Research Article
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The Role of Biomimicry in Interior Design Education and Structural Forms

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Abstract
Biomimicry is an approach that aims to develop human-made systems by mimicking nature's design principles and processes. In interior architecture education, the application of biomimicry enables students to develop their creative thinking skills and create sustainable design solutions. This approach aims to integrate the inspiring aesthetic and functional characteristics of natural systems into interior design. In this context, this study examines the course content applied within the scope of Structural Knowledge, a compulsory course in the third-semester curriculum of the Interior Architecture Department at Selçuk University's Faculty of Architecture and Design. The aim of the study is for students to analyze the structural characteristics of structures and organisms in nature using biomimicry principles and to create the main outlines of the design process in their own projects. The scope of the study included second-year interior architecture students who were asked to create shells and load-bearing systems for their interior architecture projects in the project studio as part of their Structural Knowledge course. The various shell formations that emerged as a result of the study, along with the impact of nature on the design process, were highlighted. Based on the findings obtained from the semi-structured interviews conducted, it has been revealed that there are positive views regarding the impact of biomimicry on the design process.

Keywords: Interior Architecture Education, Biomimicry, Structural Forms

1. INTRODUCTION

Biomimicry is an innovative approach that adapts functional, aesthetic, and sustainable solutions developed by nature over millions of years of evolutionary processes to human-made systems and designs (Pawlyn, 2011). This treatment, which has been addressed at different temperatures in different periods, is referred to in the literature by similar terms such as biomimesis / biomimetics / biomimicry. The concept, a combination of the words "life" (bios) and "mimesis" (mimesis), was first used by American engineer Otto Schmitt in the 1960s. It is a solution to encountered problems, drawing inspiration from methods already in use over many years (Benyus, 1997). The use of nature as a source of inspiration not only enhances the functionality and performance of design, but also provides aesthetic, efficient and sustainable approaches to design (Altıparmakoğlu, Sakarya and Pınar, 2025).

This approach not only equips interior architecture students with creative problem-solving skills but also instills in them a sustainable design mindset inspired by nature. A review of the literature on the subject indicates that biomimicry applications add value to the design processes of interior architecture students and encourage innovative thinking. In line with this, the study examines the contribution of the biomimicry approach to design education within the scope of the Structural Knowledge course in the third semester of the second year of the Interior Architecture Department at Selçuk University's Faculty of Architecture and Design. Students participated in this study in groups of two or three volunteers.

Within the scope of the course, students were provided with information about the structural elements of a building, such as columns, beams, floors, and foundations, followed by the integration of biomimicry principles into structural systems and shell design. Students developed their design processes by drawing inspiration from the

structural characteristics of natural organisms such as owls, turtles, butterfly cocoons, and spiders.

The aim is to analyze the contribution of biomimicry-based design education to students' creativity, sustainability, and structural thinking skills. In this context, biomimicry is considered as an interdisciplinary approach that contributes to the development of aesthetic and functional design decisions in interior architecture education.

2. THE IMPACT OF THE CONCEPT OF BIOMIMICRY ON DESIGN EDUCATION

Biomimicry is an approach that aims to develop human-made systems by mimicking nature's design principles and processes. Biomimicry is utilized in interior architecture education to develop innovative and sustainable design solutions inspired by natural phenomena. The impact of the biomimicry concept on design education is categorized into three key areas: drawing inspiration from nature, enhancing problem-solving skills, and utilizing functional and structural principles, with subheadings and content outlined in Table 1.

Table 1. The İmpact of Biomimicry on Design Education

	Inspired by Nature	**Problem Solving Skills**	**Functional and Structural Principles**
The Impact of Biomimicry on Design	• **Formal Learning** Students examine a living object or object taken from nature in a formal way.	• **Design Process** Researches the form and functional depth of living objects or objects selected from nature, and conducts research on information and details that will influence the design process. .	• **Formal Imitation** The formal imitation of shapes found in nature.
	• **Functional Learning** Students gather information about the functional characteristics of a living object or object taken from nature.		• **Functional Principles** Transferring functional principles found in nature to design.
			• **Structural Principles** Transferring structural principles found in nature to design.

A literature review was conducted on the concept of biomimicry, with a particular focus on the fields of architecture and interior design. The effects of this concept on design education were also examined. In his study, Bucciantini (2022) emphasizes the significance of the biomimetic approach in architecture and explores the process of creating harmonious facades and communicative interior spaces by utilizing a flower model in the design of an elementary school building. This method not only increases the amount of knowledge but also enriches the user experience. It is stated that the integration of biomimicry education can offer advanced design solutions suitable for specific environments and the Canadian climate. In conclusion, it argues that these applications have the potential to change architects' understanding of flexible forms and user interaction.

