ICONARP
International Journal of Architecture and Planning
Received: 15.03.2023 Accepted: 22.08.2023
Volume 11, Issue 2/ Published:28.12.2023
Research Article *DOI: 10.15320 /ICONARP.2023.260 E- ISSN:2147-9380*
ICONARP

A Research on Biophilic Design Patterns: The Case of AGU as a Biophilic Campus

Şeyma Ezgi Yılmaz*
Asım Mustafa Ayten**

Abstract

Examining the biophilic elements in education campuses, which are a smaller-scale representation of urban areas, would be an example of urban-scale human–nature improvements. In this context, this article aims to analyze the biophilic elements in Abdullah Gul University (AGU) Sumer Campus and 3 education buildings for the interaction tendency between nature and humans. This examination encompasses two processes, first, taking photographs through on-site observation and applying a survey. On-site observation and photography included author-collected evidence of biophilic elements on campus. A questionnaire was conducted to analyze the awareness of biophilic elements among the occupants of the AGU education buildings and campus. It was determined how many biophilic design principles exist in buildings and how aware the occupants are of these principles. Due to this detection, the potentials and shortcomings of the AGU education buildings and campus were brought to light in terms of biophilic design. In the research, the AGU campus and 3 main education buildings, which have significance in the historical spatial memory of the city of Kayseri and are in the restoration process, were chosen as a case. Buildings under restoration within the campus were excluded. In addition, 14 biophilic patterns identified by Browning, Ryan, and Clancy constitute the scope of this study. The research can be applied to other university campuses in the city of Kayseri. This awareness in education buildings will also lay the groundwork for the spread of biophilic criteria on an urban scale.The research treats education campuses and buildings as a small representation of the urban scale. With the analysis of biophilic elements, the AGU campus has original value in defining it as an example of a biophilic campus.

Keywords:
AGU Sumer Campus, biophilic campus design patterns, education buildings

*Faculty of Architecture, Abdullah Gül Kayseri, Turkey. (Corresponding author)
E-mail: seymaezgiyilmaz@gmail.com

**Faculty of Architecture, Abdullah Gül Kayseri, Turkey.
E-mail: mustafa.ayten@agu.edu.tr

To cite this article: yılmaz, Ş.E., & Ayten, A. M. (2023). A Research on Biophilic Design Patterns: The Case of AGU as a Biophilic Campus. *ICONARP International Journal of Architecture and Planning,* 11 (2), 692-715. DOI: 10.15320 /ICONARP.2023.260

INTRODUCTION

Increasing population brings rapid urbanization. There is a need for living units and buildings to accommodate the increasing population in cities. According to United Nations data, most of the world 's population lives in urban centers (Siebring, 2020; URL-1, 2018). Therefore, they consume 40% of the world 's primary energy resources and are responsible for around 50% of the total greenhouse gasses emitted (Santamouris et al., 2018). Rapid urbanization also creates various environmental problems, such as the urban heat island effect, air pollution, and water pollution, and harms both nature and living things as well as human health and psychology (Roös, 2021).

Required planning policies are researched to reduce environmental problems caused by construction in modern cities, to save energy, and to reduce health risks for living things. In this context, urban designers, planners, architects,, and municipalities have primary shared responsibility (Grazuleviciute-Vileniske et al., 2022; Russo & Cirella, 2017).

While the problems brought about by rapid construction stand on one side, human beings should interact with nature. The main reason for this need is human beings' genetic connections with nature dating back hundreds of thousands of years and their tendency toward nature (Beatley, 2016; Zhong et al., 2022).

In this sense, biophilia is a research area that can offer solutions for the strategies that stakeholders will develop against urban problems (Downton et al., 2016; Rosenbaum et al., 2018). Biophilia can contribute to various levels of environmental and spatial problems from a well-being perspective. Various biophilic design applications exists at the biophilic urbanism, biophilic campus, and building scales. The biophilia hypothesis is applied especially in hospital and education campuses (Soderlund, 2019).

The analysis of biophilic elements in education campuses in terms of the area they cover in cities will be useful both in terms of examining education buildings and in analyzing the contribution they will provide on an urban scale. In particular, university campuses are like a small representation of the city. For this reason, biophilic design applications can be prioritized in university campuses, which are one of the areas where the residents of the city spend time (Abdelaal, 2019).

Within this framework, this research examines the Abdullah Gul University (AGU) Sumer Campus in Kayseri's city for the research, first, the literature was searched. Then, the AGU campus was examined on the basis of 14 patterns determined by Browning, Ryan, and Clancy (Browning et al., 2014). The research method was carried out in two stages. The first qualitative method was tabulated by observations and photographs. The second was the survey, which could be expressed quantitatively. Through the survey research, the opinions of AGU campus users were consulted and numerical data about biophilic design were

DOI: 10.15320/ICONARP.2023.260

tabulated. In the conclusion section, there was a discussion about the potentials, shortcomings, and suggestions of the study.

