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Research paper



Biomimicry architecture: new dimensions of creativity an exploratory approach in academia

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Abstract

The Universe around us stands as a proof of the greatness of God. Everything around us, small or huge, tiny or great, all confirms the fact that this universe has a creator who initiated it and kept running and maintaining it. No one can ignore such fact. Allah has created all aspects of beauty and perfection. Despite the vast technological and scientific development that humanity witness these days, yet we still discover new indications of God's creativity and miraculous formations every day. This fact was the source of inspiration for architectural designers in coming up with new inventions and creations that help regeneration and natural environmental sustainability. "Biomimicry" is certainly one of these approaches that consider nature as its inspiration towards a different –hopefully, a better - future for humanity. This research sheds some light on a vision that took place in fall2014 at the department of architecture, Effat University, KSA. A senior studio (studio7) was targeted to explore the potential of weaving the "Biomimicry" approach within the syllabus of that studio. This initiative had been proposed by the team supervising this studio as an exploratory one before the call from "Makkah Techno-valley Company (MTV)" to design a Research Center (RIM) was launched. The RIM project aspires to play a major role in offering a support- ive environment for youth in Saudi Arabia enhancing their abilities and developing their skills to experience achievement within "MTV" main campus. The study aimed at exploring the possibilities of implementing such an approach within a GCC country with its entire unique educational context.

Keywords: *Biomimicry; Architectural Education; Sustainability; Creativity; Design Studio.*

1. Introduction comprehensive architectural education

Global trends to create unified and integrated entities depending on the integration and interaction of parts and components is rap- idly increasing in the recent decades, to be capable of interaction and coexistence amid the growing global challenges. Along with the rapid technological developments in the new century, archi- tects should search for new means to deal with these develop- ments, which should be reflected on the ideas of developing the educational process entrusted with the development of preparation of the future architects. In light of these trends it seems important that the architectural education process to be practiced as an inte- grated and comprehensive process where all parts and components act together to serve the overall objectives of the system, and this system branches out to smaller highly specialized sub-systems (Hatem, et. Al, 2003).

Architectural design studio is located in the heart of the architectural education system and represents a melting pot where all the knowledge and skills learned by architecture students merge. Accordingly, the integration between design studio applications and deliverables of other courses becomes an essential goal of the architectural education comprehensive system that relies on a set

two main axes: first, a vertical axis depends on the sequential gradient structure of design studios in successive levels in integrated system. While the second horizontal axis depends on the integration and interaction of the architectural design curricula with different curricula to serve each other (M. Fekry, 2004).

In the context of the second axis, current study raises a proposal to activate the application of the deliverables of the courses of architectural theories in the architectural design studio. The application of the model proposed in Architectural Design Studio-7 at Architecture department - Effat University through a personal experience of the researcher within the studio teaching team. The team put forward the idea of including the application of a modern architectural trends studied by students in the course of architectural theories in the design studio as one of the intended learning outcomes of the design studio. The application of this experience started by SPRING2014 semester. Through this study, the features of the experiment will be reviewed where Biomimicry concepts were chosen to be applied in architectural design project. The research will start by highlighting the main features of Biomimic- ry and then introducing the methodology of application within the design studio with a review of some models of the students' prod- ucts with the most important application remarks.

2. What is biomimicry

Universe around us stands as a proof of greatness of God. Everything around us, small or huge, tiny or great, all confirms the fact that this universe has a creator who initiated it and keeps running and maintaining it. No one can ignore such fact. All aspects of beauty and perfection have been created by Allah. Despite the vast technological and scientific development that humanity witness these days, yet we still discover new indications of God's creativity and miraculous formations every day. This fact was the source

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of inspiration to architectural designers in coming up with new inventions and creations that help regeneration and natural envi- ronmental sustainability. Many architects try to copy nature in their designs as they believe that biomimetic approach is consid- ered as the design approach that best preserves environment and sustains buildings Architects dealt with nature as a source for their designs through many different ways; we can classify these meth- odologies into four main themes: Learning from the nature; Mak- ing the nature visible and explicit first; Design with nature by metaphor formation, articulation, and configuration; Using the nature for ecological accounting design. At a time in which the sustainable paradigm has become a mainstream concern; if we are to make progress with the sustainability revolution, this paradigm has to shift from "reducing unsustainability" to "working towards sustainability" through three changes: Radical increases in re- source efficiency; Shifting from a linear, wasteful, polluting; and way of using resources to closed- loop model and changing from fossil-fuel economy to a solar economy (M. Fekry, 2015).

