A Study of Biophilic design and how it relates to the children's hospitals design

S G Abo Sabaa¹, M Abdel Azem², H Al-Shanwany³ and M El-Ibrashy⁴

¹Architecture department, Faculty of Engineering, Egyptian Russian University, Egypt.
²³⁴ Architecture department, Faculty of Engineering, Zagazig University, Egypt.

Saragamal674@yahoo.com

Abstract. As a modern design approach, biophilic design encourages the incorporation of natural components into the built environment, which has a substantial impact on human health, well-being, and productivity. The research aims to shed light on the architecture trends during the past period that addressed the design of children’s hospitals, and among these recent trends is the biophilic design, which addresses with the impact of the natural environment surrounding users within health care buildings and its great impact on improving the mental health of children’s hospital users, to suit it with the personality and tendencies of the child, and its reflection on raising the child’s morale which brings him comfort during his treatment period, and increased recovery rates. The research is based on a common strategy between the historical and the descriptive approach, to evaluate the experience of adding biophilic design patterns as a competitive advantage to raise the efficiency of children's hospitals, which is reflected in providing a good experience for patients. The results will indicate Biophilic architecture is more inclusive than trends that uses or mimics nature in design, because of it is the genetic tendencies that humans have to be affected by nature, whether physical, emotional, or psychological.

Keywords: Biophilia, Biophilic architecture, Biophilic design, children's hospitals design, 14 Patterns of Biophilic Design

1. Introduction

Natural shapes drew many architects across generations as a source of fresh ideas that could be realized in design, and these forms were regarded as progressive visions of the future. The interest in biophilic design, or the integration of natural components into spaces to create surroundings rich in positive experiences that can improve human health and well-being, peaked towards the turn of the third millennium. Biologists and human medicine scientists in all their specializations possess extensive knowledge that can lead to a major breakthrough in the design of children’s hospitals, but unfortunately in most biophilic design research, the differences between this trend and the trends that preceded it did not receive sufficient attention, and the researchers’ interest was limited to clarifying the difference Between it and only one direction, which made a confusion between the different architectural trends, which prompted some designers to unleash without knowing the scientific and intellectual meaning of biophilic architecture.

Biology has attracted worldwide interest in the field of architecture where plants, animals, or entire biological systems are used as a basis for design, both because it is an important source of new innovations and because of the effects it has on creating a more healing environment.
2. Research Method and Scope

2.1. Research problem
First, Inadequate understanding and application of the concept of biophilic design, and limiting use in children's hospitals design. Second, Most of the designers mixed between architectural strategies related to nature on the one hand, and simulating nature on the other.

2.2. Aims and objectives
Clarify the differences between architectural trends associated with nature and biophilic design.

2.3. Research hypotheses
Biophilic architecture is more comprehensive than being a trend that uses or simulates nature in design, but rather it is a genetic tendencies in humans to be affected by nature, whether that is physically, emotionally, intellectually, or even morally.

2.4. Research questions
Can biophilic architecture be employed to help development the design process in children's hospitals design? How do other strategies related to nature compare with the direction of biophilic architecture?

3. Literature Review

3.1. Historical overview of (nature) in architecture
The topic of how to conceptualize 'nature' as a concept is critical, because 'nature itself is not nature: it is concept, a standard, a recall, a good city, an alternative plan.' (Beck, 1999).
If we look at nature, we find that it has several meanings and connotations where it can be defined as the material world, including natural phenomena and living organisms, and it can also be viewed as the forces and processes that control natural phenomena in the material world independently of violations and interventions Human (Encarta, 2020).
Nature is a display of countless manifestations in life, to different degrees, whether living or non-living manifestations of (cells, organisms, waves, atoms...).
We find that the poet William Cowper described nature eloquently when he said that: (Nature is nothing but a name for the effect caused by God) (Cowper, 2002), and also described by the scientist, Ilya Prigogine (that life always informs us that there is something important in nature) (Prigogine, 1984). If we touch on the aspects of nature, we find that it consists of form and function. For the first aspect, we find that nature has provided us with countless forms, as the form is the first thing that is noticed by the eye, and it is also an embodiment of the materials used in nature. And the form as an attribute that characterizes things in every stage of tangible existence, and the aesthetic aspects that appear in an environment are a basic opportunity for the designer in particular and the artist in general to resort to as a rich dictionary of colors, lines, shapes, relationships and systems that link the elements in beautiful expressive formations, and the good artist is the one who He has the ability to contemplate nature and discern its beauty (Heerwagen, 2009).

