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EXPERIENTIAL LEARNING BASED BIOPHILIC DESIGN

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EXPERIENTIAL LEARNING BASED BIOPHILIC DESIGN

Abstract

Capturing nature-related values is the cornerstone in postmodern theories of architecture. Approaches like, sustainable, ecological, environmental, green …. etc, are labeling most of architectural interventions now. However, 'Biophilic Architecture' stands as one of these concepts that reflects a new perspective for linking the nature to architecture. The applications of this concept are accelerating among different building types and it has profound impacts on articulating the vocabulary of the used architecture. Schools are among building types that witness profound changes in architectural expressions due to radical developments in pedagogical theories. Experiential learning is one of the emerging approaches for preschoolers. It exploits child's built in curiosity to develop his/her gained cumulative knowledge through direct interaction with nature. This paper investigates the potentials of biophilic design approach to add to experiential learning qualities in the outdoor learning spaces. It reviews literature to build a correlation matrix that links biophilic patterns to different aspects of experiential learning. In addition, it introduces 'Wheel of Experiential Learning' as a theoretical model representing these correlations. An analytical study to a number of preschools' open spaces is performed -based on pictorial investigations- to give more insights to applicability dimensions of the theoretical findings. Finally, the paper uses these findings to evaluate the external education space in preschool section, College Saint Marc, Alexandria Egypt regarding its biophilic design capabilities to create an inspiring experiential milieu.

Keywords

Biophilic design, experiential learning, preschoolers, outdoor learning spaces, College Saint Marc

1. INTRODUCTION

The mutual relationship between human being and nature is now investigated in an unprecedented way. On one hand, the accelerating number of people, rapid urbanization, and the booming in technological achievements all caused a mass destruction to natural assets, on the other hand, new calls for nature preservation and working within its carrying capacity limits are raised. However, buildings themselves become an arena of this sparring. Besides the technological advancements that dramatically influence the architectural domain, a drastic back-to-nature trend is clearly monitored. Nature-labeled architecture approaches e.g. natural design, ecological design, eco-generative design, sustainable design, green architecture, biomimicry, are all about merging nature understandings into design processes and aspects ((Wanek et.al, 2015), (Ndubisi,2015), (Marsault, 2017), (Hagan, 2001), (Deviren, and Tabb, 2016), (Mazzoleni, 2013), (Arciszewski, and Joanna, 2006)). These trends are clearly reflecting the words of Richard Louv the chairman of the Children & Nature Network (CNN) "We're already seeing a convergence of a New Nature Movement focused on human restoration through the natural world" (Louv, 2011).

Humans are originally imprinted as nature-affiliated beings. On contrary to urbanization, and excessive use of technology which detached humans from their surrounding natural environment, biophilia is a therapeutic approach. It is simply defined as 'the life enhancing rootedness in nature' (Louv, 2013). Actually this goes in contrary to sustainability and its related quantitative indicators e.g. LEED, which is concerned with the impact of people and their developments on natural assets, the idea of biophilic design, is concerned with the positive impacts of natural patterns on our health and wellbeing (Epstein, 2013). It is seen as a leading design approach that has the potential to bring back humans to their natural environment context. It aims to integrate environment aspects and reflecting their processes into architectural and environmental design (Park and Lee 2019). It's philosophy is based on exposing people to natural phenomena and processes to keep them inspired by its patterns and systems (Kellert et al., 2011).

However, integrating natural elements with the urban environment is proofed to have more positive effects on users. This is evidence in many naturally blended architecture elements such as: green labeled elements e.g. green roof; green wall; interior gardens ..etc; blue labeled spaces e.g. water bodies, lakes, fountains …etc; and on a comprehensive scale nature-friendly spots such as school courtyards, or linear elements such as promenades and pedestrian routs (Kellert & Wilson., 1995). Nowadays, School design is following remarkable changes. These new trends and theories extend to cover both education environment and school buildings as well (Nicholson, 2005). External learning spaces are part of these educational facilities that have their specialty in conducting the educational message. In these regards, MSDE (2012) define number of functions for courtyards, among them sensory stimulation, and exploration and adventure which distinguish their roles in experiential learning.

This paper examines the potentials of biophilic design approach to meet challenges of articulating the external educational spaces in a way that meets the acceptable required aspects. It follows a methodology that reviews literature to investigate the interconnections between the stages of experiential learning and the patterns of biophilic design. Then, it uses 'Delphi' technique to assign weights to these correlations. And in a further step it analysis number of examples to investigate the role of biophilic design patterns in supporting experiential learning process. In this stage, fourteen examples of kindergarten and preschools are selected to show these relationships. In all of these examples, 'Curiosity' comes at the heart of the matter as the main focus of all of the experiential learning process, and 'Security' is a prerequisite for its acceptance and sustainability.

