INTEGRATION OF BIOPHILIC DESIGN IN LANDSCAPE ARCHITECTURE

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ABSTRACT
As urbanization progresses, the call for sustainable and health-oriented design in urban spaces has brought biophilic design to the fore—an approach based on the deep connection between humanity and the natural world.
This this study aims to elaborate the concepts, principles and practical aspects of biophilic design as an innovative and responsible approach in the field of landscape architecture, also to understand the importance and application of biophilic design in landscape architecture to create green and living environments that improve people's quality of life and maintain the natural wealth of our planet. With a focus on understanding the biophilic relationship between humans and nature, the theoretical and practical differences of biophilic design, as well as the impact on the environment and people, are considered.
Biophilic design is not only healthier and more pleasant environments for living, use and sustainability activities by promoting the conservation and consumption of energy consumption. Embracing biophilic principles can lead to more resilient and harmonious urban landscapes that benefit both people and the planet.
KEYWORDS: biophilia, design, landscape, architecture

Introduction

Biophilia literally means "an innate and genetically determined connection between humans and the natural world." Biophilic design is a kind of play on the human evolutionary need to be close to the natural world and is often described as the "architecture of life". Literally translated, biophilia is the love of life. It is characterized by the human need to be in contact with nature in any conditions, even in a big city.

In the era of urbanization and industrial growth of cities, natural spaces and natural elements are becoming rarer and removed from people's daily lives. Citizens face urban living and working in concrete, glass, and steel premises.

In recent decades, the concept of "biophilic design" has emerged as a response to this challenge. Biophilic design is an interdisciplinary concept that integrates natural elements and processes in the construction of urban and natural spaces. It includes the use of greenery, natural materials, natural light, and natural forms to create a better connection between man and nature.

Biophilia, defined as "an innate and genetically determined connection between humans and the natural world," highlights a deep-rooted human need to be close to nature. Often described as the "architecture of life," biophilic design draws on this evolutionary connection by incorporating natural elements and patterns within urban spaces. This approach addresses the growing disconnection from nature experienced in modern cities, where people live and work in environments dominated by concrete, glass, and steel. As natural spaces become less accessible, biophilic design seeks to bridge the gap, reintroducing nature into urban settings through greenery, natural materials, light, and organic forms.

Research Objectives

In response to the growing importance of biophilic design in both landscape architecture, this study aims to:

Investigate the Core Principles of Biophilic Design

Examine the Socio-Psychological and Physiological Impacts:

Evaluate the Role of Biophilic Design in Urban Environments:

Analyze Sustainability and Ecological Impact:

Develop Practical Guidelines for Implementing Biophilic Design:

Through these objectives, this study aims to demonstrate the value of biophilic design in enhancing the quality of life, addressing urban challenges, and promoting sustainable development. This framework will guide an in-depth exploration of biophilic design as an innovative approach to creating environments that support human well-being, ecological health, and sustainable urban living. **(Schwab, 2020).**

Methods

In this study, the significance of biophilic design in the field of landscape architecture will be elaborated, as well as the ways in which it can be implemented in urban and natural spaces. The basic terms and concepts of biophilic design are defined, how it can be implemented in landscape architecture and how it affects through the prism of scientific evidence and studies.

The following methods encompass both qualitative and quantitative approaches, aiming to assess psychological, physiological, and ecological outcomes associated with biophilic elements in urban spaces.

Real views - Inspiration comes from involving different personalities in the research and design process, with a special focus on the needs and interests of the local community, ensuring a thorough connection between the design and the users of the space. Therefore, the research process is based on interaction and communication with citizens, exploring their interactions with nature and the creative potential of the local environment.

