio, 2021; Camelo, Daros and Lucca, (2021).

The application of sustainable approaches by *designers* has the potential to generate significant positive impacts, which includes the development of sustainable materials and the implementation of more efficient production processes, resulting in a reduction in the consumption of natural resources, minimizing pollution and reducing environmental impact. These practices contribute to preserving nature, conserving ecosystems and mitigating the effects of climate change.

Design plays a crucial role in reducing solid waste, contributing to the transition to a circular economy and meeting social and environmental demands, where professionals must rethink production models, adopt sustainable approaches and promote consumer awareness, whether through greener packaging and products, or through informative interfaces on recycling and proper disposal of products.

CONCLUSIONS

This study was carried out in an effort to understand how *designers* can contribute to building a sustainable future and their ability to exert a positive influence on society, the economy and the environment by implementing sustainable strategies.

By designing products and systems that seek to minimize their environmental impact, creating innovative solutions that promote the circular economy and encouraging responsible consumption, *designers* play an essential role in protecting nature, conserving ecosystems and mitigating the harmful

effects of climate change. They contribute not only to a healthier environment, but also to building a sustainable future, where harmony between society and the environment is promoted, benefiting current and future generations.

In addition, sustainable *design* practices not only have the potential to reduce environmental impact, but can also provide positive social and economic impacts. Creating green jobs and promoting sustainable initiatives not only benefits the economy, but also contributes to improving the quality of life in communities. These holistic approaches not only protect the planet, but also strengthen the foundations of a fairer and more inclusive society, where sustainability is at the heart of progress.

During their academic training, it becomes essential to address *design* for sustainability education more strongly, as it plays a crucial role in training professionals who are able to develop sustainable and innovative solutions, providing students with the knowledge, skills and tools they need to integrate sustainability principles into their projects and design practices.

In the process of learning about *design* for sustainability, students are introduced to concepts such as the life cycle of products, eco-efficiency, the use of renewable energy, sustainable materials and waste reduction, considering social, cultural and socio-economic perspectives, questioning the *status* quo, and above all, rethinking traditional design concepts that favor a more sustainable future.

However, the role of the *designer* goes beyond simply creating sustainable products and systems. They also play a fundamental role as agents of change, capable of driving the promotion of policies and regulations that support sustainability. By highlighting more robust environmental policies, collaborating with governments and influencing legislation, *designers* can help create a regulatory environment conducive to the widespread adoption of sustainable practices. This proactive action is an essential step in building a more responsible and harmonious future, where sustainability becomes the norm, benefiting society as a whole.

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