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Biophilic Design Integration In Primary School Fosters Holistic Development In Pre-Teen

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ABSTRACT

The term "biophilic design" is derived from the Greek word "biophilia," with meaning "love of nature." The human race has lost its connection to nature as a result of growing urbanization and modernization. The idea of biophilic design has grown in popularity recently because it can improve well-being and promote holistic development in people of all ages. The incorporation of nature into our constructed environment is crucial because it can activate physiological mechanisms that promote healing. The study focuses on the notion of biophilic design and the key developmental changes that pre-teen experience in primary school. Along with their interdependence, it also addresses the close relationship between the human body and its environment. The objective is to gauge knowledge of biophilic design and its effect on preteens' cognitive development because they represent the next generation. The study includes case study results, academic articles on biophilic design and its use, as well as publications on the consequences of biophilic design. This review article emphasizes the value of implementing biophilia and its design principles in elementary schools. The research focuses on the biophilic design ideas and components that can promote pre-teen (age group 5–12) development. Finally, it will offer a few design principles and tactics that might help schools adopt biophilic design.

Keywords: Biophilia, Biophilic Design, Primary Schools, Pre-teens, Holistic Developments

1.0 INTRODUCTION

This is a world where depression and mental health issues have become the foremost causes of psychological and physical disability globally, the significance of environmental design in shaping our well-being cannot be overstated. With approximately 90% of our time spent within buildings, designers are presented with both a daunting challenge and a promising opportunity to redefine the way we interact with our surroundings (Terri Peters, 2020). In addition, a variety of studies indicate that students' challenges with mental health are now a significant barrier. Studies show that students at universities have higher rates of depression than the general population and that they also deal with stress related to their friends, their studies, their families, and their finances. These issues often begin in the early stages of life, but their impact may only become apparent later. To address them effectively, it is crucial to focus on enhancing the development of the human mind and body during the formative years, specifically from 5 years to 12 years of age. We must nurture children during their formative years, usually between the ages of 5 and 12, just as we nurture a tree during its early growth stages to ensure that its roots become strong enough to stand tall. They begin to assimilate information and knowledge during this crucial time, which has a big impact on how they develop holistically and how well they can handle stress and anxiety later in life. However, because we were not exposed to such an environment when we were younger, as adults we frequently fail to recognize this.

In recent years, the concept of biophilic design has gained recognition for its potential to enhance well-being and foster holistic development in individuals across all age groups. Numerous studies indicate that the human body has a special connection to nature and that this connection might cause the body to initiate healing processes. However, with the advent of new technologies and the rapid urbanization of the upcoming generation, this vital link is weakening. Nature and its elements possess extraordinary powers that can profoundly impact a person's cognitive, psychological, physical, and mental well-being (SALINGAROS, 2015). Biophilic design seeks to reconnect people with nature by incorporating natural elements and patterns into the built environment. The development of pre-teens' cognitive, emotional, and physical faculties can be significantly impacted using biophilic design in indoor settings like schools, homes, and recreation areas. Numerous studies have shown that adding biophilic design elements to environments, such as lots of natural light, strategically placed windows that frame outdoor views, varied lighting levels, the use of natural materials, indoor plants, green roofs, and maximizing green space around buildings, has significant positive effects on both physical and mental health (Terri Peters, 2020).

2.0 LITERATURE REVIEW

The impacts of biophilic design on people have come to light in recent years. Although its impacts on people of all ages, particularly university students, have been extensively examined, the implications on pre-teen growth have received less attention. The research and articles from journals used to develop this review paper include equivalents for the terms biophilia, built environment, primary schools, pre-teens, and design strategies. The papers date back to 2013 through 2023. The significance of biophilic design in primary schools will be emphasized in this paper because its implementation can significantly improve kids' health and well-being. Despite its importance, biophilic design in school is still largely unexplored in many nations. The paper will delve into the tenets and components of biophilic design, emphasizing how it helps preteens develop generally.