LITERATURE REVIEW OF BIOPHILIC DESIGN

The concept of biophilia was first coined by the German psychologist Erich Fromm (Barbiero & Berto, 2021; Soderlund, 2019). E.O. Wilson, a biologist, defines biopihilia as an innate emotional connection that people feel toward other living organisms. Based on Wilson 's definition, biophilia can be expressed as "love of life" and "desire to be close to living systems" and "perceiving living systems with the senses" (Downton et al., 2016; Soderlund & Newman, 2015; Tabb, 2020; Wilson, 1984).

Beatley (2016) stated that biophilia helps explain why people are happier and more relaxed in proximity to the natural environment (Beatley, 2016). It can also help explain questions such as why some areas, such as urban parks, are more favored in the city or why people prefer some interiors over others (Açmaz Özden, 2019; Kellert et al., 2008; Pedersen Zari, 2019).

Biophilic urbanism, on the other hand, is based on urban-scale representations and the dissemination of biophilia. Kellert (2016) stated that the aim of biophilic urbanism is to make the natural world experience an integral part of ordinary city life and to improve the disconnection of contemporary cities from nature. encompasses various ecological systems. It has many applications at the scale of buildings and city parks, such as resource extraction from urban areas, waste management, reducing pollutants, and increasing green elements (Kellert, 2016). Newman (2014) described one of the most common examples of biophilic urbanism in Singapore.

Similarly, biophilic design advocates creating built environments using natural systems to positively contribute to human health. It has been stated in many scientific studies that health and wellness increase in built environments designed with natural elements (Zhong et al., 2022). With the effect of technology and industrialization, urban areas are being built rapidly, and human interaction with nature decreases because of this construction. To solve this problem, biophilic design represents an innovative approach based on living, working, and learning in natural environments. According to this approach, architects, urban planners, and designers incorporate natural elements into urban planning, buildings, and interiors (Downton et al., 2017; Kellert, 2016)

Biophilic elements such as urban forests, river systems and lakes, urban parks, and green roofs and walls can also contribute to sustainability (Arof et al., 2020). Studies have shown that green elements allow spaces to increase attractiveness and make people physically active (Beatley, 2020). Elements such as vegetative elements, green roofs, and green facades used to shade the facades both contribute to energy saving and provide solutions to urban environmental problems (Makram, 2019).

Biophilic design encourages the inclusion of natural environments in built environments (Kellert, 2005; Soderlund, 2019). Kaplan (1995) reported that there are two theories on this subject in the environmental psychology literature. Stress reduction theory and attention restoration theory (Kaplan, 1995). These theories state that some places can be stressful and some places can be relaxing. Spaces, expressed as the theory of regaining attention, become more attractive because they distract people from mental fatigue and have a healing effect (Gillis & Gatersleben, 2015). Following these principles, Lee and Park (2018) stated that biophilic design is beneficial in improving human health problems such as reducing stress and increasing cognitive creativity (Lee and Park, 2018).

Mehaffy et al. (2020) identified 10 titles related to biophilic design patterns. 1. Sunlight 2. Color 3. Gravity 4. Fractals 5. Curves 6. Detail 7. Water 8. Life 9. The representation of Nature 10. Organized complexity (Mehaffy et al., 2020). In addition, names such as Christopher Alexander, Judith Heerwagen, Racher and Stephen Kaplan, Stephen Kellert, and Roger Ulrich have suggested specific titles for biophilic design elements (Browning et al., 2014).

In addition, Browning et al. (2014) provided another framework to examine in detail the nature-design and nature-health relationships in all built environments. Compared with other studies, 14 basic biophilic design criteria were defined in a systematic and detailed manner. Their work provides a basis for using the human-nature connection as a tool to increase well-being in the built environment (Browning et al., 2014).

Those who work and live in built environments need to relax by being inspired by their surroundings. They also demand that the natural spaces they like to be in be more productive and healthier (Gautam, 2017; S. R. Kellert & Calabrese, 2015). Browning et al. (2014) conducted detailed research examining the relationships between nature design and nature health. Nature health titles were grouped into three categories: stress reduction, cognitive performance and emotion, mood, and preference. These titles were associated with nature-design titles in their research in detail and presented as a matrix (Browning et al., 2014).

In this study, the subject of nature health will not be covered in detail, and nature design titles are limited to the examination. According to Browning et al. (2014), nature–design relations are based on 3 main topics. These titles, which are also the limits of this study, are nature in space, natural analogies, and nature of space (Browning et al., 2014).

<u>Nature in space:</u> Subtitles under this main title relate to nature's direct or temporary existence. The plant and water elements, natural sounds, fragrances, and other natural elements in the space are related to nature in the space. The interaction of nature in space depends on the perception of natural factors through multiple senses (Browning et al., 2014).