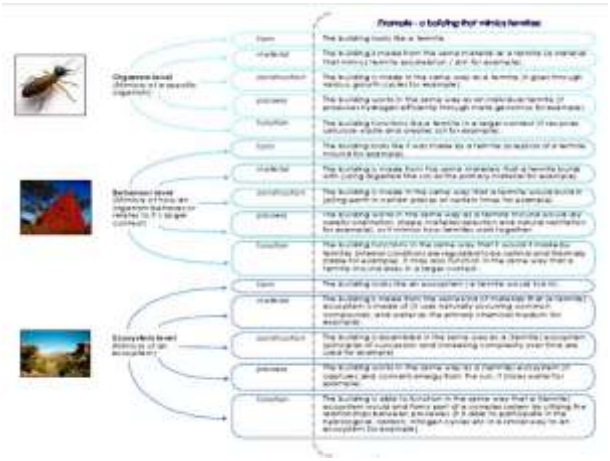


Fig. 1: Different Levels of Biomimicry.



Fig. 2: Examples for different levels of Biomimicry.

Biomimicry presents itself as a basis, a foundation of a new research methodology instead of mere serendipity. Biomimicry has to be approached in a multi-disciplinary order of thought in order to understand the principles of nature to achieve a holistic design solution. Biomimicry is a new science that studies Nature's mod- els and then imitates or takes inspiration from these designs and processes to solve human problems, where we can consider Nature as model. Biomimicry uses an ecological standard to judge "rightness" of our innovations, where we consider Nature as measure. And Biomimicry is a new way of viewing and valuing Nature, where we consider Nature as mentor (Sujit Sudhaman, 2012).

Biomimicry deals with nature on three main levels: Mimicry of a specific organism; Mimicry of how an organism behaves or relates to its larger context; or Mimicry of a holistic ecosystem. And at each level it consider five main aspects: Form; Material; Construction; Process; and Function (Vaisali K, 2013).

3. Biomimicry in the design studio

The studio team started planning to encourage the students to apply what they learned in other courses to help them understanding the integrative nature of Architectural design process. This experiment took place by the beginning of Spring2014 semester. The team initially put some criteria for selecting the appropriate level through design studios and selecting the appropriate project for application before starting the application. The experiment went through several stages including: Students' preparation, Project selection, Theory and inspiration, Application and Evaluation. We'll investigate these stages in the following part.

3.1. Students' preparation

Asking students to try and apply new concepts and ap- proaches into the design process is not an easy task and needs good preparation to encourage them to accept the challenge. This process were divided into two main parts: the first was the psychological part by introducing the ex- periment to the students and explaining the importance of thinking of the design process as an integrative process and how this will develop their skills. And this also was achieved by putting the students in the challenge mood through dealing with a real client (which form one of the main selection criteria of the selected project). This compet- itive environment encouraged the students to work hard to proof themselves in front of the client.

3.2. Project selection

The second part was the physical preparation by introduc- ing the selected approach (Biomimicry) to the students and train them to apply it in the design process. This was achieved by a set of theoretical lectures introduced to the students at the beginning of the course then the students were asked to do a research on the main features and appli- cations of Biomimicry. The results of their researches were used later establish a project startup for each students which will be discussed in the inspiration part.

Selecting an appropriate project for application is a milestone in the success of the experiment. The team tried to put a group of selection criteria focusing on the project type, size, location and requirements. Applying new approach in the design process is a real challenge, thus we need to select a project type without func- tional complexity without high demand for technical requirements to help the students to focus on definite dimensions; projects such as museums, convention centers and similar public buildings are good examples. The functional flexibility of the design program is another important factor to give the students the freedom for add- ing or modifying some elements and functions to the program. To select a project to be suitable for applying the Biomimicry princi- ples, we should find a project with structural and environmental challenge to help the students to deal with the new approach by thinking of the suitable solutions for those challenges.