2. EXPERIENTIAL LEARNING AND OUTDOOR LEARNING SPACES

According to Louv (2014), the 21th century has to draw a new invigorating relationship between human beings –especially children- and their natural context. He highlights 're-connecting children to nature' as one of three main challenges (in addition to climate change, and biodiversity degradation) that humanity has to face. He builds his vision based on a list of damaging effects that children faces when they are kept detached from nature. One of these key harmful effects is 'diminished use of their senses' leading to children 'disconnection'. In its turn, this leads to difficulties in their learning capabilities concerning the role that sensory environment plays in their development (Louv, 2013). However, many learning approaches build upon these understandings as

they recommend an education environment that is able to close the gap between children and nature based on the deterministic interconnectedness between nature and learning.

Experiential learning –defined as 'hands-on' learning (Austin & Rust, 2015)- presents a framework for children learning based on satisfying their curiosity needs. New experiences trigger children curiosity which in its turn induces them to seek for answers (Engel, 2015). Outdoor spaces provide rich milieu for children investigations and experiences. They give them a good chance to interact directly with nature, look into its cosmic phenomena, observe its processes, and be part of it. These endless experiences trigger children senses and prompt their curiosity to explore, discover, and learn. Based on a model developed by Louv (2013), children pleasure, skills, confidence, self esteem, and security are increased as consequences (fig. 1). In a similar way, a model developed by Kolb defines four phases comprising the vicious circle of experiential learning; active experimentation; concrete experience; reflective observation, and abstract conceptualization. A child can enter this circle in any point but he/she has to go through the four phases to have a meaningful learning outcomes. In addition, this circle could be practiced endless times to have cumulative learning outcomes (Sugarman,1985) in (CPI, 2019).

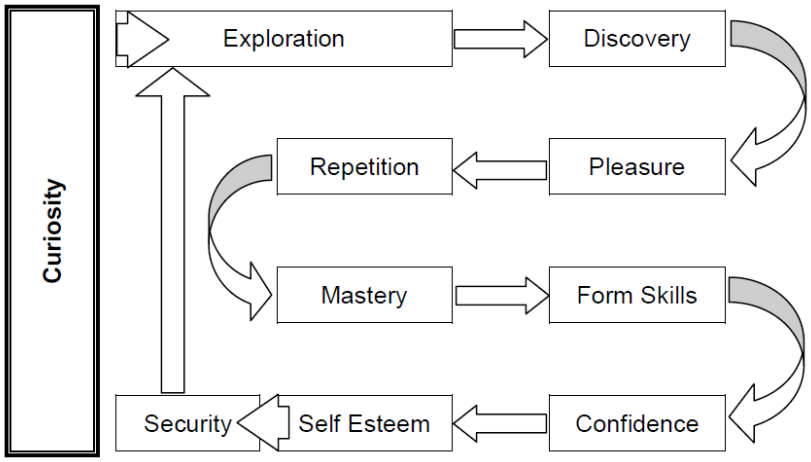


Figure 1: Experiential learning process. (Reference: The Author based on Louv, 2013)

Nicholson asserts that "all spaces in the school have distinct messages for the children" (Nicholson, 2005:55). In this context, the role of open spaces in schools has to be redefined to expand beyond just being mere recreational areas for children. Innovative Learning Environments (ILEs) initiative determines this new role under the label 'naturalness' (Osborne, 2016). It highlights two scale for 'nature' connectivity; direct and indirect. The former encompasses direct interaction with natural processes and features which has positive impacts on cognitive capabilities, and physical, social, and behavioral attitudes (Dillon et al., 2005). The latter on one scale, offers nature visual accessibility which proved to have positive impacts on learning by decreasing children's anxiety (Chang & Chen, 2005), on another scale, open spaces are responsible of accentuating other functional spaces with the required natural vibrant altitude. All of nature-related aspects e.g. lighting, air quality, sonic, color, and temperature are important prerequisites for increasing learning's levels (Barrett et al., 2015).

3. BIOPHILIC DESIGN AS AN APPROACH

Many understandings have been presented to put the 'Biophilia' philosophy, and 'Biophilic Design' approaches in an applicable way. One of these interventions is presented by Kellert Stephen in his book 'The Biophilia Hypothesis'. He identifies six elements for this design approach as follows: environmental features, natural shapes and forms, natural patterns and processes, light and space, place-based relationships, and evolved human-nature relationships (Epstein, 2013). In a much more detailed classification, Park and Lee (2019) define three main categories for biophilic

design: nature inside space; presenting nature; and spatial characteristics. They subdivide them into nine design patterns. In a more widely accepted and used classification, Browning et al., (2014) present a list of fourteen patterns classified under three main categories; nature in the space, natural analogues, and nature of the space. The detailed patterns (table 1) and their correlated definitions, offer a functioning toolkit for the abstract and ambiguous conceptual categories of biophilic design. However, this list is criticized for not including patterns that can conduct biophilic effects without direct physical contact with nature or any of its systems. Downton, et al. (2017) claim that, artistic representation or illusion of nature can cause indirect nature experience that can trigger psycho-physiological sensors in a similar way to Biophilia. In some cases it wouldn't be possible to be in direct contacts with natural environment e.g. hospitals, basements, …etc. so being in closure contact with nature emulated images or illusions of nature such as artificial sky can partly bring some of the biophilic design benefits. Accordingly it is proposed to add another pattern 'virtual connection with nature' as classified under 'Nature in the space' main category.