Contreras and Fernandez (2023) emphasize that biomimicry and biophilic design principles are having an

increasing impact on architecture and interior design, promoting advanced and sustainable building forms. It is stated that learning about natural forms and elements can enhance design and support creativity. The inclusion of these principles in education is argued to make the design process healthier and more sustainable.

In their study, Omar et al. (2020) emphasize the central role of biomimetic design in enhancing creativity and complexity in problem solving in architecture education. Integrating biomimicry into the curriculum, especially in the second year and beyond, can help students better understand creative thinking processes. Although the article does not include a specific examination of sustainable forms in interior architecture, the interdisciplinary distribution of biomimetic applications argues for potential benefits for interior architecture education.

Erşanlı and Erşanlı (2023) argue that utilizing the power of nature in interior architecture education has a significant impact on the development of the learning process. The study emphasizes that biomimicry is an interdisciplinary approach that combines biology and architecture, and that it will increase collaboration between designers and biologists. The study highlights the potential of integrating biomimicry into design education to foster creativity in the design process.

Salama et al. (2025) investigate the impact of biomimicry on the development of interior design. The richness offered by biomimicry policies promotes the creation of sustainable and advanced interior spaces through the diversity of natural forms. This encourages a deep understanding of general, aesthetic, structural integrity, and sustainability components, arguing that it increases the flexibility and critical thinking characteristics of different designs.

Białkiewicz (2024) addresses the use of biomimetic and biomimicry concepts in architectural design practice, focusing on their role as design tools. It emphasizes that functional architectural elements can inspire biomimetic function and that biomimicry encourages a holistic approach to design. These principles argue that they can support advanced and sustainable design approaches in interior architecture by promoting natural appearances and integration.

In his 2015 study, Yeter argues that the concept of biomimicry has a significant impact on interior architecture education, encouraging students to integrate concepts such as inspiration from nature, economy, and durability into their designs. This approach promotes a new environmental awareness while supporting the development of lightweight and energy-efficient structures. The concept of biomimicry is argued to contribute to students' learning of sustainable design practices that reflect the complex relationships in the living world by developing innovative architectural solutions that maximize material use and functionality through the analysis of natural forms and systems.

Ergün and Aykal (2022) emphasize the importance of incorporating biomimicry into architecture and interior design education, stating that this approach should be integrated into the curriculum to promote sustainability. Focusing particularly on building design, the study states that biomimicry policies can inspire interior architecture to mimic nature's solutions, creating resilient and flexible forms that contribute to the formation of more sustainable and efficient interior spaces.

Aziz and El Sherif (2016) emphasize in their research that biomimicry has an important role in interior

architecture education, encouraging designs to be inspired by nature's evolutionary solutions. This method is highlighted as effective in improving stability forms that increase efficiency and improvement.

Stevens and others (2019) emphasize in their studies that integrating nature as a measure and guide into the biomimicry education model can significantly influence interior architecture education and building forms. It is argued that understanding natural forms and functions enables designers to create more sustainable solutions.

The importance of analogical transfer in design thinking suggests that incorporating these elements can lead to innovative and environmentally friendly architectural applications. Pawlyn (2011) emphasizes the influence of biomimicry on interior architecture education in architecture and recommends integrating nature-inspired design principles into the curriculum.

It is noted that the study of natural forms and systems can lead to innovative structural forms that increase resource efficiency and sustainability. The study of case studies is highlighted as providing inspiration for students to explore zero-waste systems, energy production, and material production, thereby equipping future architects with the necessary tools to develop design ideas aligned with ecological principles.

Jamei and Vrcelj (2021) focus on the application of biomimicry in architecture and structural engineering and highlight its potential benefits in creating sustainable building environments. Although it does not provide direct information on interior architecture education, it demonstrates how biomimicry can inspire design applications and structural forms.

This approach can generate innovative solutions for building facades and climate-responsive designs and strengthen the educational framework for future architects and engineers. Elsamadisy et al. (2019) discuss biomimicry as an innovative approach to designing sustainable and regenerative structures in architecture.

Although biomimicry primarily focuses on structural exterior surfaces, it emphasizes that adaptive strategies from nature can also influence interior architecture education by integrating them into the design curriculum. This approach argues that it will help students develop creativity and sustainability in their designs by encouraging them to discover building forms that mimic ecological systems.