<u>Natural analogies:</u> This about the connotations of living and inanimate nature. This principle is based on using these elements in spaces by using the knowledge of the materials, textures, colors, shapes, and sequences of the assets in nature (Browning et al., 2014).

DOI: 10.15320/ICONARP.2023.260

Nature of space: This title is about spatial configurations in nature. These relationships depend on one 's admiration for dangerous or mysterious things in nature. Features such as dark views and interesting places are the criteria in this section (Browning et al., 2014). The framework defined by Browning et al. (2014) under 3 main headings is indicated in the table below in more detail with 14 subpatterns (Browning et al., 2014).

Table 1. Patterns and principles of biophilic design, adapted from Browning et al. (2014)

Nature in Space Patterns describes the presence and contact with natural, literal features and phenomena	P1- Visual Connection with Nature P2- Non-Visual Connection with Nature P3: Non-Rhythmic Sensory Stimuli P4- Thermal and Airflow Variability, P5- Presence of water, P6- Dynamic and diffuse light, P7- Connection with Natural Systems;
Natural Analogues addresses natural complexity, geometry, and materials used or imitated in art and architecture	P8- Biomorphic Forms & Patterns, P9- Material Connection with Nature P10- Complexity and Order;
Nature of Space Patterns refers to psychological references to open and closed space configurations	P11- Prospect, P12- Refuge, P13- Mystery, P14- Risk/Peril

BIOPHILIC APPROACHES ON CAMPUS DESIGNS TO SUPPORT BIOPHILIC URBANISM

Education campuses are potential improvement areas. A self-sufficient, waste-managed, accessible, user-friendly campus design has the potential to contributed to biophilic urbanism and environmental sustainability on a large scale. Campuses are not only academic learning and research areas but also important areas for cities. Urban and social textures coexist on these sites and a natural landscape character is created. They are also urban interfaces that express a common accessible space between architecture and urban design. The urban interface expresses the design of accessible spaces in living public spaces, facades, and interiors arranged adjacent to the outer frame of the building (Almusaed, 2011; Modrzewski & Szkolut, 2016).

Moderewski et al. (2016) researched the campuses in Poznan and analyzed them in terms of biophilic elements Poznan campuses, which is a biophilic campus study, also examines the relationship between the city and campus (Modrzewski & Szkolut, 2016).

Another biophilic campus work is the framework presented by Abdelaal (2019). He argues that people need innovative and sustainable spaces in terms of mental, psychological, and creative development on education campuses. University campuses can attract international businesses and researchers to create innovative and vibrant communities. Abdelaal (2019) offers a model that proposes creative university campuses to combine biophilic design principles with sustainable development goals (Abdelaal, 2019).

In another study, Elmashharawi presented an analysis of biophilic design on the Ozyegin University campus and educational spaces (Elmashharawi, 2019). Many more studies have demonstrated the potential of biophilic design factors considering innovative and sustainable solutions for the development of educational spaces.

In 2013, the Global Biophilic Cities network was established under the leadership of Timothy Beatley. 15 cities in the world are partners of this network, and some metrics have been determined. The most widely known example of biophilic urbanism in the world is Singapore. Biophilic urbanism is practiced at all scales they set their motto as Singapore, a city in the garden. Biophilic design practices, which have spread to the city scale in Singapore, cover many dimensions. Rooftop logic in buildings has been applied and is widespread in various scales such as vertical gardens, hospitals, and education campuses (Newman, 2014; Siebring, 2020).

Another study examines biophilic urbanism in the Netherlands. The study mentions that the number of organizations conducting research on biophilic design has increased and that municipalities are also working on this issue. In cities and countries such as Portland, Oregon, Spain, San Francisco, and Edmonton, Canada, biophilic elements have been successfully applied in urban park areas, transportation, and neighbourhood scales (Siebring, 2020).

The scope of this work is biophilic patterns in university campuses and education buildings. To support this argument, AGU Sumer Campus and three main education buildings, which are close to the city center in Kayseri and ranked 33rd in the "sustainable cities and communities" list according to Times Higher Education 2020, were chosen for analysis based on 14 patterns.

MATERIAL AND METHOD

This research investigated how biophilic design patterns could bring benefits at the campus scale and aimed to analyze the patterns in university campuses that are part of the city to adapt them to the urban scale. To support this argument, AGU Sumer Campus, which is close to the city center in Kayseri and ranked 33rd in the "sustainable cities and communities" list according to Times Higher Education 2020, was chosen for analysis (URL-2).

This study aims to compare and analyze the 3 main education buildings on the AGU campus according to 14 basic biophilic design patterns determined by Browning et al. (2014). First, a preliminary analysis was created using on-site observations and photographs. Second, a questionnaire was applied to understand the awareness of the users of these 3 education buildings about biophilic patterns and to understand their ideas about these patterns.