Table 1: Biophilic design patterns
(Reference: The Author based on (Browning et al., 2014) & (Downton, et al., 2017))

Context		Pattern	Definition
NATURE IN THE SPACE Plants, water, and animals in the built environment	01	Visual Connection with Nature	A view to elements of nature, living systems and natural processes.
	02	Non-Visual Connection with nature	Auditory, haptic, olfactory, or gustatory stimuli that engender deliberate and positive reference to nature, living systems or natural processes.
	03	Non-Rhythmic Sensory Stimuli	Stochastic and ephemeral connections with nature that may be analyzed statistically but may not be predicted precisely.
	04	Thermal and Airflow Variability	Subtle changes in air temperature, relative humidity, airflow across the skin, and surface temperatures that mimic natural environments.
	05	Presence of Water	A condition that enhances the experience of a place through the seeing, hearing or touching of water.
	06	Dynamic and Diffuse Light	Leveraging varying intensities of light and shadow that chang over time to create conditions that occur in nature.
	07	Connection with Natural Systems	Awareness of natural processes, especially seasonal and temporal changes characteristic of a healthy ecosystem.
	17	Virtual connection with nature	
NATURAL ANALOGUES Objects, materials, and patterns that evoke nature	08	Biomorphic Forms and Patterns	Symbolic references to contoured, patterned, textured or numerical arrangements that persist in nature.
	09	Material Connection with Nature	Material and elements from nature that, through minimal processing, reflect the local ecology or geology to create a distinct sense of place.
	10	Complexity and Order	Rich sensory information that adheres to a spatial hierarchy similar to those encountered in nature.
NATURE OF THE SPACE Differing spatial configurations of the built environment	11	Prospect	An unimpeded view over a distance for surveillance and planning.
	12	Refuge	A place for withdrawal, from environmental conditions or the main flow of activity, in which the individual is protected from behind and overhead.
	13	Mystery	The promise of more information achieved through partially obscured views or other sensory devices that entice the individual to travel deeper into the environment.
	14	Risk / Peril	An identifiable threat coupled with a reliable safeguard.

4. BIOPHILIC DESIGN PATTERNS AND EXPERIENTIAL LEARNING'S CORRELATIONS

Correlations between biophilic design patterns and experiential learning's stages are investigated comprehensively and implicitly in literature. Among many; two different but complementary approaches could be noticed as heavy-handed. The first perceives 'Curiosity' as the dominator of all other experimental learning's stages while the second appreciates 'Security' values as the core one. This paper follows the latter approach as a more precautionary one that go well with preschoolers' stage. In this approach, while it is seen as a determinant contextual condition, security

and reducing risks stand as a prerequisite for all of other experiential learning's stages. MacQuarrie et. al. (2015) highlight the role of risk prevention and classify adults' role when children engaged in a risk into either to reduce the potential risks or to offer a much more safe alternative experiences. According to Henwood & Pidgeon, (1998) a controlled degree of risk is needed to evoke "a sense of excitement, adventure and curiosity at what might be found". However these experiences are gained and collected using children's perception inlet senses: vision, taste, touch, sonic, and smell (Valtonen et. al., 2010).

Reading the biophilic main patterns; 'Nature in the space'; 'Nature of the space'; and 'Natural Analogues', and their subcategories shows the role of children's senses to grasp their surrounding environmental stimulus and transmit them into cumulating experiences that shape their knowledge domain. However, MacQuarrie et. al. (2015) shows the importance of creating a continuous relationship between children and their surrounding environment. This relation has to be supported by explanation to the rhythmic and non-rhythmic changes in contextual environment. In addition to short-term rhythms this has to extend to include a medium to long rhythmic changes such as seasonal changes. Actually, this affects many experiential learning based values such as: exploration, discovery, repetition, ….etc in a positive way. In addition, using nature as the setting and resource for children education influences the flexibility of instructive practices and offers a wide range of alternatives to enhance children's educational milieu (MacQuarrie et. al. 2015).

The principles of experiential learning give insights to these correlations. Beaton (1996) defines four main principles; diversity; coherence; quality; and involvement that the environment has to offer to guarantee an effective experiential milieu. Investigating literature shows a consensus that diversity is the key principle that permits greater opportunities for experiential learning. The correlation to biophilic domain is clear. As keeping in direct connection to nature's circumstances and its cyclic rhythms is the guarantee for maximum limits of diversity within coherent understanding. This coherence permits a degree of uniformity that in-deepen children experiences through their perception to environmental repetitive patterns. In addition, the immersive environment created by biophilic patterns shapes a domain of interwoven and stimulating experiences -when designed carefully and with an appealing quality- encourages children to be part of and actively engage. However, this -in a further stage- makes them acquire confidence that leads to a much more degree of involvement, interaction, and competence (Beaton,1996).