3.2. Defining biophilic design
The term 'biophilia' was coined by social psychologist Erich Fromm to describe the 'love of life,' which indicated two major orientations for living beings: the first is to protect these organisms' lives from risks that cause death, and the second is to positively integrate with one other. (Fromm, 1964). It took 20 years for the biophilia theory to achieve widespread acceptance after it was initially introduced. The biophilia hypothesis,' according to biologist and naturalist Edward Wilson, is "the intrinsic predisposition to focus on life and life-like processes." (Wilson, 1984). Wilson also proposed the "biophilia hypothesis" to explain why people have an innate desire to focus on the processes that occur in life or in nature in general. This means that humans are completely reliant on nature and the resources and capabilities it contains to help and provide them with beauty, ideas, and knowledge, as
well as to spiritually enrich and satisfy them. (Wilson E., 1993). He stressed that Biophilia is a study that studies the intrinsic emotional bond that exists between humans and biological organisms. Biophilia is related to nature and learning from it, just like other complex patterns of behavior that are governed by certain rules and regulations; thus, it cannot be replaced by any of the current man-made alternatives. (Kellert, 1993) Social ecologist Stephen Kellert explains the evolutionary dependency on "nature" by establishing nine values for biotopes: "utilitarian, natural, scientific, artistic, symbolic, humanistic, moral, sovereign, and passive." The last point could be a purposeful dilution of the term "innate," preventing biophilia from being confined to evolutionary psychology. (Joye, 2011)

Wilson, an American scientist, was able to define Biophilia as the intrinsic need to focus on life's or nature's processes in general. Kellert claims that biophilic design can promote positive interactions between people and nature, resulting in a "positive environmental effect." To put it another way, biophilic design is concerned with more than just lowering the environmental impact of the construction industry. While missing engagement with 'environment,' but building for Life: designing and understanding the human-nature connection (Kellert2005), This notion has gotten a lot of attention in the last two decades, thus there are a lot of theoretical research on biophilic design and its impact on human mental health, as well as its lack of use in buildings (Figure 1). (Berkebile, 2008)

Figure 1. A figure showing in years the number of research studies in which biophilia and biophilic design have been studied in comparison with buildings that have already used biophilic design. (Weijie Zhong, 2021)

3.3. Patterns to obtain Biophilia-based design

Basic biophilic design patterns established by the environmental consultant Terrapin Bright Green are among the assessment items. They're called the "14 Patterns of Biophilic Design" because they show the connections between nature, human biology, psychology, and built environment design that can help designers implement and evaluate biophilic design successfully. (Browning, 2014)

The three categories of biophilic design - Nature in the Space, Natural Analogues, and Nature of the Space – provide a framework for understanding and intentional implementation of a diverse range of tactics into the architecture of children's hospitals. (Table 1)

3.3.1. Nature in the Space

Nature's direct, physical, and fleeting presence in a location is addressed in this area. Plant life, animals, water, noises, aromas, and other natural aspects can be included into the constructed environment to achieve this. (Browning W. R., 2020)
3.3.2. **Natural Analogues**
Organic, nonliving, and indirect evocations of nature” are what natural analogies are all about. These are frequently seen in the built environment’s design, such as wood, furniture, decorations, and ornamentation, in objects, materials, colors, shapes, sequences, and patterns (Al-Rhodesly, 2019).

3.3.3. **Nature of the Space**
This category depicts natural spatial layouts, such as our fundamental urge to see beyond our immediate surroundings and to have visual exit options (Browning W. R., 2014).