Based on the literature review, it is considered that biomimicry contributes positively to design education, enhances design thinking, and that the act of imitating or drawing inspiration from nature can be integrated with other concepts to improve the design process.

3. MATERIALS AND METHODS

This article focuses on the idea of using biomimicry in the design of building envelopes. Within the scope of the study, semi-structured one-on-one interviews, interviews, and discussions were conducted as data collection techniques for identifying the problem and finding solutions. The interview technique is also referred to as an interview in some sources. According to this description, an interview is a conversation between two or more people conducted in a specific order and with a specific purpose (Coşkun, Altunışık, and Yıldırım, 2017).

Kvale (1994) extensively addressed the stages of the interview technique in qualitative research, covering the entire process from the design of the study to the reporting of the findings. In this study, Kvale's (1994) classification

was used as a basis, and the seven stages of the interview technique are presented in Table 2.

Table 2. Kvale (1994) Classification of Interview Techniques

Kvale (1994) Interview Technique	**Thematization**	**Design**	**Interview**	**Transcription**	**Analysis**	**Confirmation**	**Reporting**
	•Clarification of the objective •Outlining the conceptual framework of the subject	•Clarification of planning and objectives •Clarification of methods •Planning of the process	•Preparation of the interview form •Conducting the interview	Transcription of the verbal interview	• Determining the analysis method appropriate to the subject and purpose of the research	Comparison of the consistency of findings and data	Interpretation of findings

This study examines the course content implemented within the scope of Structural Knowledge, a compulsory course in the third-semester curriculum of the Interior Architecture Department at Selçuk University's Faculty of Architecture and Design. The course provides information on the structural elements of a building, including columns, beams, floors, and foundation types, and examines the contribution of biomimicry design approaches to the design process, as well as the stages of structural system and shell formation. The questions posed to student groups during semi-structured interviews are presented in Table 3.

Table 3. Semi-structured question groups

EXPRESSIONS NO	**EXPRESSIONS**
1	Was general information provided about the load-bearing system of structures?
2	Did you have any prior knowledge of biomimicry before the course?
3	Were you informed about biomimicry during the course?
4	How did formal learning, a subheading of biomimicry, contribute to your work?
5	What is the contribution of functional learning, a subheading of biomimicry, to your work?
6	What is the contribution of the design process, a subheading of biomimicry, to your work?
7	What is the contribution of the formal imitation process, a subheading of biomimicry, to your work?
8	What is the contribution of the functional principles process, which is a subheading of the biomimicry concept, to your work?
9	What is the contribution of the structural principles process, which is a subheading of the biomimicry concept, to your work?
10	What are your thoughts on the contribution of the biomimicry concept to design education?

Answers taken from semi-structured question groups were compiled into a written report, and general conclusions were drawn. Student work was presented in the form of course outcomes, structural shells, and objects selected in line with the concept of biomimicry, accompanied by visuals.

Figure 1. Owl object and structural shell application

The night vision abilities of owls have been utilized to develop natural lighting solutions for interior spaces. The eye structure of owls, which is one of their most important characteristics and hunting strategies, has been used in windows and openings designed to increase the level of natural light in the structure and enhance the view of the lake, which is the dominant facade. The diagonal structure of the shell was also inspired by the owl's body structure. The building has a floor area of approximately 180 m2 and consists of a single story.