DOI: 10.15320/ICONARP.2023.260

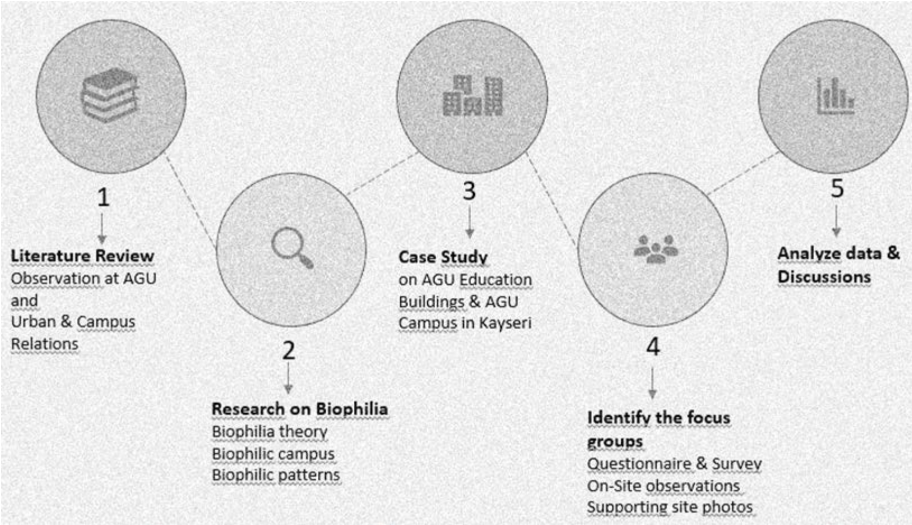


Figure 1. Research method diagram (developed by author)

In this survey, 14 different questions were prepared based on the 14 patterns (Browning et al., 2014). These questions were directed to focus groups, the departments of the participants, and the buildings where they spent the most time to learn the opinions of the users in the educational buildings. The questions were sent to different users, including academics, students, and administrative staff, through Google forms, and they were asked to be answered.

This questionnaire is answered on the basis of the Likert scale. A scoring system from 1 to 5 was used for each of the 14 questions in the questionnaire. This system is defined as 1: strongly disagree 2: disagree 3: undecided 4: agree 5: strongly agree. In addition, the snowball sampling method was used in the distribution of this questionnaire. The results were analyzed in the SPSS program and their mean values were determined. Data entry into SPSS includes 14 responses from each participant for each building. After the data entry process, values above 3, which is the mean value, support the participants' agreement about biophilic factors, whereas values below 3 indicate that they disagree.

Preliminary Information on The AGU Campus

There are four universities in Kayseri as Erciyes University, Nuh Naci Yazgan University, Abdullah Gul University, and Kayseri University (Figure.2). Abdullah Gul University is the restoration project of the Sumer Textile Factory Campus, which was one of the most important industrial centers for Kayseri in the post-republic period and contributed to the modernization and structuring of the city at that time (Asiliskender, 2013; Ayten, 2017). As this campus affected the transformation of the city in the post-republic period, it can be the pioneer of biophilic urbanism in Kayseri today and to develop the city in line with the principles of sustainability. AGU Sumer Campus is the 33rd ranked public university in the world in terms of “sustainable cities and communities” according to Times Higher Education (URL-2; URL-3).

ICONARP – Volume 11, Issue 2 / Published: 28.12.2023

In fact, AGU was designed as two campuses, one is the Sumer Campus and the other is the Mimar Sinan Campus, which is approximately 15 km from the city center (URL-4). However, due to certain reasons, the Mimar Sinan Campus has not yet started to operate within AGU. Therefore, Sumer Campus, which has been in service since its establishment (October 2014), will be examined. After the restoration process Sumer Campus started education in 2013. However, the restoration process in other buildings on the campus is still ongoing, step by step.