**Table 1.** The table shows The 14 Patterns of biophilic design (Browning W. R., 2020)

| CONTEXT                                | PATTERNS                                      |
|----------------------------------------|-----------------------------------------------|
| Nature in Space (7 patterns)           | 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            |
| Natural Analogues (3 patterns)         | 8. Biomorphic Forms and Patterns              |
|                                        | 9. Material Connection with Nature            |
|                                        | 10. Complexity and Order                      |
| Nature of The Space (4 patterns)       | 11. Prospect                                  |
|                                        | 12. Refuge                                    |
|                                        | 13. Mystery                                   |
|                                        | 14. Risk/Peril                                 |

3.4. **Architectural trends associated with nature:**
Over the years, many architectural trends have emerged, which some agree as emanating from the organic school, with the aim of ridding contemporary architecture of monotony and rigidity, even if it sometimes tends to exaggerate its forms in the natural world. They also see in it an invitation to give adequate attention to the sensual and spiritual aspect of man. This is an important aspect that has been neglected by contemporary architecture in its successive quest to meet the material and utilitarian needs of man. It can be summarized in four main directions: environmental architecture, green architecture, sustainable architecture, and bio-architecture (Figure 2). (Capra, 2002)

![Figure 2](image.png)

**Figure 2.** A figure illustrating the architectural trends associated with nature that is confused with biophilic architecture (Source: authors)

3.4.1. **Environmental architecture**
Environmental architecture appeared since antiquity, then civilizations followed and humans dispensed with this thought relatively as a result of progress and the search for luxury, and the need to look at the concepts of environmental architecture to lessen the negative environmental impact, began in the seventies the emergence of some steps towards this direction and followed in the nineties More
advanced to shed light on human consumption of the natural resources of the earth and reduce pollution rates, and many architectural schools appeared that called for the building to be part of the environment and to preserve it and not to disturb it. Sustainable architecture, etc (Abdullah, 2012).

Environmental architecture is defined as "architecture that considers environmental conditions in the design of buildings and the selection of materials in order to achieve thermal comfort for its users; to building compatibility with the surrounding environment and access to an architectural design to suit the climatic diagnosis and human environmental needs," according to some. (Siraj, 1990)

3.4.2. **Sustainable Architecture**

It's a broad phrase that refers to ecologically responsible architectural design strategies. It is the process of designing buildings in a way that is environmentally friendly, taking into account minimizing energy, material, and resource consumption as well as reducing the consequences of construction and use on the environment while maintaining natural harmony. Then, by examining the pressing economic and political concerns in our world, clarify sustainable architecture from a broader perspective. Sustainable design, on a large scale, aims to limit buildings' negative environmental impacts by maximizing the effective use of materials, energy, and space. (Sustainable Architecture and Simulation Modeling”, 2018)

3.4.3. **Green Architecture:**

Green architecture, or environmentally friendly buildings and cities, is one of the modern trends in architectural thought, which is concerned with the relationship between buildings and the environment, and there are many concepts and definitions that have been developed in this field.

Green architecture, according to architect Ken Yang, must meet the needs of the present without ignoring the right of future generations to meet their own needs, and green buildings, according to architect William Reed, are buildings that are designed, implemented, and managed in a way that considers the environment, and He also sees that one of the concerns of green buildings is reducing the building's impact on the environment. (Akhimien .N, 2017)

Green design is one of the modern trends in architectural thought, which is concerned with the relationship between buildings and the environment, and green architecture is a highly efficient system that matches its biosphere with minimal damage to the environment. The environment and its sources, hence the description of this architecture as green as plants, as it achieves success and adaptation in its place as it takes full advantage of the ocean to obtain its nutritional requirements (Muhammad Arshid, 2015)

3.4.4. **Biomimetic architecture**

The term design that mimics nature was defined in the twenty-first century, in which the world called for a shift towards nature and attention to the surrounding environment, although looking at nature is not new, but the angles of visions differ from one period to another: such as the appearance of paintings and drawings containing plant or animal decorations on the walls of the temples of ancient civilizations And the use of human and animal statues in palaces and entrances to important public buildings (Benyus, 1997).