2.1 UNDERSTANDING BIOPHILIA

The word "biophilia" was originally used in 1973 by German psychologist Fromm, who defined it as "the passionate love of life and everything alive." The expression has Greek roots; bios is an acronym for life and philia is the term for love. The American scientist Wilson subsequently made this term prominent in 1984. The definition of biophilia given in the theory is “the desire to connect with other life forms”. As proven by human evolution, 99.9% of all living species have an adaptive response to the natural world and the forces that it generates. These coping mechanisms increased human dependence on the environment and its resources (Farhan Asim, 2020). The mathematical principles of biological shapes, which serve as a blueprint for us, are the second source of biophilia. The building is said to trigger a universal, recognizable "kinship" response in people that bridges the gap between living things and inanimate objects (SALINGAROS, 2015).

Most often, biophilia is misunderstood to mean modeling a structure after anything in nature. That is essentially biomimicry, which involves applying inert replicas of natural structures to a building's exterior (SALINGAROS, 2015). Furthermore, the concept of "bio-phobia" is connected to biophilia. The quickest way to understand this is to consider the concept of attraction as biophilia and repulsion as biophobia. Although some researchers contend that biophobia is a part of the biophilic system for the sake of researching biophilic design, it would be more practical to keep the two ideas of biophilic and biophilic separate. (Bettina Bolten, 2019).

2.2 BIOPHILIA TO BIOPHILIC DESIGN

We got much more disconnected from nature during the industrial revolution. Because of how difficult to feel isolated was, many people felt the urge to reclaim their biophilia by spending as much time as possible in nature. The idea of biophilic design first surfaced around this time. It is an intentional strive to include knowledge of the universal human tendency, known as biophilia, to relate to natural systems and processes in the planning of constructed environments (Bettina Bolten, 2019). Within the past forty years, biophilic design has gained popularity and is now seen as a means of bridging the gap between people and nature. Buildings should not serve as a barrier or divider that prevents access to another area since they are intended to act as a filter between people and their natural surroundings (Farhan Asim, 2020).

Natural environments make people feel good, capture their attention in a calming way, and help them recover from stress and mental tiredness. Nature has elements that help us feel more focused, interested, and at ease. It also has things that our brains naturally respond positively to, like things that help us survive. On the other hand, city environments often have things that make us feel stressed, bored, or not excited. The idea of biophilic design suggests that we can make buildings more relaxing by including natural things in their design. This fits into a bigger idea of designing spaces that help us feel better. Many studies that have investigated biophilic design use research about restorative places to show that adding natural elements to our surroundings is good for our health and well-being. Even though the term "biophilic design" is relatively new, there's a lot of research about nature and places that make us feel restored, which strongly supports the idea that including natural elements in design can be good for our health and well-being. (TAHOUN, 2019).

2.3 MISCONCEPTION OF BIOPHILIC DESIGN TO GREEN BUILDINGS

Buildings with biophilic designs are frequently mistaken for green structures. We may explain this by stating that all structures created by the principles of biophilic design come under the category of green structures. However, the biophilic design approach does not always need to be used when designing green structures. For instance, for a structure to be deemed "green," it must adhere to several fundamental standards, including the use of natural resources, the reduction of carbon emissions, the use of water carefully during construction, the inclusion of native plants, and the use of design strategies for ventilation, lighting, and airflow. The use of natural materials, proper daylighting, color palettes, and similar elements are the focus of biophilic design, in contrast. Biophilic design goes beyond the environmental aspects of a green building and dives into designing environments that truly link humans with nature, even if both concepts have a relationship to sustainability and well-being.

2.4 PRINCIPLES AND PARAMETERS OF BIOPHILIC DESIGN

Instead of bringing nature inside the home, biophilic design refers to an effort to re-establish a connection between

people and the natural world and its components. Three categories make up "biophilic design," including "Direct Experience of Nature," "Indirect Experience of Nature," and "Experiencing Space and Place" (Bettina Bolten, 2019), (Terri Peters, 2020). To fully create a biophilic design, five principles must be followed about biophilic design (Rokhshid Ghaziani, 2021),

1. It involves consistent and ongoing interaction with nature.
2. It focuses on how, over the history of evolution, human adaptation to the natural world has enhanced human health, fitness, and welfare.
3. It promotes emotional connection to specific locations and settings.
4. It facilitates beneficial interactions between people and nature, which fosters a deeper feeling of connection to and accountability for the communities of both people and wildlife.
5. It promotes linked, integrated, and mutually reinforcing architectural solutions.