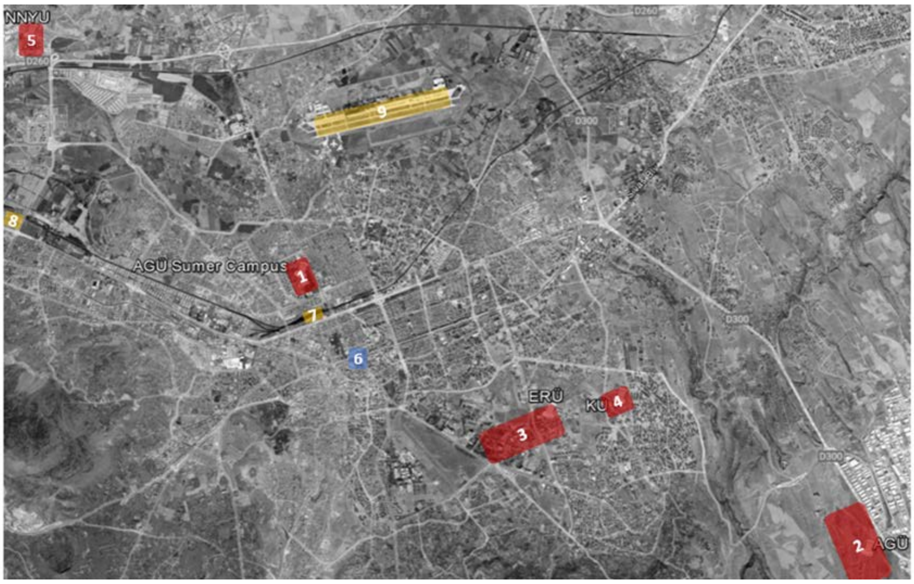


Figure 2. AGU Sumer Campus, 2: AGU Mimar Sinan Campus, 3: Erciyes University Campus, 4: Kayseri University Campus, 5: Nuh Naci Yazgan University Campus, 6: City Center 7: Kayseri Train Station, 8: Kayseri Bus Terminal, 9: Kayseri Erkilet Airport (taken from Google Earth 23.09.2021)

According to information from the school administration, there are approximately 2800 students and 400 academic and administrative staff at AGU. It has an area of approximately 28 ha. This makes the campus a relatively small-scale campus for Kayseri's city.

AGU Sumer Campus is located close to the city center, and it is easily accessible in terms of transportation hubs such as bus station, train station, and city airport. In addition, Mimar Sinan Park and Inonu Parks, which constitute the important green areas in the city center support the need for green areas in the city center and the AGU campus supports this green zone too (Figure.3).

The campus has a large landscape with perennial trees and natural open spaces. It has 3 main entrances used for both pedestrians and vehicles. The functions of the building blocks on the campus are as follows: education blocks, student affairs building, staff and student accommodation units, presidential museum and library, guesthouse, and technical units whose restoration process continues. Almost all of these units are based on the restoration of the remaining structures from the old textile campus (Figure.4).

Within the scope of this study, we examined the biophilic elements in the interiors of the education units where most of the time is spent on. 3 main education buildings (Figure.4), (Steel, great storehouse, and

DOI: 10.15320/ICONARP.2023.260

research laboratory building) in AGU were analyzed to evaluate the campus according to biophilic design criteria (Figure 5).

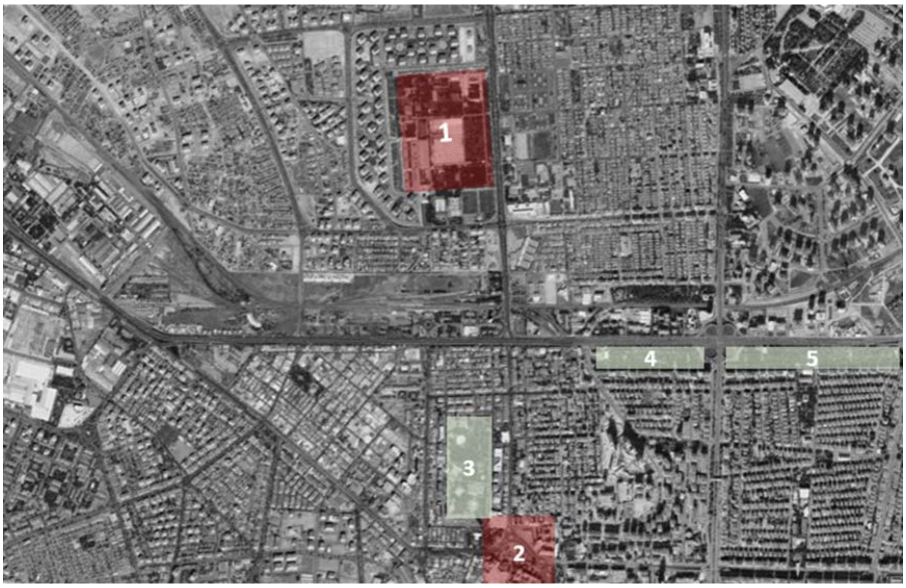


Figure 3. AGU Sumer Campus, 2: Kayseri City Square, 3: Mimar Sinan urban park, 4&5: open green parks (taken from Google Earth dated 24.08.2021)

Figure 4. Steel building, 2: great storehouse building, 3: research laboratory building, 4: President Museum & Library, 5: Student Affairs, 6&7: under restoration building blocks, 8: water element, A&B&C: campus

Figure 5. Three main education buildings: left: steel building (URL-5), middle: great storehouse building, right: research laboratory building (URL-6) entrances (taken from Google Earth dated 24.08.2021)

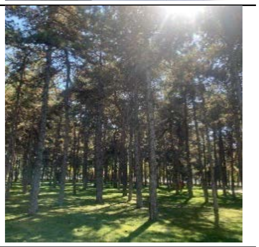
ICONARP – Volume 11, Issue 2 / Published: 28.12.2023

Analysis of The AGU Campus and Education Buildings

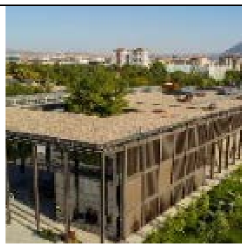
AGU "campus" evaluation according to biophilic design patterns

AGU Sumer Campus has 3 main education buildings (Figure.4 and Figure.5). In addition, there are education buildings that are currently under restoration. The campus has dense perennial greenery and an abundance of trees.