The process of simulating nature is a two-way process: the first begins with conducting many biological and scientific research on certain characteristics or behaviors in an organism or an ecosystem, then determines areas and possibilities of exploiting and applying them in the form of design ideas, and the second begins with identifying a need or a design problem, then an attempt Searching for solutions to them by observing living organisms and ecosystems, with the help of previous biological research and available information, and in the latter case the designer often lacks in-depth scientific understanding in his access to the possibility of simulating nature. These trends can be defined as those that examine natural models and then draw inspiration from designs and processes to solve human problems, and it is a broad and inclusive term for many notions that are synonymous with design emulating nature. (Dosen, 2013)
Biomimetic architecture is a modern architectural concept that seeks solutions for sustainability in nature through knowledge of the rules that govern those forms, rather than by the reproduction of natural shapes. It's an interdisciplinary approach to sustainable design that adheres to a set of principles rather than a set of stylistic guidelines. It's part of a bigger movement called biological movement, which examines nature and its models, systems, and processes in order to find inspiration for fixing man-made problems. Biomimetic design not only aids in the discovery of new and sustainable architectural solutions, but it may also be used in other ways to meet human needs. (Youssef, 2021)

4. Materials and Methods
The research initially presented a historical overview of (nature) in architecture to study the characteristics of Biophilic design for children's hospitals. Defining biophilic design and summarizing the elements that were included in biophilic design patterns in previous studies. Second, we analyzed the Architectural trends associated with nature; environmental architecture, green architecture, sustainable architecture, and Biomimetic architecture. The article will build and revise a definition that is based on the literature and addresses the study's conceptual and theoretical assumptions. The extent to which biophilic design is related to (architectural trends associated with nature), as well as the extent to which biophilic design patterns incorporate the fundamental principles on which these trends are built, are discussed in this study.

In the following table ( ) are put in vertical direction biophilic design patterns developed by environmental consultancy Terrapin Bright Green. It is the “14 Patterns of Biophilic Design” to show the relationships between nature, human biology, psychology, and the design of the built environment that can help designers in the successful implementation and evaluation of biophilic design, and in the horizontal direction are put architectural trends associated with nature; Environmental architecture, green architecture, sustainable architecture, and Biomimetic architecture, and the basic principles on which each direction is based were developed to measure their compatibility with biophilic design patterns, and then the points obtained for each direction were calculated to find out which directions are closer to the biophilic design.

From this table, it was concluded that architecture Biomimetic architecture is the closest approach to biophilic design, then environmental architecture, green architecture, and finally sustainable architecture (Figure 3).

Figure 3. The research can conclude that biophilic architecture is a mixture of architectural trends related to nature (Source: authors)
### Table 2. Comparison of architectural trends related to nature with biophilic styles (Source: Authors)

| Architectural trends associated with nature | Biomimetic architecture | Green Architecture | Sustainable Architecture | Environmental Architecture | Total |
|--------------------------------------------|-------------------------|--------------------|-------------------------|---------------------------|-------|
| Creativity in training is the result of adaptation, benefit and efficiency | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 11 |
| Examine nature, its models, systems, and processes for inspiration Maximize resources by rationalizing inputs and rotating outputs | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 44 |
| The shapes are derived from the environmental environment and have the ability to grow and expand in the future | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 14 |
| Form follows function, adapts to the environment, and is shaped by matter | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 11 |
| Providing a healthy environment | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 36 |
| Preserving the environment and the nature surrounding the building | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 15 |
| Reducing the use of building materials and recycling building materials | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 36 |
| Reduce environmental pollution, waste | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 15 |
| Energy conservation and green energy production | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 36 |
| Reducing energy consumption from non-renewable energy sources | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 15 |
| Efficient use of resources | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 36 |
| Harmony with the environment (including environmental assessment) | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 36 |
| Using materials that have a benign effect on the environment, preventing pollution | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 15 |
| Achieving energy efficiency | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 36 |
| The acceptable limit of healthy conditions for human living | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 36 |
| Achieving a minimum level of environmental pollution. | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 15 |
| Preserving the available environmental resources, maximizing harmony with nature. | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 36 |
| Reducing the impact of construction and use on the environment. | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 15 |
| The compatibility between economic performance and social responsibility. | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 36 |
| Respecting the environmental dimension in architectural work. | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 36 |
| Environmental Architecture | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 15 |
| Achieving a minimum level of environmental pollution. | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 44 |
| Preserving the available environmental resources, maximizing harmony with nature. | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 14 |
| Reducing the impact of construction and use on the environment. | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 36 |
| The compatibility between economic performance and social responsibility. | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 14 |
| Respecting the environmental dimension in architectural work. | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 14 |
| Architectural trends associated with nature | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | ● ● ● ● ● ● ● ● ● ● | 15 |
| Visions for Future Cities | IOP Conf. Series: Earth and Environmental Science 992 (2022) 012003 | doi:10.1088/1755-1315/992/1/012003 | 7 |
5. The Selected Case Study of the Biophilic Children’s Hospital: The Royal Children's Hospital