There are around 72 biophilic design elements that we may apply to create a healing atmosphere, according to study publications. These attributes are evaluated using a reliable method called the Biophilic Quality Index. Biophilic design is broken down into three topics in Terrapin's Bright Greens '14 Patterns of Biophilic Design: Nature in the Space, Natural Analogues, and Nature of the Space, as seen in Table 1. Individual patterns are examined, and their advantages are emphasized within these three themes (Stephen R. Kellert, The Practice of Biophilic Design, 2015).

Table 1: 14 PATTERNS OF BIOPHILIC DESIGN *(Stephen R. Kellert, The Practice of Biophilic Design, 2015)*

THEME	NO.	PATTERN
NATURE IN THE SPACE	1	Visual Connection with Nature
	2	Non-Visual Connection with Nature
	3	Non-Rhythmic Sensory Stimuli
	4	Thermal and Airflow Variability
	5	Presence of Water
	6	Dynamic and Diffuse Light
	7	Connection with Natural Systems
NATURE ANALOGUES	8	Biomorphic Forms and Patterns
	9	Material Connection with Nature
	10	Complexity and Order
NATURE OF SPACE	11	Prospect
	12	Refuge
	13	Mystery
	14	Risk/Peril

Any building type may be designed using these criteria. The '14 Patterns of Biophilic Design (14 PATTERN OF BIOPHILIC DESIGN) brochure from Interfaces uses Terrapin Bright Green's work to describe each pattern and delve into its experience. The guide also provides step-by-step instructions for applying each design. Although the practical examples are mostly geared toward workplace settings, they do serve as a foundation for further exploration of how biophilic design might be incorporated into other constructed environments, such as schools.

2.4.1 NATURE IN SPACE

The phrase "nature in space" alludes to nature's direct, apparent, and transient presence in a place or setting.

2.4.2 NATURE ANALOGUES

Organic, non-living, and indirect representations of nature are called natural analogies. The artwork, decoration, furniture, décor, and textiles in the built environment contain elements, materials, colors, forms, and patterns that may be found in nature.

2.4.3 NATURE OF SPACE

The formation of veiled perspectives and revelatory moments leads to the best experiences when combined with patterns of nature in space and natural analogues.

Table 2: Parameters of biophilic design and its pattern and experience (14 PATTERN OF BIOPHILIC DESIGN) (Rokhshid Ghaziani, 2021)

S.NO.	THEME	PARAMETERS	PATTERN	EXPERIENCE
1.	Nature in The Space	Visual Connection with Nature	A perspective on natural components, living things, and organic processes.	Feels complete, attracts attention, energizing or soothing, provides an awareness of time, weather, and other aspects of daily life
2.		Non-Visual Connection with Nature	Hearing, feeling, smelling, and tasting are additional senses	Feels balanced and new, Ambient circumstances are viewed as
			Outside sight that intentionally and favorably allude to nature, living things, or biological processes.	complicated and changing but also comforting and familiar. There are textures, scents, and sounds that make you want to go outside in nature
3.		Non-Rhythmic Sensory Stimuli	Random and temporary interactions with nature can be studied but cannot be exactly anticipated.	It has the impression of exposing you to something unique and brand-new suddenly. Interesting, energetic, and stimulating, A momentary yet welcome diversion
4.		Thermal and Airflow Variability	Mild variations in surface temperatures, airflow over the skin, relative humidity, and temperature that resemble natural conditions.	Feels revitalizing, vibrant, dynamic, comfy, and energizing. Feels both flexible and in control.
5.		Presence of Water	A circumstance where the sight, sound, or touch of water improves one's perception of a location.	Impressive, fascinating, and enticing. A venue's flow, sound, lighting, closeness, and accessibility determine whether it is exhilarating, calming, or both.
6.		Dynamic and Diffuse Light	Create settings that resemble those seen in nature by providing various levels of light and	Causes feelings of drama and mystery, has a sense of time, and exhibits indicators of time and movement.
			shadow that fluctuate over time.	
7.		Connection with Natural Systems	Understanding natural processes, particularly seasonal and temporal variations, is a sign of a healthy ecosystem.	Evokes a connection to a larger entirety, increases awareness of seasons and life cycles, anticipatable, calming, nostalgic, deep, or illuminating
8.	Nature Analogues	Biomorphic Forms and Patterns	Symbolic allusions to the shapes, designs, textures, or number groupings seen in nature.	Feels interesting and comfortable, possibly feels fascinating, attractive, thoughtful, or even absorptive.
9.		Material Connection with Nature	Natural elements with little processing that, by displaying the geology or environment of the area, provide a place with a distinct feeling of identity.	Rich, genuine, and pleasant feeling; occasionally arousing to the touch