Table 2: Correlations between biophilic design patterns and stages of experiential learning
(Reference: The Author)

Inauguration value ☑ Prerequisite value ☐ No relation- Average Relation ✓ Strong Relation ✓✓

Context		Pattern	CURIOSITY	Exploration	Discovery	Pleasure	Repetition	Mastery	Form Skills	Confidence	Self Esteem	Security
Nature in the space	P01	Visual Connection with Nature	☑	✓✓	✓	✓	✓	-	-	-	-	☐
	P02	Non-Visual Connection with nature	☑	✓✓	✓✓	✓	✓	-	-	-	-	☐
	P03	Non-Rhythmic Sensory Stimuli	☑	✓	✓✓	✓	-	-	-	-	-	☐
	P04	Thermal and Airflow Variability	☑	✓	✓	-	✓	✓	✓	✓	-	☐
	P05	Presence of Water	☑	✓	✓	✓✓	✓	✓	✓	✓	-	☐
	P06	Dynamic and Diffuse Light	☑	✓✓	✓✓	✓	✓	✓	✓	✓	✓	☐
	P07	Connection with Natural Systems	☑	✓✓	✓✓	✓	✓✓	✓	✓✓	✓✓	✓	☐
Nature of the space	P08	Prospect	☑	✓	✓✓	✓✓	✓	✓✓	✓	✓	✓	☐
	P09	Refuge	☑	✓✓	✓✓	✓✓	✓	✓	✓	✓	✓	☐
	P10	Mystery	☑	✓	✓✓	✓	-	✓	✓	✓✓	✓	☐
	P11	Risk / Peril	☑	✓✓	✓	✓	✓	✓	✓✓	✓✓	✓✓	☐
Natural Analogues	P12	Biomorphic Forms and Patterns	☑	✓	✓	✓	✓	✓	✓	✓	✓	☐
	P13	Material Connection with Nature	☑	✓	✓	✓	✓	✓	✓	✓✓	✓	☐
	P14	Complexity and Order	☑	✓✓	✓✓	✓	✓✓	✓	✓✓	✓✓	✓✓	☐

Catalyst conditions for experiential learning are recognized in biophilic design context and its related patterns. They are responsible for incubating the potentials for desired experiences and interactions (Beaton, 1996). Initiating opportunities for direct connection to nature is the first condition and is the key of all of the others. It permits children to gain experiences of how to become infected with real world and face its challenges. Stimulating curiosity stands as the second condition. It provokes children's interest and utilizes the surrounding mystery and challenge to open new exploration horizons. In these regards, natural environment has the potential to stimulate latent capabilities related to 'sensitivity'. As mentioned by Hungerford &Volk (1990), this is a function of child's enjoyment's contact with the outdoors. Consequently, this brings attention to the 'qualitative focus on environment 'as the third condition. The other conditions contain: creating opportunities for exploration and discovery, promote increased knowledge, and finally to encourage sharing and communication.

To conclude a more robust correlation matrix, this paper utilizes 'Delphi' technique to investigate the interrelationships between biophilic design context and its subcategories patterns, and the stages of experiential learning process. Interviews, meetings, and discussions with education experts (teachers, and senior teachers) were utilized to conclude correlations in both, table no. 2 and figure no. 2. They were asked –based on their experiences in children's education domain - to rate relations as one of the followings: no relation, weak relation, or strong relation. They were also asked to comment on a pictorial matrix (table no. 3.) to figure out their views about these correlations in practice.