At the prestigious World Architecture Festival (WAF) Awards in Singapore, the Royal Children's Hospital in Melbourne earned the 'World Health Building of the Year 2012' Award. A jury of some of the world's most influential architects and urban planners chose the structure. The hospital fostered the idea of patient-environment harmony through well-integrated design with nature, such as picking the building's site, furniture design, and broad windows, as well as making the hospital a part of the surroundings. (Batessmart, 2012)

Table 3. Information about the Royal Children's Hospital (The Royal Children's Hospital Melbourne, 2020)

| Information about the hospital |
|-------------------------------|
| Location: 50 Flemington Road, Parkville Victoria 3052, Melbourne, Australia |
| Architects: Billard Leece Partnership and Bates Smart |
| Building area: 165000 m² |
| Beds: 340 |
| Completion date: 2011 |

The Many parts of the hospital's design were inspired by the nearby Royal Park's original bush land environments. Courtyards, a sweep of colored 'leaves,' panoramic vistas of the parkland, a two-story coral reef aquarium, large-scale artworks, and a miniature zoo were among the innovative architectural elements employed to optimize the connection to nature. Surprisingly, these new design ideas have significantly reduced the hospital's users' pain, worry, and anxiety by normalizing tactile and engaging environmental experiences (Figure 4). (Detail. Nature-Inspired Design, 2013).

Table 4. Applications of Biophilic Design Patterns in Royal Children’s Hospital (Source: authors)

| Biophilic design patterns | Applications of Characteristics of Biophilic Design Elements and Patterns in Royal Children’s Hospital |
|--------------------------|-------------------------------------------------------------------------------------------------|
| Group one: Nature in Space (7 patterns) | This pattern was achieved by looking at the elements of nature, living systems and natural processes, and it was easily applied in this hospital due to the presence of the Royal Park around the hospital from three sides, Space design that can stably and comfort ably allow for gazing at the nature outside, while seated |
indoors in Outpatient waiting rooms and patient rooms.

### 2-Non-Visual Connection with Nature

This pattern was achieved by auditory, tactile, olfactory, or gustatory stimuli that generate a deliberate, positive cue to nature, living systems, or natural processes. Provision of natural tactile and olfactory stimulation through outside recording space that has functions such as gathering, play, and performance.

### 3-Non-Rhythmic Sensory Stimuli

This pattern was achieved by Stochastic and transitory interactions with nature that can be statistically examined but not accurately anticipated.

### 4-Thermal & Airflow Variability

This pattern was achieved by Natural-looking variations in air temperature, relative humidity, airflow across the skin, and surface temperatures which positively impacted comfort, well-being and productivity; The patient's room provides a feeling of both flexibility and a sense of control.

### 5-Presence of Water

A condition that improves a person's perception of a place by allowing them to see, hear, or touch water. This pattern was achieved by the fountains scattered around the hospital and in the children's play areas, as well a two-story coral reef aquarium which are located in the waiting room.