10		Complexity and Order	Discrete sensory information that is organized spatially, as in nature.	Interesting and information-rich, with just the right amount of dull and overwhelming.
11.	Nature of Space	Prospect	Unobstructed long-distance vision for planning and observation.	Gives a sensation of safety and control, especially when one is alone or in an unknown area. Feels open and liberating.
12.		Refuge	A place of refuge where one may retreat from their surroundings or the main activity stream while yet being protected from above and behind.	Gives a sense of safety and withdrawal, whether it is for work, protection, relaxation, or healing. Feels different/ distinctive from surroundings Although not always, spatial features can be kind, accepting, and protective. disconnected
13.		Mystery	A sensory device or partially veiled views that entice a person to explore their surroundings more deeply by promising more information.	A genuine sensation of suspense or being teased provides the senses with a sort of denial and reward that drives further in-depth investigation, generates interest, and/or promotes exploration.
14.		Risk/Peril	A recognized threat and a trustworthy defense.	Feels exciting, and with a suggested threat, maybe even a little harmful, feeling of danger, but intriguing all the same, worth exploring and possibly even irresistible

2.5 GROWTH CHANGES IN PRE-TEEN

A critical period for the growth and development of the brain is the pre-adolescent stage, also referred to as the pre-teen years. During this time, children's cognitive abilities significantly develop, shaping their thinking, problem-solving skills, and worldview. These alterations provide the framework for the risks and challenges they'll experience as they enter adolescence. There may be some noticeable changes, such as:

1. Cognitive Development Spurts: Cognitive developmental periods similar to those in early childhood occur in preteens. In contrast, these waves are more refined and precise. As their brains continue to develop, preteens show improvements in abstract thinking, decision-making, and complex problem-solving. They begin to consider many point of view and carefully consider the outcomes of their choices.

2. Development of Executive Functions: The decision-making abilities of the preadolescent brain expand significantly throughout this period. Some of the most complex cognitive processes are working memory, flexibility in thinking, and inhibitory control. When presented with challenges, pre-teens are better able to restrain their urges, establish plans, and adjust their strategies. These skills are necessary for both academic success and general success in life.

3. Self-Identity and Social Cognition: Preteens embark on a journey of self-discovery and frequently struggle with questions of identity and belonging. An increase in self- awareness and a growing ability to understand the ideas and feelings of others define this stage. As they navigate complex peer connections, group dynamics, and social interactions, preteens acquire social cognition.

4. Increased Capacity for Abstract Thinking: Pre-teens are better able to understand metaphors, analogies, and symbolic representations because their capacity for more abstract thought develops throughout the pre-adolescent years. This improves their understanding of challenging concepts in a variety of subjects, from mathematics to literature.

5. Language Development: Due to their improving language skills, preteens are now able to express themselves with greater complexity and depth. As their vocabulary develops, they get better at articulating complex ideas and emotions. This increase in language development has an impact on both the development of spoken and written language understanding as well as communication.

6. Developing Problem-Solving Skills: Preteens are beginning to develop their aptitude for critical thought and problem-solving. They can analyze problems, break them down into more manageable pieces, and develop solutions. This

rising potential is closely tied to how their executive functions and cognitive flexibility are developing.

7. Emotional Regulation: Preteens work to develop better emotional control as their cognitive skills advance. They become better at identifying and understanding their emotions, which helps them manage their reactions and responses to various situations.