Biophilic design

Biophilic design is a modern design philosophy rooted in the human need to connect with nature, aiming to integrate natural elements into the built environment. It goes beyond simply adding greenery to spaces; it creates environments that resonate with humans' innate attraction to nature, improving well-being and fostering a sense of harmony. This concept builds on historical insights into humanity's relationship with nature, brought to prominence by influential figures like Erich Fromm, Edward O. Wilson, and Stephen Kellert, whose theories remain foundational to understanding and applying biophilic design today. (**Wilson, 1984).**

1. Historical Foundations and Theoretical Background

Biophilia refers to the innate human connection to the natural world. The term was first coined by the social psychologist Erich Fromm in 1965 and later popularized by biologist Edward O. Wilson in the 1980s. It describes the intrinsic human tendency to seek out and connect with nature, stemming from our evolutionary history where humans lived closely with natural environments for thousands of years. Biophilia suggests that humans have a biological need for contact with nature, and this connection can enhance physical, mental, and emotional well-being. (**Fromm, 1965).**

Biophilia is the concept that humans are instinctively drawn to nature due to an evolutionary relationship.

Biophilic design is the application of the principles of biophilia in the built environment. It involves incorporating natural elements into architectural and interior design to enhance human well-being, productivity, and overall connection to nature. The goal of biophilic design is to create spaces that not only mimic nature but also facilitate a meaningful interaction with it, which can be achieved through natural light, vegetation, water features, materials, textures, colors, and forms inspired by nature. The design principles of biophilic design can be applied to buildings, interiors, landscapes, and urban spaces.

Biophilic design is the practical implementation of biophilic principles in architecture and design, aimed at improving human connection to nature within the built environment.

Building on Wilson's hypothesis, Yale University's Stephen Kellert expanded the concept of biophilic design. Kellert and his research team identified specific ways to bridge the gap between human life and natural elements through structured design frameworks that support mental and physical well-being. His model of biophilic design serves as a foundational framework for the field, incorporating three primary pillars: direct experience of nature, indirect experience of nature, and spatial elements. (**Kellert, S.R., & Calabrese, 2015).**

Biophilic urbanism is an extension of biophilic design applied at a city or urban planning scale. It refers to the integration of nature and natural systems into the structure of entire urban environments. This concept involves creating cities that prioritize ecological sustainability, promote biodiversity, and foster connections between urban residents and the natural world. Biophilic urbanism encourages city-wide initiatives such as green roofs, urban parks, street trees, water management systems that mimic natural cycles, and the integration of nature into infrastructure and public spaces. The focus is on building cities that are not only livable but also resilient and ecologically integrated, allowing urban dwellers to experience nature in daily life.

Biophilic urbanism is the broad application of biophilic principles on an urban or city-wide level, where nature and human-made environments are harmoniously integrated to create sustainable, resilient, and healthy cities.

2. Contemporary Principles and Framework: Stephen Kellert's Model

Stephen Kellert's model remains central to biophilic design practices and provides a structured approach for integrating natural elements. By applying these principles, designers can create spaces

that are psychologically beneficial, reduce stress, and increase productivity and satisfaction. **(Kellert, 2008).**

Direct Experience of Nature: This component involves tangible and immediate interactions with natural elements within a space, including:

Plants and Greenery: Adding live plants, green walls, or outdoor gardens. For example, offices with abundant indoor plants provide air purification and a calming effect, aligning with this principle.

Water Elements: Incorporating fountains, water walls, or ponds, which add soothing soundscapes and visual interest while supporting mental relaxation.

Natural Light: Designing to maximize natural sunlight through large windows or skylights. Exposure to daylight is associated with improved mood, concentration, and productivity.

Animals and Biodiversity: Including aquariums, birdhouses, or even spaces that encourage local wildlife. Studies suggest that observing animals or plants can help reduce stress and enhance mood.

Indirect Experience of Nature: This category includes visual, material, and sensory connections to nature, even when natural elements aren't physically present:

Natural Materials and Textures: Using wood, stone, and other organic materials, or incorporating textures and colors that mimic those found in nature. For instance, wood grain patterns, bamboo, and textured fabrics can create warmth and a sense of natural beauty indoors.

Nature-Inspired Imagery: Including artwork, murals, or patterns that reflect natural scenes or biomorphic forms. These elements can evoke the essence of nature in the absence of actual natural features.

Colors from Nature: Applying earth tones and shades of green, blue, or brown in design choices that reflect landscapes and contribute to a calming atmosphere.

Natural Fragrances and Sounds: Using essential oils or sounds that mimic natural settings (e.g., waves, birdsong) can enhance the sensory experience of a space, making it feel closer to nature.