Fig. 3: MTV Project Campus and Proposed Project "RIM".

The team contacted key-persons in Makkah Techno-Valley Company (MTV) to consider them as the real client and select one of the new buildings at MTV new campus to be designed by the stu- dents. After the discussion between the studio team and MTV team, Research, Innovation and Marketing Building (RIM) was selected to be the design project. The project lays at the heart of the campus

and presents one of the most important buildings of the project which puts a great responsibility on the students and encourage them accept the challenge. The proposed program by the client was simple and flexible and they showed maximum possibility for modifications to the program which gave more flexibility to the students to deal with project. The project will be located in a desert site carrying out a big environmental challenge. And finally the project had several open and interactive spaces which added another structural challenge.

3.3. Application methodology

The studio team proposed sequential steps for the experiment application. Those steps were proceeded as follows:

3.3.1. Exploring biomimicry as a theoretical approach

It started by an introductory lecture by course instructors about the Biomimicry approach and its application in Architecture, then the students were asked to conduct a research where they explored different principles and classifications of the approach.

3.3.2. Project investigation

MTV representatives were invited to introduce the project brief to the students explaining MTV campus project and its objectives and components and the project site. Then the students visited the project site and studied the environmental conditions of the project and applied a site analysis for the project. The students were been asked to conduct an analytical study about the design principles for this project type (science parks), they analyzed the initial pro- ject functional program and discussed it with the client representatives.

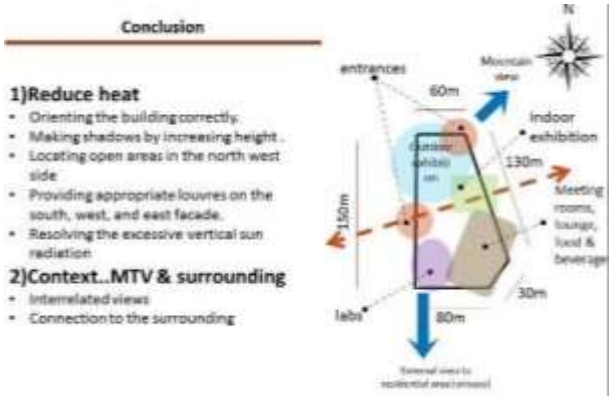


Fig. 4: Example for Site Analysis.

Throughout this discussion they added a new environmental challenge as they agreed with the client to define increasing the exposure and interaction with nature as a main objective of the project. This stage ended up by defining a detailed different design program for each group of the students.

3.3.3. Biological analogy

Biomimicry doesn't mean applying a direct copy from nature but it's concerned by understanding natural principles and mimicking those principles in the design process at one or more of the three main Biomimicry levels (Organism, Behavior and Eco-system). To protect the students from using the first approach, the team asked each student to select one natural feature (at any level) and conduct a detailed study to analyze it in terms of form; material; construction; process; and function. And they were been asked to avoid linking this study to their proposed project to insure a good understanding of all the 5 aspects to instead of copying the form.

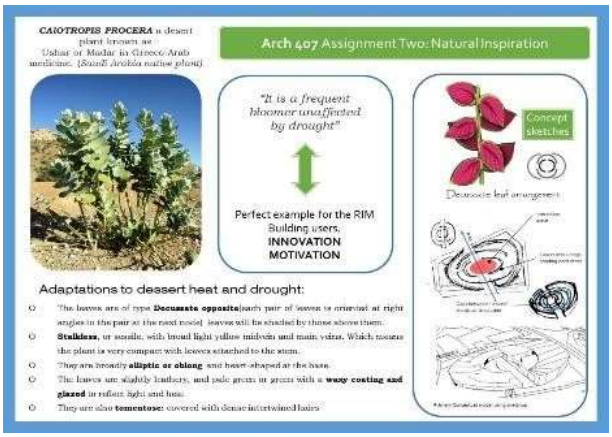


Fig. 5: Samples of the Biological Analogy Analysis.