Table 2. Evaluation of AGU campus according to 14 patterns (all photos taken by author except defined references)

Patterns	Explanation	Photo
P1	Natural elements are already in open spaces. A direct visual connection with nature is easily provided.	
P2	Artificial elements are not needed because of the presence of natural elements. There are no artificial plants or artificial pattern elements and like that.	
P3	Natural sounds and smells are available on campus. Natural bird sounds and the diversity of plants on campus support this pattern. For users, aromatic plants are attractive on campus and increase movement and interaction in those areas. Many plants and fruit trees, such as the lavender plant, also contribute to the fragrance. In addition, it is a campus away from noise in terms of natural sound, so it creates a meditative effect and calms down.	
P4	Although the campus is colder in winter with northerly winds, the wind and trees provide coolness for the summer . In addition, the increasing presence of vehicles and exhaust gasses on campus negatively affects the quality of campus air.	
P5	There is only one water element in the campus. In addition, despite the design of water elements in the direction from the entrance(C) (Figure.4.) to the steel building in the renovation plan of the campus, there is no water element in the current situation.	
P6	Dynamic and diffuse light elements are present on campus. The shadows of trees and leaves and the shadows of buildings support this pattern.	
P7	Natural areas are easily accessible. There are 3 controlled entrances on campus. Off-campus and on-campus transportation is easily provided for both pedestrians and vehicles	

DOI: 10.15320/ICONARP.2023.260

P8	It is possible to observe natural forms and textures on campus. The textures of tree trunks, leaves, natural plants, and animals such as turtles, birds, and foxes support this pattern.	
P9	There are natural materials on campus. The garden includes wooden seating elements, natural stone building materials, and the structures of plants include natural materials. In addition, materials such as andesite, basalt, and black stone are also used in buildings.	
P10	There are elements of order and complexity on campus, such as rows of trees, plants, and building layouts**.**	
P11	Although the campus itself may seem difficult to contact outside the campus, it is actually part of the city. For off-campus users, for example, the AGU campus provides a wide prospect for viewing from the surrounding residential blocks.	 Source: (URL-5)
P12	There are no specially designed individual study areas in the open areas of the campus, but working environments are created by sitting on the grass, especially in summer.	
P13	The water element and the open landscape next to it can be given as examples for the spaces that will support this element on campus. This area can feel attractive and mysterious as it is relatively far from educational buildings and among the trees.	
P14	Because the campus is currently a restoration area, the risk element may be evaluated for buildings under restoration.	

Evaluation of "educational buildings" according to biophilic design patterns

For the analysis of biophilic elements in AGU education buildings building interior images were first used. The interior functions are specific to buildings; therefore, not every space is available in every building. To evaluate the education buildings, three tables were created for three main headings (1. nature in the space, 2. natural analogs 3. nature of the space). In these tables, biophilic patterns are supported by photographs as much as possible. Photos of some patterns are not possible; therefore, they are expressed with additional explanations.

The evaluation of nature in space patterns

P1: For this pattern, which represents the direct visual connection with nature, the large glass elements in the steel building, the great storehouse, and the research laboratory building provide direct visual contact with nature.

P2: Steel buildings and storehouse buildings do not have direct visual contact with nature, but this pattern is supported by decorative stone elements inside the building using natural elements. For the laboratory building, wooden finishing elements may remind us of contact with nature.

P3: Since this pattern represents natural sounds and smells, they are not directly in buildings. However, natural sounds and smells are rarely felt through window openings.

P4: Thermal air flow and ventilation principles are provided both mechanically and naturally in all 3 buildings. While ventilation is provided by both the entrance doors and window openings on the ground floors, thermal comfort is provided by mechanical elements.

P5: There are no water elements in all 3 buildings. Access to the water element on campus is approximately the same distance for all three buildings.

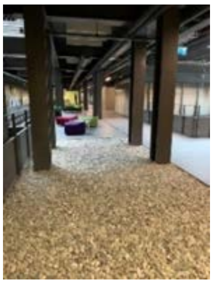
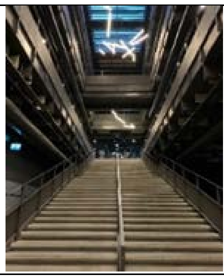
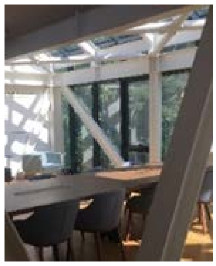
P6: In all 3 buildings, changing and dynamic natural light and shade are provided by both skylights and window openings. In addition, artificial lighting elements can be changed with pendant elements in corridors, and lighting elements can be selected according to the function of the space in some spaces.