Spatial Elements: This component of Kellert's model considers the layout and structure of spaces to evoke natural environments and foster a sense of freedom and refuge:

Prospect and Refuge: Designing spaces that provide both open views (prospect) and secluded areas (refuge), enabling people to feel secure yet free. These concepts, drawn from environmental psychology, support mental comfort and a sense of relaxation.

Complexity and Order: Balancing intricate details (such as patterns, textures, or layouts) with an orderly design promotes visual interest and harmony, echoing the structured complexity of natural environments. **(Browning, W.D., Ryan, C.O., & Clancy, 2014).**

Scale and Movement: Including design elements like varying ceiling heights, curved pathways, or multi-level layouts that mimic natural terrains. These create dynamic spaces that offer both movement and exploration.

Elements

The ideas of biophilia were supported and developed by the American social ecologist Stephen Kellert. He created a framework of elements that can be introduced into building design to enhance the connection with nature, in three key areas: **(Kellert, S.R., & Calabrese, 2015).**

1. Direct Connection with Nature in Urban Spaces

Urban areas often suffer from a lack of direct exposure to natural elements, which can lead to diminished mental and physical health for residents. Introducing natural features such as plants, trees, water, and natural ventilation into urban spaces allows people to reconnect with the environment in a visceral way. Urban parks, green rooftops, living walls, and street trees provide residents with opportunities to experience nature directly in their daily lives. This connection promotes mental stimulation, reduces stress, and improves overall mood. Additionally, incorporating elements like water features, which have a calming effect, and maximizing access to fresh air can significantly improve air quality and the comfort of urban spaces. By creating environments that simulate natural experiences, urban spaces can foster a sense of tranquility and mental clarity, which is crucial in bustling city settings. **(Miller, J., & Searle, 2014).**

2. Indirect Connection with Nature in Urban Settings

In cases where it may be difficult to introduce direct natural elements due to space or infrastructure constraints, indirect connections with nature can be just as effective. These connections are achieved through the use of natural materials, textures, colors, and patterns in design. Urban buildings and spaces can incorporate natural materials such as wood, stone, and bamboo to create a sense of warmth and naturalness. The use of colors inspired by nature, such as earth tones and greens, as well as patterns that mimic natural forms (e.g., honeycomb shapes or floral motifs), can evoke a sense of nature even in the absence of actual plants or trees. Urban art installations, such as murals,

photographs, and sculptures depicting natural scenes or wildlife, also serve as a reminder of nature's presence, helping to counterbalance the sterile nature of concrete and steel structures. This indirect interaction encourages a connection with nature without requiring large physical spaces, making it an adaptable solution for densely built urban areas. (**Lohr, V.I., & Pearson-Mims, 2005).**

3. Human Reaction to Space in Urban Environments

The human response to space is crucial in shaping how we perceive and interact with our environment. In urban settings, the design of spaces that promote physical and mental well-being is essential. The integration of biophilic elements helps create urban environments that are more attuned to human needs. For example, spaces designed with clear mobility and orientation pathways allow for easier navigation, reducing feelings of stress or confusion. The careful design of transitional spaces—areas that bridge the indoors with the outdoors, such as balconies, terraces, or walkways with views of nature—creates a flow that promotes a sense of continuity and calm. Additionally, creating zones within urban spaces that vary in energy—such as areas for active engagement and areas for quiet relaxation—can enhance productivity, creativity, and well-being. In office buildings, public spaces, and residential areas, designing for human perception encourages a harmonious relationship between individuals and their surroundings, allowing people to thrive.

According to Oliver Heath, when creating functional buildings, all these aspects are important.

Biophilic design is about choosing different patterns in these three areas to help achieve the stated goals in the workspace itself. **(Heath, 2017).**

In essence, the biophilia theory explains why we want to be outdoors and live surrounded by nature.