This skill is necessary for forming healthy relationships and navigating adolescence's emotional challenges.

8. Building Autonomy: Growing independence in preteens and brain development are related. As their cognitive abilities develop, they acquire a sense of independence and a desire to take charge of their own lives. During this time, parents and educators have the potential to encourage pre-teens' sense of responsibility while assisting them in making responsible decisions.

During the preteen years, there is a huge period of cognitive development. From infancy to adolescence, children's cognitive skills develop, becoming more complex and subtle. By fostering their executive functions, abstract thinking, social cognition, and emotional regulation, pre-teens are provided the skills they need to excel academically, socially, and emotionally. It is crucial to recognize and support these cognitive changes to help pre-teens navigate the difficult transition to puberty with confidence and resolve.

It is obvious from the discussed changes how crucial the pre-adolescent period is. But because we regard them as children and fail to consider the need for their full growth, we typically ignore this.

2.6 CONNECTION OF BIOPHILIC DESIGN AND PRE-TEEN HOLISTIC DEVELOPMENT

In today's rapidly changing environment, the importance of holistic development during the preadolescent stage is now more widely recognized than ever. An innovative strategy called "biophilic design," which is founded on the notion of bringing nature into artificial environments, has attracted considerable interest because it has the potential to improve several aspects of human well-being. Let's reveal how the incorporation of nature-inspired elements could promote the overall development of pre-teens by examining the intriguing
relationship between biophilic design and this age group.

1. ENHANCING COGNITIVE GROWTH: Research suggests that biophilic elements in learning spaces can enhance preteens' cognitive development. Natural light, organic shapes, and visual connections to the outside world inspire their creativity and curiosity, fostering an environment that is conducive to learning and discovery.

2. STRESS REDUCTION AND EMOTIONAL WELL-BEING: The presence of
biophilic variables has been shown to reduce stress and improve mental well-being. Since pre-teens commonly deal with social pressures and academic demands, it is crucial to establish calm environments that foster relaxation and emotional resilience. Indoor plants, organic textures, and calming hues can all be used to create an atmosphere that is more calming and encouraging.

3. PROMOTING PHYSICAL EXERCISE AND CONNECTION: The outside
experience and physical activity are essential for pre-teens' healthy development, and biophilic design may encourage these behaviors. Pre-teens can be persuaded to spend more time outside and forge closer relationships with nature by incorporating green spaces, outdoor seating areas, and interesting natural features.

4. FOSTERING SOCIAL INTERACTION AND EMPATHY: Biophilic environments can also foster pre-teens' social skills and empathy. Natural settings encourage interactions that build teamwork, communication, and the development of interpersonal skills.

The intriguing relationship between biophilic design and the holistic growth of preadolescents suggests that habitats can be included in living and learning spaces. As we seek to provide the best conditions for their growth, using the power of biophilic design may assist create situations that are more harmonious and enriching for pre-teens. By nurturing pre-teens' cognitive ability, emotional well-being, physical health, and social skills, we can help them get through the challenges of this transitional stage and set them on the path to a better and more balanced future.

3.0 FINDINGS

From the case studies of primary schools around the world which used biophilic design, some specific strategies were observed in the primary school based on the parameters mentioned. It was observations are given below:

Table 3 Effects observed in primary schools *(14 PATTERN OF BIOPHILIC DESIGN) (Rokhshid Ghaziani, 2021)*