P7: Buildings have easy access to natural areas. Since they are not high-rise buildings and have long corridors, there are many entrance doors on the ground floor, especially for steel buildings and large storehouse buildings. Thus, the possibility of access to natural areas is high.

DOI: 10.15320/ICONARP.2023.260

Table3. Representation of nature in space patterns by photos (all photos taken by author)

Nature in space Patterns *describe the presence and contact with natural, literal features and phenomena*

Patterns	Steel Building	Great storehouse building	Research Laboratory Building
P1- Visual Connection with Nature			
P2- Non-Visual Connection with Nature			There are no natural elements in this building. However, the wood floor finishing element may feel a non-visual connection with nature.
P3: Non-Rhythmic Sensory Stimuli	It depends on scents and sounds, and there are no natural sounds and scents in each building.		
P4- Thermal and Airflow Variability			
P5- Presence of water	There is no natural or artificial water element in the interior design.		
P6- Dynamic & Diffuse Light			

P7- Connection with Natural Systems			

The evaluation of natural analogues

P8: There are forms of natural stone and wood textures in the steel building. The brick elements used for the great storehouse building and the wood and decorative stone elements in the interior support this pattern. The wooden elements and circular form elements used for the research laboratory building also support this pattern.

P9: It includes natural stone and wood materials in the steel building, decorative stone and brick materials in the storehouse building, and wooden and natural materials in the laboratory building.

P10: For all three education buildings, the order element is especially clearly felt by the structural column elements.

Table 4. Represent natural analog patterns by photos (all photos taken by author)

Natural analogs address *natural complexity, geometry, and materials used or imitated in art and architecture*

Patterns	Steel Building	Great storehouse building	Research Laboratory Building
P8- Biomorphic Forms and Patterns			
P9- Material Connection with Nature			
P10- Complexity and Order;			

DOI: 10.15320/ICONARP.2023.260

The evaluation of the nature of space patterns

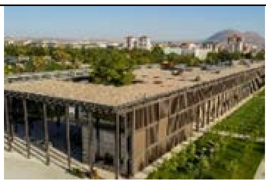
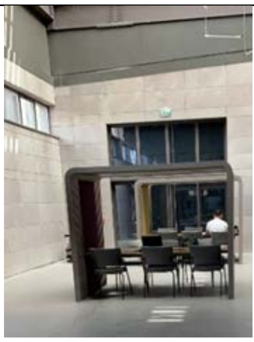
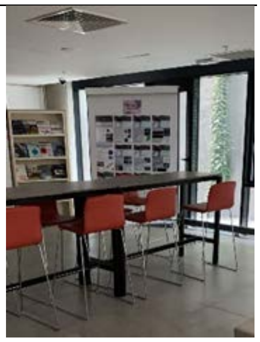
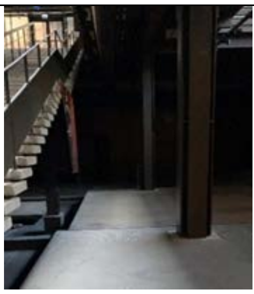
P11: AGU Education buildings have low floors compared to the surrounding buildings and provide a sense of privacy due to the density of trees on the campus. However, the buildings have a prospect in the city.

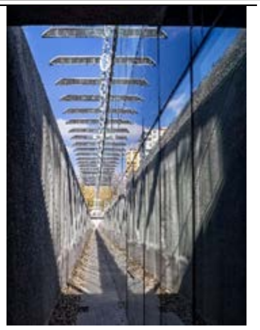
P12: Individual study areas are available in all three buildings. Individual study units serve their users in corridors.

P13: In a steel building, the conference room often looks mysterious, in a dimly lit area at the bottom of a large staircase. In the large warehouse building, the units at the end of the long corridor can feel mysterious. The circular staircase for the laboratory building makes it feel mysterious with its high parapet.

Table 5. Represent nature of the space patterns by photos (all photos taken by author except defined references)

Nature of Space Patterns ***refers to psychological references to open and closed space configurations***

Pattern	**Steel Building**	**Great storehouse building**	**Research Laboratory Building**
P11- Prospect	 Source: (URL-5)	 Source: (URL-5)	 Source: (URL-6)
P12- Refuge			
P13- Mystery			 Source: (URL-7)

P14- Risk		No photos matching the risk definition were found.	 Source: (URL-7)

P14: Although there are security measures in all buildings in general, the section in the garden with depth in the steel building serves as the indoor garden of the workshops however, campus users are not always adults, but sometimes children. The same deep space is also available in the laboratory these regions support the risk pattern.

After these evaluations, a questionnaire was administered to learn the opinions of AGU campus users about biophilic patterns.