Biophilic design and biophilic elements in landscape architecture

In today's fast-paced, technology-driven world, there is a growing desire to reconnect with nature. That is why biophilic design is a solution that is gaining popularity. It is a concept that integrates nature and architecture to create harmonious spaces that promote health, well-being, and productivity. In response to the human desire for a healthy life, biophilic design features are increasingly found in residential architecture. The focus of architects, designers, engineers, and homeowners is on human health and well-being. This orients the entire industry towards the creation of residential buildings according to the principles of biophilic design and maximum integration of natural elements in the environment of megacities. One way is to green all possible urban spaces and building areas. Plants serve as protection against noise and wind, and in summer they create natural shade. **(Sandeva,V., & Despot, K. 2019)**

This approach helps us to create an environment as close as possible to nature, despite the dominance of industrial architecture, thereby improving the quality of human lives.

Another useful idea is urban gardening. This creates an opportunity for residents of densely populated areas to grow a garden and thus be closer to nature. For example, urban areas, pedestrian islands and green areas in residential areas are used to grow flowers and vegetables. Amateur gardeners are not limited in their creativity. The concept and architecture of residential buildings create a basis for living and working in close connection with nature - even in urban environments.

By 2050, experts estimate that 68 percent of the world's population will live in cities, and 90 percent of their time will be spent indoors. Nature is no longer an enemy to contend with by uprooting trees in your yard, masking the texture of stone and sand with glitter, and fending off the wind and rain with thick walls. This is man's friend, source of inspiration and loyal ally. Biophilia is literally "love of nature and all living things."

The "Nostradamus by Design", trend specialist Lee Edelkort, sees the future this way:

"Nature, with which man again learns to coexist in harmony and happiness, becomes a potential for new biologically based technologies. There is more and more organic design. More materials we'll call 'humble' - plywood, concrete, cork, rattan, clay, jute."

Landscape architecture arises to ensure that the urban ecological quality of cities remains accessible to everyone, conserving natural resources with the intention of promoting more sustainable cities. Using the environmental planning methodology developed by Ian L. McHarg and developing concepts from the ecosystem theory of Drumstad, Olson and Forman, it includes examinations of the physical support associated with urbanization, guiding the construction of green infrastructure networks as the driving axis of sustainable development. (**New York City Department of Environmental Protection (DEP). (2013).**

Green infrastructure in urban areas promotes the perception of the natural landscape of the territory, something essential for the formation of environmental awareness among the population, an ideal condition for improving the relationship of man with nature, promoting, and maintaining the quality of life and the quality of the urban environment. As biophilic design emerges in the increasingly constant context of adaptation to climate change, the work of the contemporary architect is linked to strategies

and techniques in architectural design to minimize the impact of the building and the city on the environment.

Issues such as flexibility and adaptation, always oriented towards an increasingly personal, diverse and experimental offer, are clearly interdisciplinary competencies that biophilic design presents as an integrative position.

Biophilic design from the perspective of architectural and urban practice (biophilic urbanism) integrates, connects, creates connections between natural elements and systems to give a sense of belonging, experience in buildings and urban environments.

This can be done by creating an integrated ecological network and pedestrian paths throughout the city, designating certain parts of land for vegetation and forests, green and biophilic features of building design. and using flora and fauna throughout the city.

Recently, landscape architecture, design and biophilic urbanism have established a conceptual and pragmatic connection. **(Sauer, T., & Young, 2017).**

Any modern developer who fills yards with concrete for parking and minimizes the flow of daylight into apartments is acting very recklessly. Without contact with nature, the harmonious life of the urban man is impossible, and it is difficult to build healthy and friendly communities.

Architecture can be made more biophilic by simple means:

• gardens on the roofs of the houses and business spaces in the yard,

• smooth building lines and layout of apartments that maximize access to daylight,

• large windows and comfortable balconies.

But many architects turn modern residential complexes into real gardens. For example, the One Central Park residential complex in Sydney was the result of the joint work of the famous architect Jean Nouvel and the landscape designer Patrick Blanc. According to their plan, the park is in the center of the site, rising smoothly to the facades of the glass towers. At an altitude of 116 meters, 350 varieties, the strongest and most resistant to environmental influences, grow. They are watered with purified LCD wastewater.