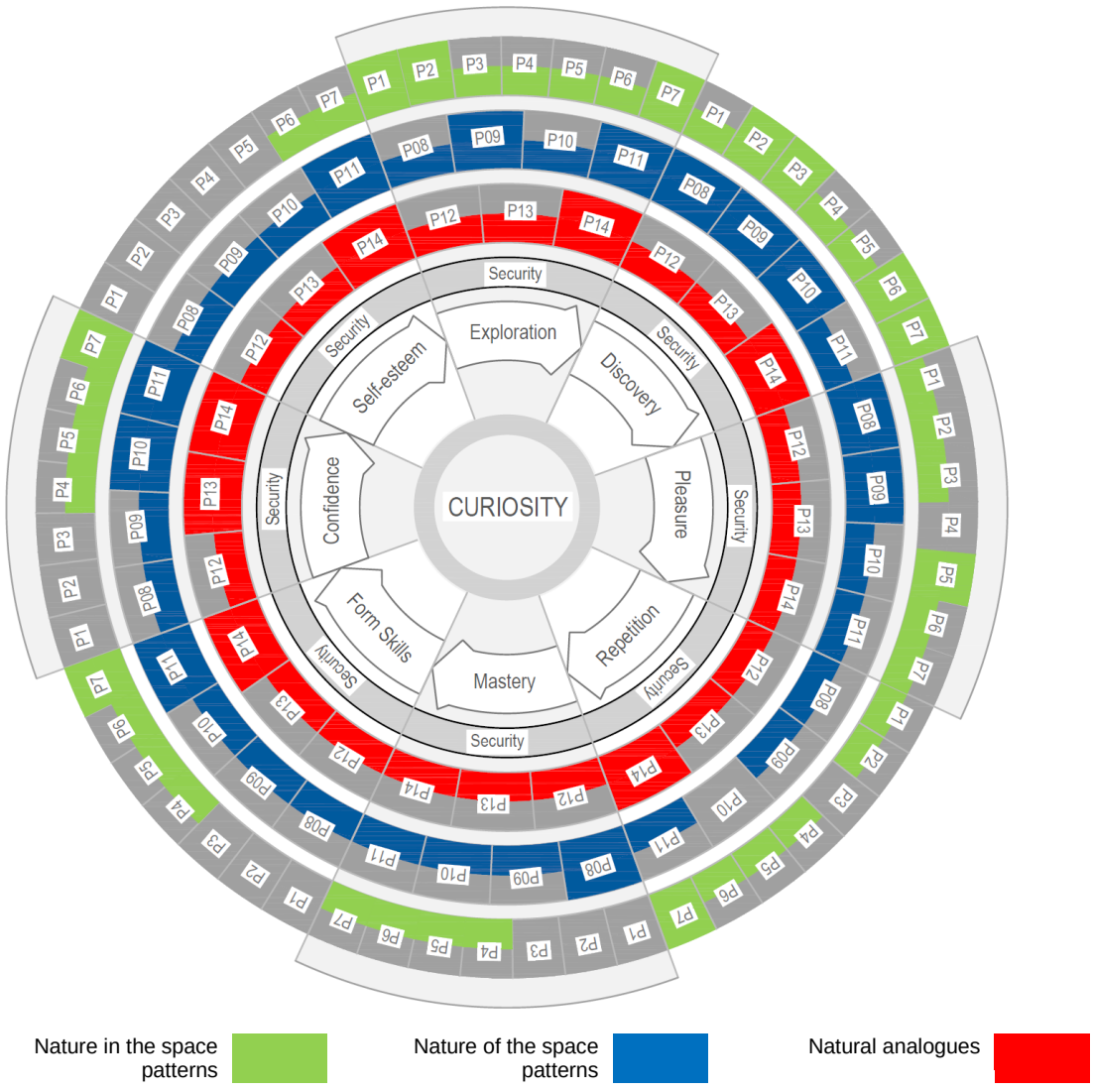


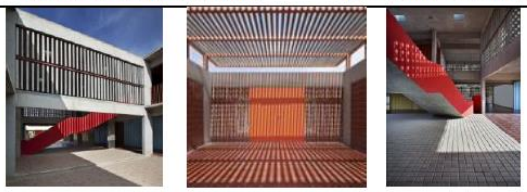
Figure 2: 'Wheel of Experiential Learning': Correlations between biophilic design patterns and stages of experiential learning (Reference: The Author)

5. APPLICATIONS OF BIOPHILIC PATTERNS IN PRESCHOOL DESIGN

This paper follows a methodology that analysis number of examples to investigate the role of biophilic design patterns in supporting experiential learning process. These examples of kindergarten and preschools are selected based on their success in achieving a recognizable relationship between built and unbuilt environment (according to critiques' evaluation. In all of these examples, 'Curiosity' comes at the heart of the matter as the main focus of all of the experiential learning process, and 'Security' is a prerequisite for its acceptance and sustainability.

The paper uses the pictorial matrix technique to show the applicability potentials of biophilic design patterns to create a stimulating experiential milieu.

Table 3: Pictorial Matrix: showing the applicability potentials of biophilic design patterns to create a stimulating experiential milieu (Reference: The Author)

Context	Pattern		Experiential skills
Nature in the space	P01 Visual Connection with Nature	 Vilhelmsro Skol, Denmark [1]  Forfatterhuset Kindergarten[2]	- Triggers children curiosity to explore and discover. - Increases children pleasure. - Giving the chance for children to observe the rhythmic changes in nature.
	P02 Non-Visual Connection with nature	 Lucie Aubrac School [3]  DPS Kindergarten School [4]	- Triggers children curiosity to explore and discover. - Increases children pleasure. - Giving the chance for children to observe the rhythmic changes in nature.
	P03 Non-Rhythmic Sensory Stimuli	 Centro de Educação Infantil [5]  Ivanhoe-grammar-school [8]	- Triggers children curiosity to explore and discover. - Increases pleasure and joyful ambiance
	P04 Thermal and Airflow Variability	 DPS Kindergarten School [4]  Frederiksvej Kindergarten[9]	- Elicit curiosity to explore and discover. - observing rhythmic changes in nature. - Mastery of nature enhances children's confidence & skills.
	P05 Presence of Water	 Centro de Educação Infantil [5]  inventive preschool [6]	- Increases pleasure and joyful ambiance - Elicit curiosity to explore and discover. - Enhances confidence and forming skills.
	P06 Dynamic and Diffuse Light	 DPS Kindergarten School [4]	- Observing rhythmic changes and repetition patterns. - Mastery of changing patterns enhances children's confidence.

