

Board 1: WIP: Biophilic Design and Its Effects on Mental and Physical Health

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Work in Progress: Biophilic Design and its Effects on Mental and Physical Health

Abstract

The design of interior spaces can greatly impact one's health. People living in urban areas have lost their connection to the natural environment in their daily lives. Because people spend more time indoors, the importance of well-designed interior spaces has increased dramatically. Using biophilic design in architecture can increase productivity and creativity and positively impact mental health. Biophilic design involves incorporating organic materials, patterns, colors, textures, and plants into the built environment. This project aims to highlight the importance of biophilic design in architecture and how it can be incorporated into interior architecture.

Introduction

In 2007, for the first time in history, the population of people living in cities surpassed that of people living in rural areas [1]. In 2050 it is estimated that 75% of people will live in urban environments [1]. While this is good for nature because people moving out of rural areas will allow nature to take back those areas, but for people, this means spending less time outdoors [1]. It is estimated that people spend approximately 90% of their time indoors [2]. Being in a natural environment has many health benefits [1], [2], [3], [4]. Biophilic design brings nature into our buildings and allows people to reconnect with nature and reap the benefits of being outdoors in indoor spaces where they spend an extended period of time [3].

This project aims to show the benefits of biophilic design on mental health, physical health, sustainability, and general quality of life. It will also show how biophilic design can be incorporated into existing buildings. The project will begin with extensive research by interviewing professionals with experience on this subject and visiting buildings in the region that utilize biophilic design. A model of an educational building will then be created incorporating biophilic design, and students will be asked to share their thoughts. A guide will be created that shows the most effective ways to incorporate biophilic design into a building for students to use in their projects.

Literature Review

“Biophilia” comes from the Greek words “bio,” meaning “life,” and “philia,” meaning “love.” German Psychologist Erich Fromm first used the term “biophilia” to describe the psychological orientation to like things that are alive [1], [2]. In the 1980s, American Biologist E.O. Wilson used the term to describe the evolutionary adaptation that allows one to connect with the living world and nature [1], [2], [3].

Health

Spending time outdoors in natural environments has been shown to improve mood, concentration, working memory, self-esteem, energy levels, self-perceived health, and reduce stress [5]. Studies have even found that in greener cities, crime and aggression decrease and there

is greater social cohesion [3]. Even just looking at a representation of nature, such as a painting, can utilize the benefits of the natural environment [5], [6], [7].

In a study at a hospital in Korea, patients recovering from an appendectomy were placed in a room containing 12 foliage or flowering plants or a control room with no plants added [6]. “Patients in the plant group experienced a statistically significant reduction in anxiety, pain intensity, pain distress, and the amount of analgesics used” [6, p. 10]. Another study focusing on the significance of live plants versus pictures of plants or no plants found that patients utilizing the waiting rooms where the plants or posters of plants were added experienced significantly less stress compared to the control waiting room with no plants or plant posters [6].

Air Quality

As the need for more energy-efficient buildings increases, insulated buildings reduce the airflow between the inside and outside [8]. This, combined with smaller confined spaces often seen in energy-efficient buildings, can lead to poor air quality [8]. Poor indoor air quality can lead to sicknesses such as Sick Building Syndrome with symptoms such as headache, irritated eyes, nose, and throat, dizziness, fatigue, and nausea [8]. It is estimated that over 27 million people that work in offices experience sick building syndrome [3], [8].

The need for more air filtration systems drives up energy usage and the cost of operating the building [8]. In 1989, a study was conducted by NASA to determine more natural ways to filter the air [9]. In the experiment, several common houseplants were tested to see how effectively they filtered the air [3], [8], [9]. They found that plants could effectively filter Formaldehyde, Benzene, and Trichloroethylene out of the air [9]. The bacteria found in the potting soil of the plants were also found to be effective at filtering the air [9]. The study determined that “The plant root-soil zone appears to be the most effective area for removing volatile organic chemicals” [9 p. 18]. When plants are used appropriately for air ventilation, they can reduce air-conditioning and ventilation energy loads by 10-20% [8].