3.3.4. Concept inspiration

The clear understanding of the aspects of the selected natural feature helped the students to find a biological reference for their projects' inspirations. Each student tried to find a link between the proposed project program, environmental and urban site analysis, and biological reference analysis and use this integration as an inspiration for the project concept on different levels.

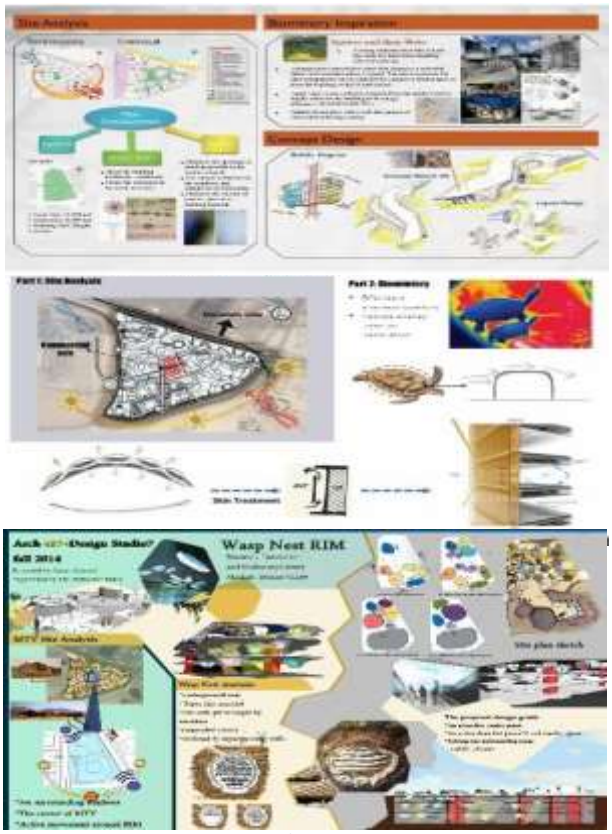


Fig. 6: Samples of Concept Inspirations.



Fig. 7: Example for Final Project Poster.

3.3.5. Design development

At this stage the client representatives were invited to discuss with the students the proposed programs and students' design concepts before asking the students to develop their concepts into detailed designs. Then the students went through the design process to develop their designs studying the integration between all design aspects (functional, aesthetics, structural, environmental …). Then they produced the final posters for their projects where MTV representatives were invited to participate in the evaluation process and announce the selected designs.

4. Conclusion

The implementation of a comprehensive educational process, a 5-step process for design is presented in this research to introduce a new approach to the architectural design studio. The developed approach uses new resources of inspiration that are tailored to senior studio students. The approach is developed, described, im- plemented, reflected on and discussed. It is based on the applica- tion of principles of Biomimicry on architectural design. The ap- proach was developed to enhance creativity, imagination, and innovation by exploring new sources of inspiration. Its implemen- tation is described as an action research where an experimental architectural design project was applied in real life studio settings. The project entitled "RIM" was concerned with the design of an inspirational research center in "MTV". The Building was also supposed to respond to harsh environmental settings, and to varia- ble needs of the building users. Reflections and feedback about the approach and the project implementation are measured by struc- tured questionnaire and unstructured discussion and interviews. Feedback about the project implementation suggests the success of this approach as an alternative or supportive to conventional de- sign approaches. It achieved its goal of enhancing innovation in design which was clear in the products that were different from all previous and concurrent results. The client's feedback was very positives where they selected three projects to be submitted to the project's main consultant to be used in developing the design con- cept of the "RIM" building. However, the new design approach has some limitations as its participants pointed out. One of these is that it puts limitations on selecting suitable projects for the pro- posed approach. The other is the time limitation, which puts more pressure on the students to explore new design approach and apply it in their designs in very short time; this point could be converted into a very positive point if the students were prepared psychologically to take it as a competitive challenge.

Possible future extensions of this research include its implementtion in design practice, especially where responsive environmental design is required. Another extension is the implementation ofdifferent design approaches and trends and preparing a list of suitable projects for each approach.

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