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Biomimicry in Furniture Design

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Abstract

Nature, is a big factory, where the faults are kept at a minimum, choosing the most suitable material of all for the purpose, recycling them, and even changing every ingredient as conditions impose. Biomimicry examined models in nature, then imitating these designs or taking inspiration from them which aims to provide solutions to people’s problems is one of the new branches of science. From past to present many disciplines have produced designs and solutions inspired by the nature. Interior architecture is also one of the this disciplines. Interior design, interior, structure, comfort, and materials in furniture design, as well as the influence of these designs are carried out. Furniture has always been a symbolic aspect of the life style and cultural richness of mankind. Form, structure or materials in the nature as used for furniture design both for aesthetic and practical purposes. In the study, designs were made with inspiration from macro and micro sized living beings in the nature. Within the concept of Biomimicry, furniture designs were made, which were inspired by both forms and structures in the nature and applied exactly.

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1. Introduction

Nature has always been a source of inspiration for the human. Indeed, human met all his needs such as shelter, survival and protection in caves which were readily available in nature. It was only later that they built shelter for protection and defense. Therefore, we may conclude that human observed and tried to learn about natural forms and structures and needed shelter simultaneously. Designers have also observed how life proceeded in nature and began

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to develop the first shelters either by observing or imitating the natural structures. Nature gave them plenty of opportunities with its admirable mechanisms, designs and potential to enrich a various aspects of life. As a result of the increase of our accumulation of knowledge and the development of technological opportunities, this potential reveals itself a bit more in every single day.

Science; from nature to model, measure, and mentor, taking a lot to learn. Biomimicry examined models in nature, then imitating these designs or taking inspiration from them which aims to provide solutions to people's problems is one of the new branches of science.

Being a guiding spirit for all of the sciences today and making progress as a result of the imitation and observation of nature, biomimicry also affects us in the architectural domain (Tokman, 2012). Undoubtedly, Biomimicry will be increasingly influential on the understanding of design in the future. Therefore, it will give the chance to introduce the concept of Biomimicry to the designers, enabling them to widen their perspective and evaluate things around more uniquely.

It will help designers to understand that a spider is not only a spider but a material producer and designer while an ant is not only an ant making structures similar to sand castles. In short, Biomimicry basically refers to the importance of seeing the nature from a different point of view and understanding it.

Looking at the nature and seeing the solutions is particularly important for the designers. Design must follow this principle and this value must be generalized. Biomimicry is a method that has consciously or unconsciously been tried at every period of design and yielded positive results. Supporting Biomimicry in every type of design training will undoubtedly have significant benefits as it is seen as a science rather than a design approach despite its short history.

The main goal of the study is to demonstrate students how living beings in nature contribute to design. Objectives related to this main goal are examination of the relationship of Biomimicry to design, generalize the method of bringing solutions by looking at nature through teaching the concept of Biomimicry and measuring the effects of the method in design training.

2. Biomimicry

Both biomimicry and biomimetric are the new sciences that observe the materials in the nature and then aim to produce solutions for humans by imitating these designs or by taking inspiration from them. The biomimicry concept that was discussed in this study is a new work area that selects the principles of proceeding of the nature and design materials and processes in accordance with these principles that have ensured the continuity of the life for 3.8 billion years. In short, biomimicry can be defined as 'the innovation that gets inspired by the nature'.

Biomimicry is a concept that was first put forward by a writer and science observer Janine Benyus who is from Montana. Upon thinking about the wonderfulnesses that he saw in the nature, Benyus believed that the models in the nature should be imitated.

Some of the examples which direct him to supports such an approach are the followings:

• The fact that the bea-eaters can go through the Mexican Gulf with fuel less than 10 gr,
• The fact that the damsel flies can be out on maneuvers even better than the best helicopters,
• The fact that air conditioning and ventilation in the thermite towers stand head and shoulders above those of humans in terms of equipment and energy consumption,
• The fact that multifrequency transmitters of bats are much more efficient and sensitive than the radars that humans created,
• The fact that the beaming algae draw various chemicals together so as to lighten their body warping ends,
• The fact that polar fishes and frogs can revive after they are have been frozen for a long time and that their organs are not damaged owing to ice,
• The fact that the chameleons and the cuttle fishes are perfectly in harmony with the environment they are present,
• The fact that the whales and the penguins can dive without oxygen tubes,
• The DNA helix’s capacity to collect data,
• The fact that the leaves perform the greatest chemical process in the world by generating 300 billion tons of sugar each year photosynthetically (Benyus, 1997).