	Pattern		Experiential skills
	P07 Connection with Natural Systems	 Kadawittfeldarchitektur [7] Ivanhoe-grammar-school [8]	- Elicit curiosity to explore and discover. - Observing rhythmic changes and repetition patterns. - Mastery of nature enhances children's confidence & skills.
Nature of the space	**P08** Prospect	 Kindergarten and Nursery [13]	- Elicit curiosity to explore and discover. - Observing rhythmic changes and repetition patterns. - Observing nature enhances children's pleasure & confidence.
	P09 Refuge	 Beijing kindergarten [11] El Pinal Nursery [14]	- Being under a shelter enhances exploration & discovery qualities. - It Observing rhythmic changes and repetition patterns. - Increases pleasure and joyful experiences.
	P10 Mystery	 Kindergarten in Guastalla [10] El Pinal Nursery [14]	- Secured mystery triggers exploration & discovery qualities. - It increases children's self confidence. - Increases pleasure and excitement experiences.
	P11 Risk / Peril	 Kindergarten and Nursery [13]	- Well designed risk experiences triggers exploration & discovery qualities. - It increases children's self confidence, making him form skills and affects positively self esteem.
Natural Analogues	**P12** Biomorphic Forms and Patterns	 Kadawittfeldarchitektur [7] Kindergarten in Dobrin [12]	- Supports making more nature correlations leading to better exploration & discovery qualities. - It increases children's ability to make rational conclusions based on their observations.
	P13 Material Connection with Nature	 Kindergarten in Guastalla [10] Kindergarten in Dobrin [12]	- Making more nature correlations leading to better exploration & discovery qualities. - Increases children's confidence based on their familiarity with materials.
	P14 Complexity and Order	 Kindergarten in Guastalla [10] Ivanhoe-grammar-school [8]	- Enhances all experiential learning related qualities. - Interpretation of complexity and being part of it supports many qualities such as: forming skills, confidence, and self esteem.

Resources of table 3.

[1], [2],[3],[4,],[5],[9],[13],[14], https://www.archdaily.com / [6] https://www.curbed.com / [7] https://www.baunetzwissen/ [8] http://www.mcbridecharlesryan / [10] https://architizer.com / [11] https://www.designboom.com / [12] https://www.plataformaarquitectura.cl

6. CASE STUDY

To investigate the applicability potentials of the 'Wheel of Experiential Learning' developed earlier in this paper, it analysis the outdoor court in preschool section, College Saint Marc, Alexandria Egypt as a case study. The school –dates back to 1926- is one of the oldest school buildings in Alexandria. It was erected under an encouragement and support of HM King Fouad 1st. The building, its courts and landscaping elements was planed, designed and built, up to the highest standards at its time. Till now, the school is highlighted as a role model in providing excellence in the educational environment. The preschooler's section in the school is located at the southern east corner of the complex. It has its court yard linked to a botanical garden designed on levels and directly linked to classrooms (as shown in figure 3). Among the design features is a supported bridge. It flies over the botanical garden linking the court to the classes.