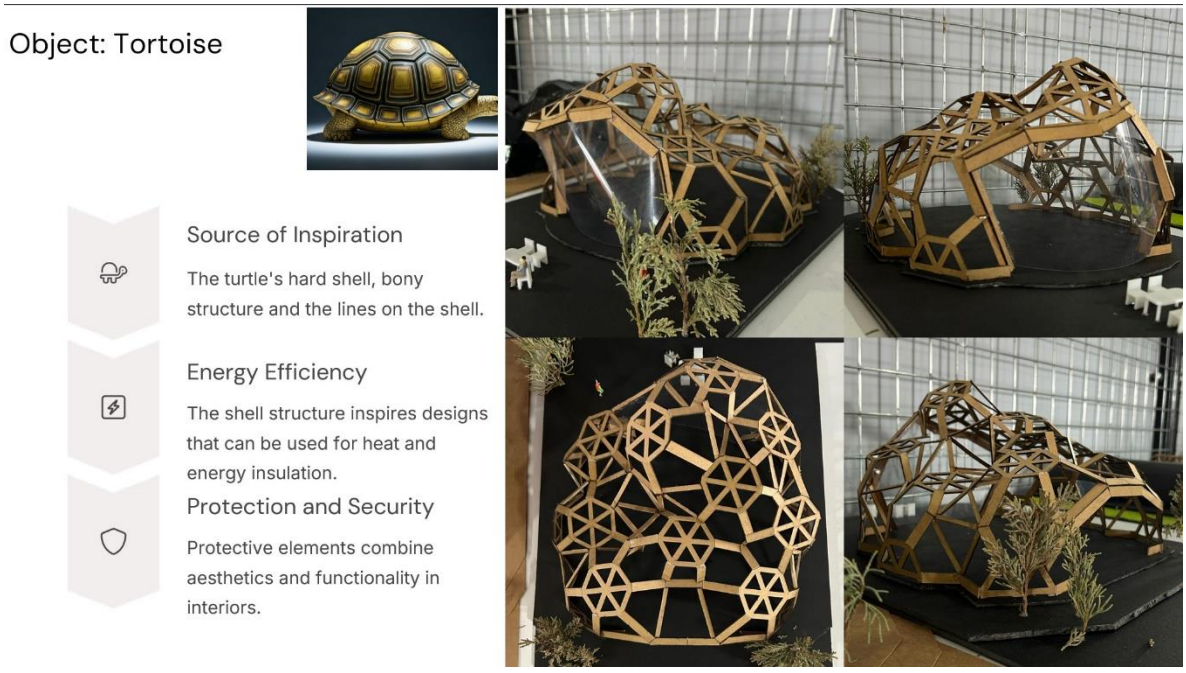

Figure 2. Turtle object and building shell application

The design was inspired by the turtle's hard shell, its bony structure, the idea of a living creature inside, and the lines on the shell. The work consists of a combination of solid and empty spaces. Additionally, the rigid structure of the shell inspired the design of the building's structural shell. The large window opening left on the facade was utilized in the facade design to dominate the view.

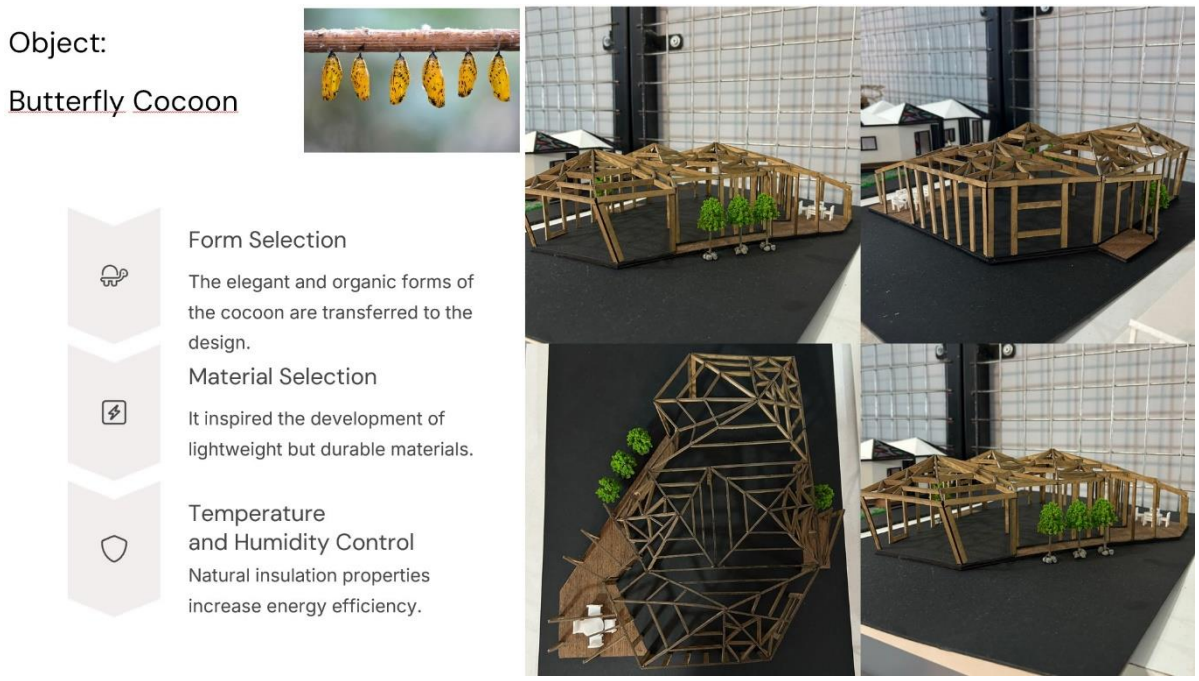

Figure 3. Butterfly cocoon object and structural shell application

The abstract form of a butterfly cocoon was chosen based on the elegant and organic shape of the cocoon. The limiting walls, columns, and structural elements on the plan are designed based on the outer shape of a butterfly cocoon. The light and durable structural properties of a butterfly cocoon contributed to the development of materials to be used in the structure.