Adding Biophilic Design to a Space

Restorative environmental design (RED) was proposed by Stephen Kellert and includes low-impact, sustainable design combined with biophilia to improve the human-nature connection [7]. “The goal of RED is to combine the preservation of long-lasting and positively impactful buildings with interior and exterior biophilic features” [7, p. 117]. Rating systems such as LEED and the Living Building Challenge encourage designers to design more sustainable and biophilic buildings [7].

According to Kellert, people tend to be drawn to biophilic design; thus, it should be added where they spend a significant amount of time [7], [10]. There are two main dimensions of biophilic design, organic dimension and place-based [7]. The organic dimension has three main categories, direct experience of nature, indirect experience of nature, and symbolic experience [7]. Direct experience is perhaps the most obvious attribute of biophilic design because it involves coming into contact with natural elements such as plants, natural light, and animals [7]. Indirect experience of nature includes things that require more human involvement, such as a potted plant

[7]. Symbolic experience is things such as images or videos, but the person has no direct contact with nature [7]. The organic dimension also includes things like botanical patterns and shapes without straight lines [7]. Place-based biophilic design connects to the local natural environment, for example, the geography of the area [7], [10]. Place builds upon the connection that people share with a space and each other [1], [7], [10].

Ryan *et al.* [11] suggest that there are many patterns of biophilic design, including visual connection with nature and non-visual connection with nature. Visual connection with nature requires seeing something organic to experience the benefits of biophilic design while engaging senses other than sight [11].

Case Studies

One of the most obvious forms of biophilic design is direct experience [7], [12]. In Utrecht, the Netherlands, an office building that incorporates an indoor garden into the middle floors of the building. The indoor garden features a stream and boardwalk that meander through 1,500 different species of plants [13].

A less obvious version of biophilic design that is still direct connection to nature can be seen in a pavilion in Hoge Veluwe National Park in Otterlo, the Netherlands [12], [14]. The designers De Zwarte Hond, Monadnock, and Vos Interieur make references to the outdoors without being as obvious as adding live plants. Instead, they choose to rely on light and sound. One unique element that the pavilion utilizes are the chandeliers designed by Beersnielsen Lighting Designers [14]. The chandeliers consist of 20 individual light fixtures that can be dimmed. Above the lights is a Pringle-shaped shade with cutouts. The chandelier casts a shadow on the white vaulted ceiling that creates shapes that resemble the sun shining through a forest canopy [14]. The lights change intensity creating the illusion that the branches created above the viewer are moving in the wind. Shapes of birds and chipmunks also make appearances on the ceiling. Dozens of speakers located around the building play birdsong reinforcing the idea that the occupant is experiencing nature [14].

Methodology

This is an exploratory study for me as a student to understand Biophilic Design and how it can be used inside existing buildings. I will fulfill my goals by interviewing professionals who have experience with biophilic design and its use inside buildings. I will also research buildings that incorporate biophilic design. I will determine what aspects are used and how they can be incorporated into my own designs. My next step will be to create a model of my chosen educational building on a local university campus and create a pre and post-design of the building. Using a VR headset, I will allow students to experience the area with and without biophilic design and survey them on which they prefer and why. If they prefer the design with biophilia, I will survey them on which parts they like the best and why. A guide will be created for students to use that emphasizes different ways to incorporate biophilic design into their projects. The guide will act as a tool to help students understand how biophilic design can be incorporated into new buildings and existing ones.

Timeline

Item	Date	Completed
Preliminary Research	January/February	Yes
CITI Training	February	Yes
IRB Approval	February	Yes
Begin Building Modeling	February	Yes
Case Studies	March	In Progress
Interview Architects	March/April	In Progress
Complete Building Model	April	In Progress
Survey Students	April	
Begin Checklist	May	
Complete Checklist and Final Paper	Nov	

Current Research

I have begun my research on biophilic design and have completed my CITI training. I have created the materials needed to begin surveying students and have IRB approval to begin. I have also begun doing case studies. I have begun modeling the room that students will be viewing when I survey them.





I have used natural materials such as wood on the walls, floors and tables. Plants have been added around the room to create the direct experience with nature that Kellert mentions [7].