S.NO.	STRATEGIES	EFFECTS	DESIGN PARAMETER
1.	1. Working area with windows that overlook the outdoors (trees, mountains, water, sky)	**1.** Positively impacted attitude and overall happiness	Visual Connection with Nature
	2. Plants, flowers & green walls in the classroom space	2.Improved mental engagement /attentiveness 3. Lowered blood pressure and heart rate	
2.	1. Sound (animals, conversation, music, water) 2. Smells (perfume, fragrant plants) 3. Touch (handrails, water for cooling the space)	1. Decreased stress hormones and systolic blood pressure 2. Had a beneficial impact on cognitive performance 3. Perceived enhancements in peace and mental health	Non-Visual Connection with Nature
3.	Indoor: Kinetic facades (facades with moving elements that can be seen from the corner of the eye), interactive design displays. Outdoor: The sound of passing insects, dripping water, and waving grass	1. Enhanced sympathetic nervous system activity, systolic blood pressure, and heart rate 2. Attention and exploratory behaviors that have been seen and quantified	Non-Rhythmic Sensory Stimuli
4.	1. Windows that can be opened manually & controlled individually 2. Class spaces with outdoor balconies 3. Visible mechanical ventilation	1. Improved productivity, well-being, and comfort 2. Had a favorable effect on concentration 3. A more accurate understanding of temporal and spatial pleasure	Thermal and Airflow Variability
5.	1. Water base in lobby 2. Water walls 3. Fountains 4. Aquarium	1. Lessening of tension, an increase in calmness, and a reduction in heart rate and blood pressure	Presence of Water
	5. Paintings of Ocean life 6. The color blue	2. Increased mental clarity and memory recovery 3. Enhanced awareness and emotional receptivity 4. Noticed preferences and gratifying emotional reactions	
6.	1. Daylight from multiple angles (glass ceilings, windows) 2. Firelight 3. Light distribution 4. Ambient diffuse lighting on walls and ceilings 5. Personal user dimmer controls	1. Positively impacted circadian system functioning	Dynamic and Diffuse Light
7.	1. Primary Schools with patios or rooftop gardens 2. Native plantings that grow & die with the seasons	1. Enhanced positive health responses; shifted perception of the environment	Connection to Natural Systems
8.	1. Organic shapes 2. Natural colors 3. Spirals 4. Fractals	1. Observed view preference	Biomorphic Forms and Patterns

	5. Curves 6. Other geometrical forms		
9.	Materials made of types of wood, clay, leather, stones, wool, and other materials that reflect the local ecology	1. Decreased diastolic blood pressure improved creative performance 2. Improved comfort	Material Connection to Nature
10.	1. Repeated and symmetrical forms 2. Wallpaper and carpet design pattern hierarchy	1. Positively impacted perceptual and physiological stress responses	Complexity and Order
	3. Exposed mechanical and structural facades, 4. Window and spandrel hierarchy	2. Observed view preference	

When discussing primary schools, the nature of space characteristics of prospect, shelter, mystery, and risk/peril is not mentioned because their effects are not as noticeable and do not affect pre-teens.

4.0 DISCUSSION

The results show how design may impact a person's overall development, particularly in terms of a preteen's health development. Realizing how sensitive and significant the age span of 5 to 12 can be is crucial. We need to provide them with an appropriate environment and a habitat that will influence how they develop. It's also crucial to understand that a child's trauma at that age corresponds to a student's trauma if they perform poorly in school or a businessman's trauma if his company loses money. In such cases, we must provide them with the proper attention and help them understand the kind of environment that would be helpful.

5.0 FUTURE DIRECTION

This review omits to discuss biophilic design's sustainability component. Additionally, it talks in detail about the elementary education design pattern for pre-teens. Understanding each sort of building's architectural patterns and the people who live in them must come first. Further enhancing the connection to nature is research into how to employ technology to simulate natural events and processes inside of interior settings. Finally, making sure that everyone can use biophilic design, regardless of their age, ability, or financial standing.

6.0 CONCLUSION

The intriguing relationship between biophilic design and the holistic growth of preadolescents suggests that natural elements can be included in living and learning spaces. As we seek to provide the best conditions for their growth, using the power of biophilic design may assist create situations that are more harmonious and enriching for pre-teens. By nurturing pre-teens' cognitive ability, emotional well-being, physical health, and social skills, we can help them get through the challenges of this transitional stage and set them on the path to a better and more balanced future.
Pre-teens' overall development could be considerably improved by incorporating biophilic architecture into primary schools. Schools may create an environment that promotes well-rounded people by designing places that foster cognitive development, support emotional well- being, promote physical activity, encourage social interaction, and deepen a person's connection to nature. Adopting biophilic design concepts becomes a commitment to the intellectual development of children as we become more aware of the crucial role that preteen years play in forming future adults.

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