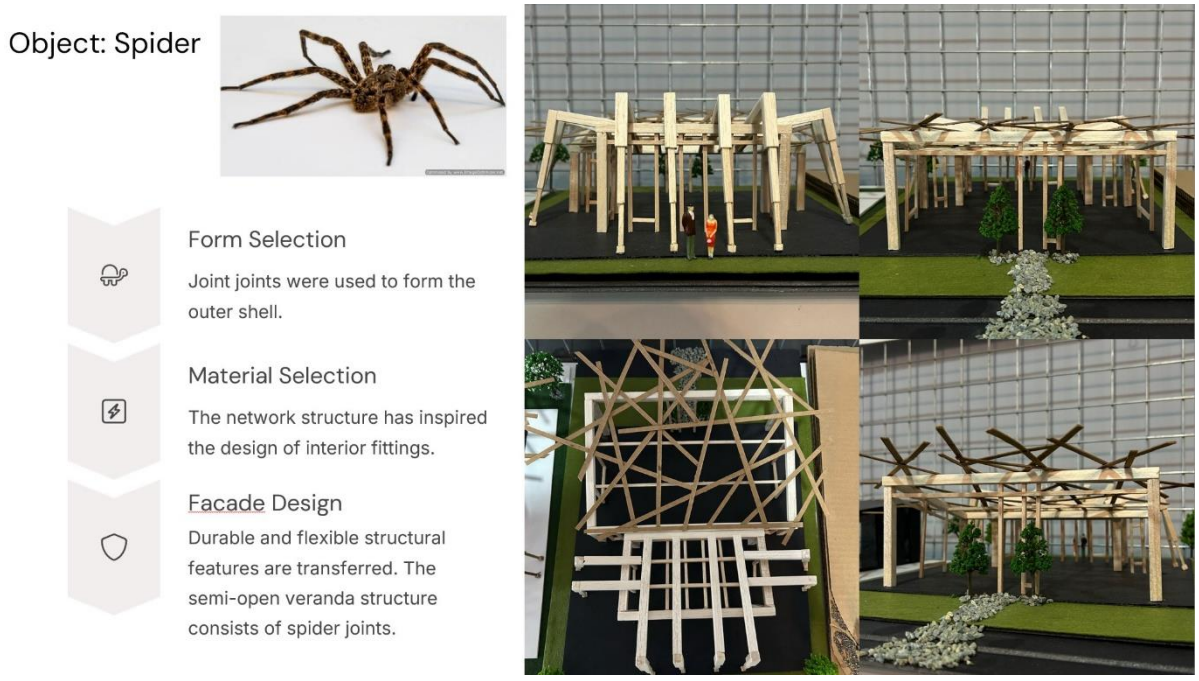

Figure 4. Spider object and structure shell application

The joint connections found in the physical structure of spiders have been an inspiring element in the creation of the outer shell and the load-bearing system. In addition, the spider's web structure has been utilized in other fixture designs for use in interior spaces.

CONCLUSION

The research findings demonstrate that the biomimicry approach is a valuable tool that fosters creativity and design diversity in interior architecture education. The integration of biomimicry in the Structural Knowledge course enabled students to understand structural systems better and transform this knowledge into innovative design decisions.

In their designs, various biological features were transferred to structural systems, ranging from the night vision ability of owls to the shell structure of turtles, and from butterfly cocoons to the joint structure of spiders. These findings reveal that biomimicry enriches students' design processes by offering an interdisciplinary perspective.

The use of semi-structured interview techniques classified by Kvale (1994) as a methodology has enabled an in-depth analysis of students' experiences with the concept of biomimicry. The data obtained revealed that biomimicry-based design education contributes to students' problem-solving skills, balancing aesthetic and functional concerns, and adopting sustainability principles. The studies are limited to structural forms, and design solutions related to interior architectural plans, sections, façade openings and reinforcement designs are included in the Interior Architecture Project-2 course.