### 6-Dynamic & Diffuse Light

Using different intensities of light and shadow that change over time to produce natural-looking settings, exposing the sky through the ceiling, providing a natural ecosystem view and dynamic light in the environment, and in the moving space.

### 7-Connection with Natural Systems

This pattern is achieved by Natural processes, particularly seasonal and temporal fluctuations are important aspects of a healthy ecosystem. Through the outpatient courtyard features two-toned synthetic turf and concrete donuts, there is a space structure where visitors can feel the changes of nature, such as seasons and weather, and moving spaces. Meerkats have been quarantined inside the Royal Children's Hospital. The objective of the meerkat display is to entertain children and divert their attention away from the fact that they are in hospital, which may be distressing to them, but the meerkat exhibit will make
Results and discussion

The debate continues among designers about the best strategies for designing hospitals, especially children's hospitals, to increase recovery rates, and thus reduce the length of stay for the patient. This study discussed some of these strategies, especially those related to nature, to find out which is better for children's hospitals, and the results were as follows:

- Biophilic architecture is more inclusive than trends that uses or mimics nature in design, because of it is the genetic tendencies that humans have to be affected by nature, whether physical, emotional, or psychological.
- Biophilic design is a mixture of the following architectural trends: environmental architecture, green architecture, sustainable architecture, and biomimetic architecture. When comparing these trends and the 14 patterns of biophilic design, it was found that most of the patterns include the basic principles of these trends.
- Biomimetic design is closer to biophilic design with a number of points (44), which is the largest number, followed by environmental design with (37), green design with (36) and finally sustainable design with (15).
- Biophilic design is one of the trends that care about human health in the first place, which makes it the most suitable for application in children's hospitals.

Conclusion

This study delves into the notion of biophilic design, including how it came to be, how it is defined, how it may be used to children's hospitals architecture, and what the key design strategies are. We started by looking into the underlying theories and interpretations of biophilic design. The numerous benefits of biophilic design and the multiple problems in architectural trends associated with nature were then compared and integrated. We proposed a biophilic design framework and assembled design methods, bringing together the fundamental principles of many natural aspects in building.

Recommendations

Many uncertainties remain, given that biophilic design has only been used in building for 20 years. Although the concept of biophilic design gives many design inspirations, architectural terminology is
rarely employed to describe children’s hospitals. Future study should look at examples from an architectural standpoint, taking form and technology into account. According to the findings, the following actions should be taken: The importance of a relationship and communication between architectural and interior architecture, on the one hand, and nature, on the other. Increasing architects’ understanding of the relevance of environmental design, current and modern trends, and natural simulation. Ensure the application of biophilic design foundations in the fields of architecture and interior architecture. Supporting research and specialized study in areas related to environmental preservation.

9. References

[1] ADR. Royal Children’s Hospital. (2012, May 14). Retrieved Nov 1, 2021, from Australian Design Review: https://www.australiandesignreview.com/architecture/royal-children’shospital/

[2] Batessmart. (2012). Retrieved Oct 2021, from https://www.batessmart.com/2012/sep-oct/royal-childrens-hospital-melbourne/.

[3] Detail. Nature-Inspired Design. (2013, March 15). Retrieved Nov 22, 2021, from The Royal Children’s Hospital in Melbourne: https://www.detail-online.com/article/natureinspired-

[4] Sustainable Architecture and Simulation Modeling”. (2018). Dublin Institute of Technology.

[5] Arch.Ahlamontada. (2020). Retrieved 2021, from https://arch.ahlamontada.net/t250-topic.

[6] The Royal Children’s Hospital Melbourne. (2020). Retrieved 2021, from https://www.rch.org.au/home/.

[7] Abdullah. (2012). “A Sustainability Approach, Towards a Traditional Square Design Model”. Faculty of Engineering, Misr International University, Ph.D. thesis, p.3.4.

[8] Akhimien , I. A. (2017). Green Architecture as a panacea to the Environmental effects of Architectural development. Department of Architecture, Ambrose Alli University, Ekpoma, Nigeria.