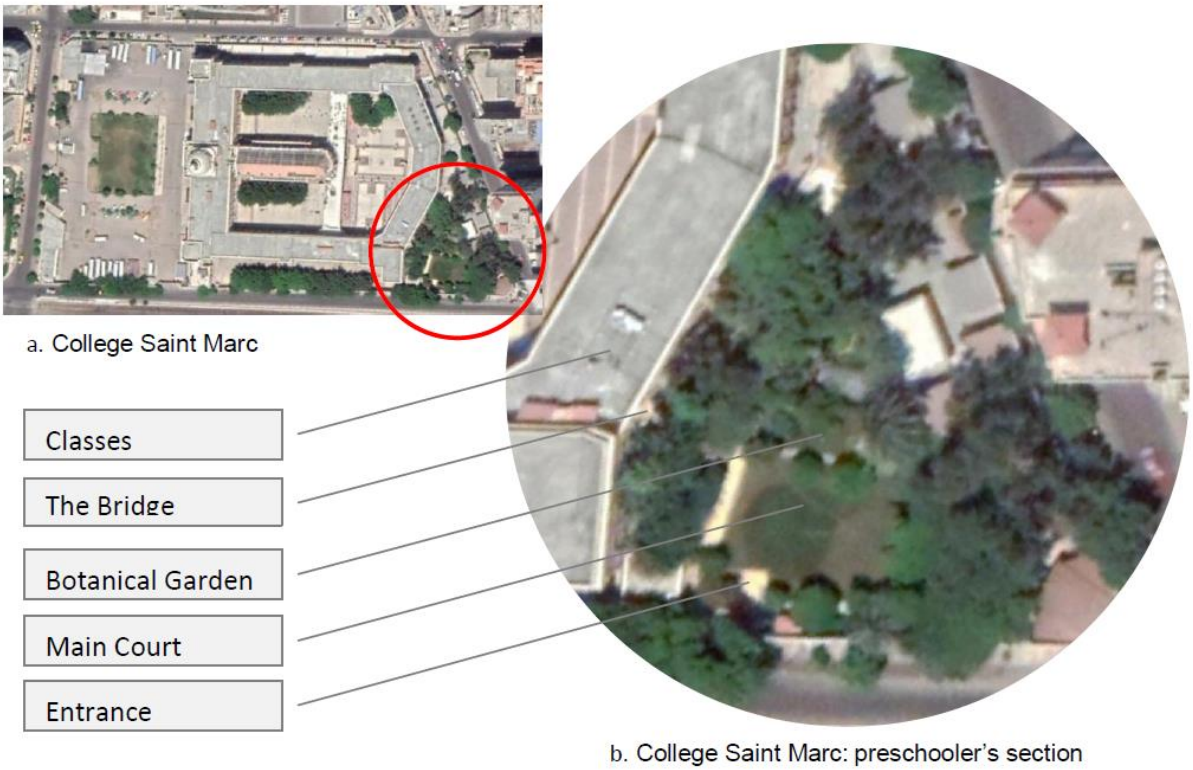


Figure 3: Layout of the preschooler's section at College Saint Marc, Alexandria, Egypt. (Reference: The Author)

Figure 4 presents an evaluation to the potentials of experiential learning based biophilic design in preschoolers' section at College Saint Marc. The diagram consists of two circles sharing the same center comprising two rings; inner and outer. The inner circle represents the theoretical model of the 'Wheel of Experiential Learning' while the outer ring shows the existing configurations of biophilic design at the external open space of the preschoolers' section. Comparing existing biophilic design configurations -presented at the outer ring- to the inner theoretical model gives insights to the performance of existing design concerning its ability to meet the requirements of biophilic patterns. The diagram shows this process as applied to all of the corresponding experiential learning steps.

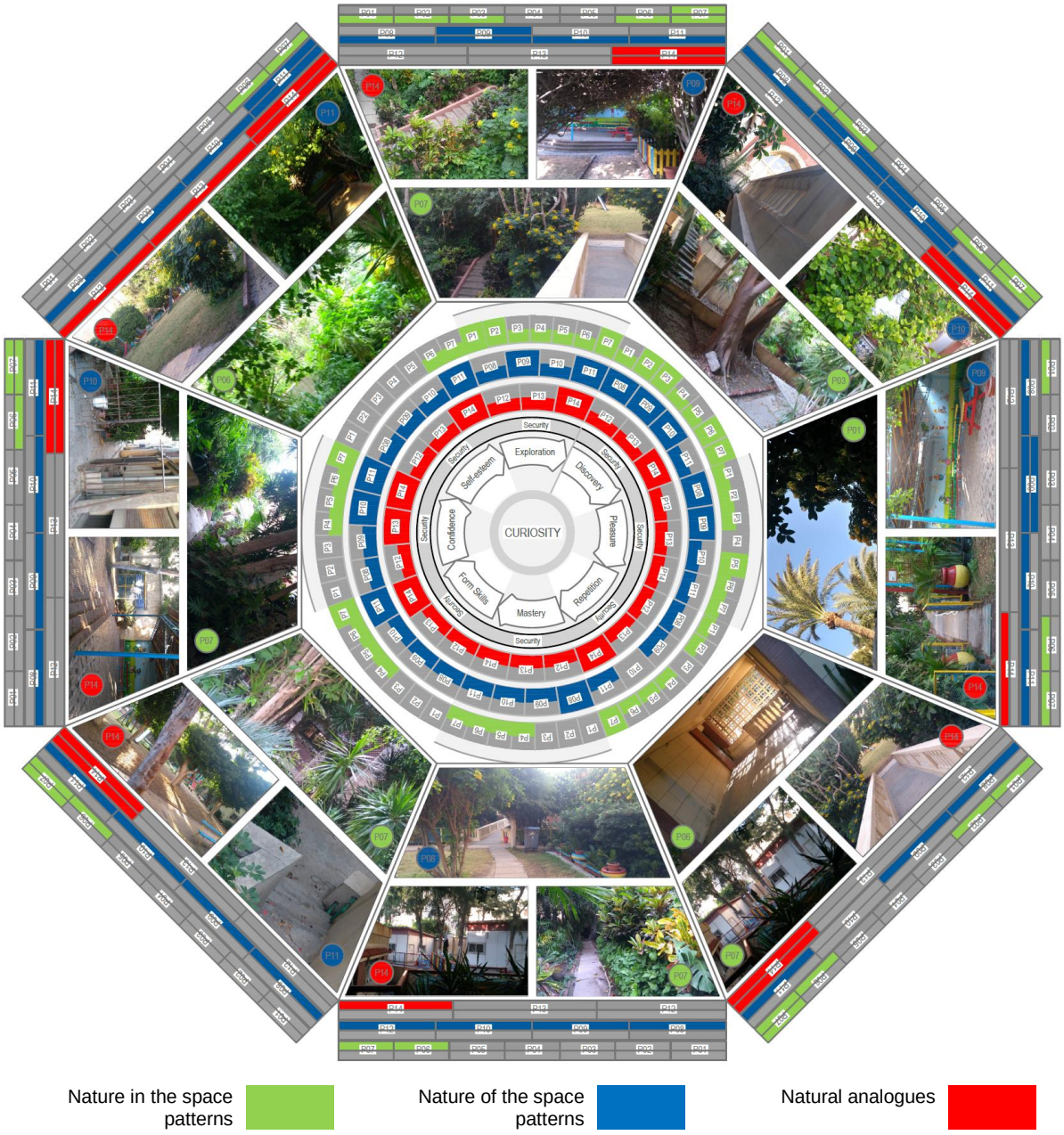


Figure 4: Applying 'Wheel of Experiential Learning' to the preschooler's section at College Saint Marc, Alexandria, Egypt. Correlating biophilic design patterns to stages of experiential learning. (Reference: The Author)