Below we have offered only a few examples of such mechanisms and designs; shortly the concept of Biomimicry, which has been dealt with and popularized by Janine Benyus’ friends and other people interested in the subject since it was dealt with as a science by Janine Benyus. The field that was of particular interest to scientists and designers have begun to be realized consciously. Therefore, Biomimicry has turned into an attitude that is applied in numerous professions, yielding positive results (Kuday, 2009).

3. Biomimicry in Design

Derived from the stems “bios-life” and “mimesis-to imitate” and similarly used with “Biomimetic”, “Biomimesis”, “Biognosis” and “Bionic” terms, this concept is used in various disciplines in researches and studies towards developing more advanced technologies by “learning from nature”. Biomimicry may also be translated into our language as “learning by imitating the best ideas of nature” and has begun to be regarded as a new branch of science by embodying “likely solutions and solution potential in the nature” in various different disciplines and even through an interaction that integrates disciplines. “Thus, man who used to gain experience through observation of nature have begun to take lessons from nature as a means of comparison and an instructor beyond taking it a model” (Benyus, 1997).

“Imitating the nature” has been a popular theme for centuries in almost every kind of art, social and science fields and now is resorted to in numerous disciplines including architecture, sculpture, painting, interior architecture and industrial design etc. to find solutions. Observation, analysis and modeling the features of materials and forms in the nature including stability, lightness, resistance to dynamic and static loads, figural and structural properties enabling energy saving, silence, self-repairing directed attention of many scientist to living and non-living forms in the nature. Therefore; Benyus thinks that a “biomimetic revolution” will happen in the following years if this learning process is popularized in other disciplines” (Benyus, 1997).

Interior architecture has also been influenced by increasing popularity of Biomimicry among scientific branches and materials and forms in nature have begun to find themselves a place particularly in furniture design. It is no possible to see furniture samples influenced by microorganisms, plants or animal skeleton structure, designed precisely or amended and produced with macro or micro-size inspiration from the nature.

The armchair, an exact copy of a lily designed by Albina Basharova (Figure 1).

Figure 1a-b. Fiori Divano’s lotus armchair (URL-1)
Mantis Table, designed by Alvaro Uribe who was inspired by body parts and joints of the mantis (Figure 2).

![Mantis Table](URL-2)

Biomimicry chair designed by Lilian Van Daal who used plant cell structure (Figure 3).

![Onion cell and Biomimicry chair](URL-3)

“Bone Chair” designed by Joris Laarman, who was inspired by bone structure under osteoporosis (Figure 4).

![Bone structure and Bone Chair](URL-4)
“Quartz Chair” designed by Davide Barzaghi, who was directly inspired. Having a crystalloid appearance, “Quartz Chair” is made up of mostly smooth and curved geometric shapes within the frame” (Figure 5).

Figure 5a-b. Quartz Chair (URL-5)

“Tree Table” was designed by metal artist Scott Cawood. A table of forged and welded steel with an exact figure of a tree (Figure 6).

Figure 6a-b. Tree Table (URL-6)

4. Studies

Aiming to create designs inspired by micro and macro sized living beings in the nature, the study was carried out during “Furniture Design” course given to Karadeniz Technical University Interior Architecture 3rd grade students. 44 students participated in the 6-stage study.