Figure 1. One Central Park in Sydney https://www.researchgate.net/figure/Central-Park-Sydney-Australia-Biophilic-facade-Source-Katherine-Lu_fig1_348792473

By applying biophilic design principles, architects and designers strive to create spaces that evoke a sense of calm and vitality and promote a deep connection with the natural world. This design philosophy takes inspiration from the patterns, textures and colors found in nature, as well as the use of natural light, vegetation, and views of nature.

Implementation of biophilic design principles

To effectively implement the principles of biophilic design, architects and designers consider several key elements:

1. Natural Light - Maximizing access to natural light is critical to biophilic design. Large windows, skylights, etc., allow enough daylight to enter the space, creating a connection with the outside world and reducing the dependence on artificial lighting, while ensuring well-being.

2. Views of Nature - Incorporating views of nature, whether through windows or strategically placed outdoor spaces, helps establish a visual connection to the natural world. This allows residents to enjoy the beauty of nature and feel its calming effect.

3. Living materials - Using natural materials like wood, stone or bamboo adds warmth and authenticity to the design. These materials provide a tactile connection to nature, creating a sensory experience that enhances well-being.

4. Indoor plants and greenery - Introducing indoor plants and greenery can make a significant contribution to creating a biophilic experience. Plants not only improve air quality, but also add visual interest, texture and a sense of life and vitality.

5. Water Features - The use of water features, such as fountains or reflecting pools, add dynamism to a space and enhance the calming effect of nature. The sound and movement of the water evokes a feeling of calmness and tranquility.

6. Biomorphic Shapes and Patterns - Using organic shapes, patterns and textures inspired by nature can create a sense of harmony and balance. Curved lines, fractal patterns and biomorphic structures mimic the natural world, creating a soothing and visually pleasing environment.

Some studies suggest that employees who work in natural design and outdoor environments are 6% more productive in business and have 15% higher levels of inner well-being and self-confidence. By embracing the principles of biophilic design and implementing them thoughtfully, we can create spaces that not only capture the senses, but also nurture the human innate connection to the natural world. **(Sandeva,V., & Despot, K.** (2019) Art principles in park art as a factor for street landscaping in cites)

Materials and psychological effects

Biophilic design offers an opportunity for the built environment to act as part of a proactive and salutogenic approach to health rather than the standard reactive and pathogenic approach to health.

It can be argued that biophilic design is one of the directions of human-centered design. Oliver sees it as a kind of protective shield, something much more important than just one direction. Biophilic design has not only material but also psychological benefits. If a man enters a building and sees a lot of plants and greenery, his visual senses will tell him: if the plants can live here, he can be here - like the plants, he too will develop and flourish.

A salutogenic approach sees "health" as encompassing multidimensional factors such as psychological, cognitive, social, and environmental influences, rather than just biological ones.

Houseplants improve indoor air quality by absorbing mold spores, pollutants, and toxins. They moisten the air, reducing human vulnerability to allergens and respiratory pathogens, and have a calming effect on people and lower blood pressure.

The biophilic design reduces stress levels, putting the person in a calm state. With less demand on cognitive functions for perceptual processing of natural environmental stimuli, attentional resources get the opportunity to replenish more quickly than when experiencing fake nature or a busy urban street.

Natural light regulates sleep cycles and increases energy levels as well as productivity. Using biophilic principles increases creativity, improves memory and learning, and promotes clarity of thought, including during relaxation.

The benefits of biophilic design go far beyond aesthetics. Research has shown that incorporating nature into the human environment can have a profound impact on human well-being, productivity and overall quality of life.

A study by Caitlin Gillis and Birgitta Guttersleben found that including plants in indoor environments reduces stress and increases pain tolerance; the use of water features and incorporating views of nature are also mentally restorative for residents. **(Gillis, C., & Guttersleben, 2016).**

Biophilic design follows the principles of sustainability by promoting the use of natural materials, passive design strategies and energy efficient technologies. By minimizing the impact of buildings on the environment and maximizing their connection to the natural environment, biophilic design helps to create more sustainable and ecological spaces.

In doing so, the benefits of green space may increase with higher levels of biodiversity.

Scientific justification

After man lived most of his history in the savannah, the forest, or the sea, today he finds himself in an urban, noisy, and unhealthy environment.