6.1. Findings and Discussion

Richness of external open spaces and the variety of potential experiences they offer draws the starting point for preschoolers' curiosity to go through a fruitful experiential learning process. Multi facets composition of external space elements (open court, flying bridge, multi leveled botanical garden, outdoor children shelter) all together improves the configurations of environmental context, and accordingly the quality of biophilic patterns.

However, reading the diagram (figure 4) shows that:

- Both 'Connection with Natural Systems' (Pattern no. 07), and 'Complexity and Order' (Pattern no. 14) stand as the most influential patterns among all patterns. The botanical garden with varieties of inhabited plants and old trees forms an overwhelming natural domain. This natural based immersive milieu has positive impacts on core experiential learning stages. In addition the contrast between the organic typology of the botanical garden and the geometrical order of the court, playing areas, and landscaping elements created an inspiring mixture between complementary elements. However, these conditions have the potential to inaugurate 'Exploration'

as the basic experiential learning stage. And accordingly its impact extends to cover all other stages of experiential learning; discovery, pleasure, repetition, mastery, confidence, and self esteem.

- All of 'Presence of Water' (Pattern no. 07), 'Biomorphic Forms and Patterns' (Pattern no. 12), and 'Material Connection with Nature' (Pattern no. 13), stand as the least influential patterns among all patterns. Analyzing the case study shows lack of water sources except for a rain drain in one spot of the site. This affects negatively all of the aspects of experiential education especially the 'Pleasure' aspect as it is directly influenced by this pattern. In addition the rigid form of the children's shelter, seats, and children's playing fixtures and the choice of their materials (steel structure covered with corrugated sheets for the shelter, concrete for seats, and steel tubes and box sections for playing fixtures) affects negatively patterns related to forms, patterns, and materials. The negative impacts of loosing these two patterns are distributed among different aspects of experimental learning especially 'pleasure' and 'confidence' which are focusing on children's interaction with his/her close surroundings.

- Between the previously mentioned two extremes of patterns achievements, patch of biophilic patterns are partially realized. Among these are 'Visual Connection with Nature', 'Dynamic and Diffuse Light', 'Prospect', and (Risk/Peril). The impact of these patterns could be noticed as incompletely effective as they are distributed in limited spots and/or sometimes in a poor quality. However they play a supportive role to the primary ones. For example, the perforated screen used in entrance canopy plays impressive role in diffusing and distributing light. The patterns shaped after this process has the power to inspire children and triggers their curiosity to explore and discover. However the small size and the location of this canopy limit the role of this feature pattern.

7. CONCLUSION

Experiential learning is a trending education approach used widely for children. It depends on activating child's built in curiosity to initiate a cycle of knowledge. However, this has to go within completely safe and secured conditions. This cycle starts with exploration and continues to include all of: discovery, pleasure, repetition, mastery, form skills, confidence, and finally self esteem. Actually this is an endless circle; starts where it ends. Each cycle adds to the child's gained knowledge in a cumulative way.

This paper studies the correlations between steps of experiential learning and biophilic approach for school design. It uses fourteen patterns classified under three categories: nature in the space, nature of the space, and, natural analogues, to set these correlations as presented in a two-dimensional matrix. It classifies these correlations into three levels based on experts' points of view. In addition it presents this matrix in a generic form 'Wheel of Experiential Learning' that could be easily used to compare the performance of case studies to the theoretical model.

The impact of biophilic patterns varies according to their coverage to experiential learning stages. On one hand, 'Connection with natural system', 'risk/peril' and 'complexity and order' patterns stands as the most influencing patterns as they cover most of the experiential learning stages and they are primarily responsible for inaugurating children's curiosity to know. On the other hand, 'non-visual connection to nature', and 'non-rhythmic sensory stimuli' are the least influencing patterns as they affects limited number of experiential learning stages. However the impact of other patterns lies between these two categories. Moreover, reading this matrix vertically shows that 'Exploration' and 'Discovery' as the most experiential learning stages that are shaped after biophilic patterns. This gives an indication to the importance of biophilic design aspects as they have direct impacts on these two key stages and consequently all of the other experiential learning stages.

Using 'Wheel of Experiential Learning' to evaluate the performance of biophilic design patterns in achieving a proper experiential learning milieu at preschooler's section at College Saint Marc proved its applicability potentials. Comparing the theoretical model to the existing conditions shows that 'connection with natural systems', and 'complexity and order' stand as the most influential patterns meanwhile, 'presence of water', 'biomorphic forms and patterns', and 'material connection with nature', stand as the least influential patterns.

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Detailed Resources for table 3.

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