In conclusion, the integration of biomimicry into interior architecture education enables students to develop creative and innovative designs, achieve sustainability goals through nature-inspired structural solutions, and gain an interdisciplinary design perspective. In the future, the widespread adoption of biomimicry-focused education programs could contribute to the development of more sustainable and innovative design approaches in the field of interior architecture.

STATEMENT OF RESEARCHERS' CONTRIBUTION RATE

The author's contribution to the study is 100%.

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DECLARATION OF CONFLICT OF INTEREST

There is no conflict of interest with any institution or person within the scope of the study.

REFERENCES

Altıparmakoğlu Sakarya, G., Sakarya, K., & Pınar, E. (2024). A furniture design experience with a biomimetic approach: LOT-US. *Res Mobilis: Revista de la Universidad de Oviedo,*13(19), 15-32.

Aziz, MS & El Sherif, A.Y. (2016). Biomimicry as an approach for bio-inspired structure with the aid of computation.

Alexandria Engineering Journal, 55 (1), 707–714. https://doi.org/10.1016/J.AEJ.2015.10.015

Benyus, J. (1997). *Biomimicry: Innovation Iinspired by nature*. New York: Harper Collins Publishers.

Białkiewicz, JJ (2024). Biomimetics and biomimicry. Their role as a tool and ideology in contemporary architecture. *Architectus*, 3(79). https://doi.org/10.37190/arc240310

Bucciantini, M. (2022). *Biomimicry in Architecture.* Carleton University.https://doi.org/10.22215/etd/2022-15105

Contreras, GS & Fernandez, EJL (2023). Architecture learns from nature. The influence of biomimicry and biophilic design in building. *Modern Applied Science,* Vol. 17, No. 1; 2023. https://doi.org/10.5539/mas.v17n1p58.

Coşkun, R., Altunışık, R. & Yıldırım, E. (2007). *Sosyal bilimlerde araştırma yöntemleri: SPSS uygulamalı*. Sakarya yayıncılık.

Elsamadisy, R., Nagy Sarhan, A. E, Farghaly, Y. & Mamdouh, A. (2019). Biomimicryas a design approach for adaptation. *Journal of Al-Azhar University Engineering Sector,*14 (53), 1516–1533. https://doi.org/ 10.21608/auej.2019.64210

Ergün, R. & Aykal, FD (2022). The use of biomimicry in architecture for sustainable building design: a systematic review. *Alam Cipta*, 2 (15), 24–37. https://doi.org/10.47836/ac.15.2.paper03

Erşanlı, E.T. & Erşanlı, C.C. (2023). Biomimicry: Journey to the Future with the Power of Nature. *ISVOS Journal*, 7(2): 149-160 – DOI: 10.47897/bilmes.1388402.

Jamei, E. & Vrcelj, Z. (2021). Biomimicry and the built environment, learning from nature's solutions. *Appl. Sci*, 11 (16), 7514. https://doi.org/10.3390/app11167514.

Kvale, S. (1994). Interviews: An introduction to qualitative research interviewing. *USA: Sage*. Access Address (02.10.2023) https://www.researchgate.net/publication/257496914_InterViews_An_Introduction_to_Qualitative_Research_Interviewing_Steinar_Kvale_Thousand_Oaks_CA_Sage_1996_326_pp

Omar, M., Kamel, S., Hassan, D. & Abdelmohsen, S. (2020). Biomimetic Approaches in Architectural Design Education. In: Kamel, S., *et al.* Architecture and Urbanism: A Smart Outlook. Springer, Cham. https://doi.org/10.1007/978-3-030-52584-2_2.

Pawlyn, M. (2011). *Biomimicry in Architecture*. Riba Publishing

Salama, W., Al-Masri, A., Abdulsalam, M. & Hashaykeh, N. (2025). Bio-Mimicry in Architecture: An Explorative Review of Innovative Solution Toward Sustainable Buildings. *An-Najah University Journal for Research – A Natural Sciences, vol:39,p:39-46.* https://doi.org/*10.35552/anujr.a.39.1.2256*

Stevens, L., de Vries, MJ, Bos, MMJW & Kopnina, H. (2019). *Biomimicry design education.* Design Society: International Conference on Engineering Design, 1(1):459-468, DOI: 10.1017/dsi.2019.49.

Yeler, G.M. (2015). Influences of the living world on architectural structures: An analytical insight.

Uludağ University Journal of The Faculty of Engineering, 20 (1), 23–38. https://doi.org/10.17482/UUJFE.14962