The theory behind biophilia is to use nature to reduce stress, restore strength, and improve a person's overall mental and physical well-being. Creating the necessary atmosphere to maintain a positive mood in various areas that are directly related to human activity has many benefits. Oliver Heath emphasizes that these benefits have been confirmed by numerous studies over the past 30 years, analyzing different types of buildings. **(Heath, 2017).**

Students learn better in natural light; patients recover faster and take less medication if they have access to nature. There is evidence that incorporating natural elements into offices improves productivity, creativity, and engagement at work. Biophilic design is an evidence-based approach, yet few architects and designers are aware of it or study it during their training.

As a clear example, Oliver Heath cites hotels, that is, with rooms with windows on two sides: one facing the city and the other facing the beach. According to him, a window facing the beach is what most people will choose, and perhaps be willing to pay more for.

The biophilic design trend is fueled by a few scientific studies showing that nature, whether it's indoor plants or natural light, is good for human health.

Furthermore, a landmark 2019 study found that children in Denmark who saw more greenery around them had 55% fewer mental health problems later in life compared to those who had less interaction with nature.

Research also links plants to productivity. Scientists in Norway found that subjects who completed reading and attention tasks while surrounded by greenery performed better over time than another group of examinees.

One idea is called the "attention-retrieval theory": we spend a lot of time at work, constantly staying focused, which leads to mental fatigue. Even if the person takes his eyes off the screen for a few seconds and looks at the plant on his desk, you can relax and regain the ability to concentrate.

As a result, companies like Google, Etsy, and many others have embraced biophilic design as a way to make employees happier, more creative, and more valuable. Living walls in the offices of technology companies are so common that they have become a design cliché. Furniture companies are now designing office desks with built-in plant boxes.

Impact on other industries

The biophilic design movement is taking over entire buildings and even cities. Scientists believe plants can act as sensors, helping to track mold and volatile organic compounds in buildings.

A 2016 report from engineering firm Arup argued that all buildings should be covered in greenery to pull carbon dioxide from the air, filter it, reduce noise, and keep cities cooler. The Biophilic Cities project aims to demonstrate how different cities give residents the opportunity to get closer to nature, whether through parks or less traditional options like rooftop gardens.

All people feel better when there is more nature in their lives. Biophilic design simply acknowledges this fact and helps make human indoor spaces, human buildings, and even human cities a little less gray and a little more green. **(Browning, W.D., Ryan, C.O., & Clancy, 2014).**

Most people feel best in nature. Being in nature improves human health, relieves stress, improves human mood and well-being, and even increases human intellectual and creative potential. However, with the modern way of life it is not always possible for a person to spend a lot of time in nature. He lives and works in an urban environment. Thus, the concept of biophilic design helps to make urban environments more natural by incorporating natural forms and principles into spaces and architecture.

Conclusion

In conclusion, in the face of escalating urbanization and its associated challenges, the integration of biophilic design principles in landscape architecture appears as a compelling solution to foster a harmonious coexistence between the built environment and the natural world.

This this study has identified the important socio-psychological and physical impact of nature on human health and well-being.

Through the implementation of biophilic design principles, architects can create spaces that unite man and nature, reduce stress, and increase general happiness and productivity.

Also, biophilic design has the potential to be implemented in various types of projects, from urban squares and buildings to residences and gardens, to ensure sustainability, aesthetics, and functionality.

This this study advocates a paradigm shift in architectural practices, calling on architects and designers to prioritize biophilic design principles in their creations. Adopting biophilic design principles is not just a design strategy, but a declaration of commitment to creating landscapes and designs that inspire, rejuvenate, and contribute to the overall health and vitality of individuals and communities.

To promote the wider adoption and success of biophilic design, the following action steps and recommendations are proposed:

1. Integrate Biophilic Design into Urban Planning Policies
2. Increase Awareness and Training for Architects and Designers
3. Research and Quantify Biophilic Design Benefits
4. Promote Biophilic Design as a Core Strategy in Sustainable Architecture
5. Encourage Community Involvement in Biophilic Projects

As we look to the future, the integration of biophilic principles into landscape architecture is becoming a powerful tool for shaping a sustainable, resilient, and deeply connected built environment.

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