[9] Al-Rhodesly, A. M. (2019). Biophilic Approach to Architecture:Case of the Alhambra, al-Andalus. Architectural Engineering Department , Faculty of Engineering, Alexandria University.

[10] Beck, U. (1999). World risk society as cosmopolitan society? Ecological questions in a framework of manufactured uncertainties. . Cambridge: World Risk Society. Polity Press, pp. 19-23.

[11] Benyus, J. (1997). Biomimicry - Innovation Inspired by Nature. New York, Harper Collins Publishers.

[12] Berkebile, B. F. ( 2008). Reflections on implementing biophilic design. In: Biophilic Design: the Theory, Science and Practice of Bringing Buildings to Life. pp. 347-356.

[13] Browning, W. R. (2014). 14 Patterns of Biophilic :Improving Health & Well-Being in the Built Environment. New York: Terrapin Bright Green,LLC.

[14] Browning, W. R. (2020). What is biophilia and what doesit mean for buildings and spaces? Nature Inside: A Biophilic Design Guide. RIBA Publishing, pp. 1e5.

[15] Capra, F. (2002). The Hidden Connection : Integrating the Biological, Cognitive, and Social Dimensions of life into a Science of Sustainability. Double day, NewYork, U.S.A, P14.

[16] Cowper, W. (2002). The Task, book VI, The Winter Walks at Noon, in Ahmed Yehia, Mostafa: Architecture as a manifestation of mans understanding of nature. Cairo: Masters of science in Architecture, Cairo University , P.12.

[17] Dosen, A. O. (2013). Prospect and refuge theory: constructing a critical definition for architecture and design. . Int. J. Des. Soc. 6, 9-23.

[18] Encarta. (2020), World English Dictionary [North American Edition]. Microsoft corporation by Bloomsbury publishing plc.

[19] Fromm, E. (1964). Love of death and love of life. In: The Heart of Man: its Genius for Good and Evil. New York: New York: Harper & Row.
[20] Heerwagen, J. (2009). *Biophilia, health, and well-being*. USA: Pennsylvania, USA: USDA Forest Service, Northern.

[21] Joye, Y. d. (2011). “Nature and I are two”: a critical examination of the biophilia hypothesis. Environ. Val. 20, 189-215.

[22] Kellert, S. (1993). *The biological basis for human values of nature* In: Kellert, S.R., Wilson, E.O. (Eds.), *The Biophilia Hypothesis*. Island Press, pp. 42-69.

[23] Kellert, S. (2005). *Building for Life: Designing and Understanding the Human-Nature Connection*. Island Press, Washington.

[24] Muhammad Arshid, A. (2015). *Applications of green architecture in the interior design of Irbid heritage houses*. Master's thesis, University of Islamic Sciences, Jordan, page 9.

[25] Prigogine, I. (1984). *Order out of Chaos*, Bantam New York. In *Capra, Fritjof*(1996). The Web of Life, NY:Anchor Book, P.86.

[26] Siraj, N. M. (1990). *Energy-Guiding Architectural Design in Radiation Research Buildings*. Faculty of Fine Arts (Department of Interior Architecture), Helwan University, PhD thesis in Environmental Sciences, pp. 54, 55.

[27] W. Zhong, T. S. (2021). *Biophilic design in architecture and its contributions to health, well-being, and sustainability: A critical review*. Netherlands: Architectural Design and Engineering, Department of the Built Environment, Eindhoven University.

[28] Wilson, E. (1984). *Biophilia: The Human Bond with Other Species*. MA: Harvard University Press, Cambridge.

[29] Wilson, E. (1993). *Biophilia and the conservation ethic*. In: Kellert, S.R., Wilson, Edward Osborne (Eds.), *The Biophilia Hypothesis*. Island Press., P.20-31-32.

[30] Youssef, Y. R.-E. (2021). *Biomimetic approaches to sustainability and its application in interior design of the tourist*. International Design Journal, Volume 4, Issue 2.