In the first stage, conductor gave students information with a seminar on “Biomimicry”. In the second stage, students carried out more comprehensive research personally on the topic. In the third stage, conductor selected the product that would form the furniture structure. A white plastic stool was selected as the furniture (product) as it is easily available, economic and different forms may be applied on it. After students gained enough knowledge of the topic and product was selected, they passed onto the fourth stage where they formed 2 or 3 dimensioned models out of minimum 5 samples they obtained at the end of their research. In the fifth stage, they selected the best design work among the suggested ones and applied it on 1/1 model. In the term-end delivery which was the sixth and final stage, 2 and 3 dimensioned images and 1/1 scaled sheet of Furniture (Product) presentation were delivered (Figure 7-8).
<table>
<thead>
<tr>
<th>Student Work</th>
<th>Interaction</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.jpg" alt="Image" /></td>
<td><img src="image2.jpg" alt="Image" /></td>
<td>Inspired by “Bacillus subtilis” bacteria form. Covered the stool surface with a material of the same shapes.</td>
</tr>
<tr>
<td><img src="image3.jpg" alt="Image" /></td>
<td><img src="image4.jpg" alt="Image" /></td>
<td>Inspired by “Smooth muscle cell” form. Completed the design by using the same gaps on the surface.</td>
</tr>
<tr>
<td><img src="image5.jpg" alt="Image" /></td>
<td><img src="image6.jpg" alt="Image" /></td>
<td>Inspired by cell form of “Protozoa” bacteria. Tried to reflect this effect by opening similar gaps on stool surface.</td>
</tr>
<tr>
<td><img src="image7.jpg" alt="Image" /></td>
<td><img src="image8.jpg" alt="Image" /></td>
<td>Inspired by “Nerve Cell”. Applied structures like nerve structure on the stool surface.</td>
</tr>
</tbody>
</table>

Figure 7. Example of Student Work
<table>
<thead>
<tr>
<th>Student Work</th>
<th>Interaction</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Student Work" /></td>
<td><img src="image2" alt="Interaction" /></td>
<td>&quot;Peacock&quot; influenced from. The peacock colors and feathers abstracted form in the backrest.</td>
</tr>
<tr>
<td><img src="image3" alt="Student Work" /></td>
<td><img src="image4" alt="Interaction" /></td>
<td>&quot;Luminous algae&quot;s. In the depths of the sea of their own folds and spot light, form and functional design as is reflected.</td>
</tr>
<tr>
<td><img src="image5" alt="Student Work" /></td>
<td><img src="image6" alt="Interaction" /></td>
<td>&quot;Diatoms&quot; microscopic sea creatures from being influenced. Diatoms' colors and parts of the stool is reflected as a form.</td>
</tr>
<tr>
<td><img src="image7" alt="Student Work" /></td>
<td><img src="image8" alt="Interaction" /></td>
<td>&quot;Pollen&quot;s microscopic images of the superficial layer of the structure is affected.</td>
</tr>
</tbody>
</table>

Figure 8. Example of Student Work
To examine the outcome of this application, students were asked the question “Did beginning furniture design with Biomimicry have any use on design?”

Students stated that with natural imitation in furniture design they

- understood that every beauty in nature served another one,
- developed their ability to think differently in design,
- realized how perfect and inspiring the nature was,
- enjoyed lessons,
- enhanced their general knowledge by learning about different living beings,
- made different designs thanks to natural diversity,
- created unique designs by abstracting the natural designs in the nature,
- communicated differently with nature thanks to the designed furniture,
- found starting point easily for design,
- interpreted the existing design instead of new one,
- understood how extensive starting points were,
- discovered mysterious aspects on macro and micro scale,
- could make more aesthetic and effective designs with the proportions, systems and forms in the nature.

5. Conclusion

As a design method, Biomimicry has given us the chance to use in our designs the system, technique, color, harmony, proportion etc. that the nature offers us. As a result of this method that employs exact functioning of the nature, designs that occur are stronger because an exact copy of this method is in the nature and functions. Methods derived from the perfect nature provide rich starting points in our studies and integrated designs may occur with correct technique. Instructions of the nature’s perfect order will contribute significantly to the development of our designs. The fact that everything in nature exists in compliance with rules facilitated the starting process.

To conclude, Biomimicry has given us the chance to use in our designs the system, technique, color, harmony, proportion etc. that the nature offers us. It was effective in basing the designs formed with this method on concrete scientific data. Methods derived from the perfect nature provide rich starting points in our studies and integrated designs may occur with correct technique. The perfect order of nature facilitated the process of decision-making and trial and error and helped to animate the design on mind, give it a form or find a solution through production.

References