SURVEY RESULT AND DISCUSSION

General Information

According to information from the administration, there are approximately 2800 students and 400 academic and administrative staff at AGU, and 252 participants answered the questions. 25 academics, 223 students, and four administrative staff participated in the survey. Preparatory students were not included because they were not present at the school during the online education process. The survey was applied to 3 education buildings (Figure.4 and Figure.5). Campus-scale evidence was supported by photographs and observations (Table 2).

The percentage results, including participant profiles are as follows.

Table 6. Percentages of survey respondents and building users.

Focus groups	Attendance rate
Academics of Engineering	%9,9
Students	%88,5
Administrative	%1,6

The fact that more answers were received from the student population, which is large in terms of user density, supports the accuracy of the study. Moreover, the departments and percentages of the participants, as well as the percentages in which building they spend most of their time, are shown in the tables below.

Table 7. Represents the percentages of survey participants and building users to which faculty they belong.

Departments	Attendance rate
School of Engineering l of Engineering	%48,4
School of Life and Natural Science	%13,5
School of Architecture	%21,8

DOI: 10.15320/ICONARP.2023.260

Faculty of Management Science	%9,5
School of Humanities and Social Sciences	%5,2
Faculty of Educational Science	%1,6
School of Physical Education and Sport	%0

Table 8. Represents the percentage in which building users spend most of their time.

Education Buildings	**Frequency of presence in the building**
Steel Building Engineering	%53,2
Great Store House Building	%33,7
Research Laboratory Building	%13,1

42 responses of each of the 252 participants, that is, a total of approximately 10584 values, were entered into SPSS. The average values for each building were analyzed in SPSS and the results are listed in Table 9. Table 9 shows the values over 5 points based on the Likert scale. The interpretation of the data in the table is explained in detail in the pages that follow the table.

P1 For the "class" category of P1, the lab building received the highest score (3.8), and the large warehouse building received the lowest score (2.8). In other words, the visual connection with nature can be interpreted as classrooms, with the strongest connection in the laboratory building and the weakest connection in the large warehouse building. For the "office" category, the steel building has a stronger communication with nature with a score of 3.2 compared to the great storehouse building with a score of 2.7. The offices in the great storehouse building do not have visual contact with nature. For the "corridor" category, the laboratory building has the highest score and the steel building the lowest. But all of them are above 3. Corridors are places where visual contact with nature is provided the meeting rooms in the steel building are a place where visual contact with nature is weak, with a score of 2.8. The 3-storey "library" in the steel building was evaluated as a place where visual contact was quite good, with a score of 3.8. However, the rooms in the basement of the library do not receive light; however, the other two floors provide a direct visual connection with nature thanks to the large glass elements. "Conference rooms" scored below 3 points in the steel building and the large warehouse building. However, as a function requirement, these spaces may not be expected to connect with nature. The "dining hall" in the great storehouse building supports the existence of the P1 pattern with 3.2 points. Finally, it was shown that visual contact with nature is easily achieved with a score of 3.3 for "laboratories" in the laboratory building.

P2 For the "class" category of the P2 pattern, only the laboratory building was evaluated above 3. Elements that will remind students of nature in classrooms are the wooden material on the floor in the laboratory building. In the classes in other buildings, the elements supporting this element are not visible. On the other hand, in “offices”, users gave less than 3 points and evaluated that there is no element to remind nature. “Corridors” scored 3 and above in all three buildings. The presence of elements reminiscent of nature in the corridors was supported. It is understood from the score below 3 that this pattern does not exist in the meeting rooms in the steel building. The existence of this pattern is supported by the “library” in the steel building. this pattern does not exist in “conference rooms”. This pattern does not exist in the “dining hall” in the storehouse building. In the labs in the research lab. building, this pattern was evaluated positively with 3 points.

Table 9. Represent survey results according to 14 questions based on 14 patterns. Average values over 5 points based on the Likert scale are shown.

PATTERNS	STEEL BUILDING						GREAT STOREHOUSE BUILDING						RESEARCH LABORATORY BUILDING	
	class	office	corridors	meeting rooms	library	conference rooms	class	office	corridors	conference rooms	dining hall	class	corridors	laboratories
P1. Visual Connection with Nature	3,4	3,2	3	2,8	3,8	2	2,8	2,7	3,1	2,3	3,2	3,8	3,3	3,3
P2. Non-Visual Connection with Nature	2,6	2,8	3	2,5	3	2,3	2,8	2,7	3	2,4	2,8	3,2	3,1	3
P3. Non-Rhythmic Sensory Stimuli	3	2,9	2,9	2,7	3,1	2,4	2,8	2,7	3,1	2,4	3,1	3,5	3,1	3
P4. Thermal and Airflow Variability	2,9	3	3,2	2,9	3,3	2,7	2,8	3	3,3	2,9	3,1	3,2	3,3	3,2
P5. Presence of water	2,4						2,7						2,9	
P6. Dynamic and Diffuse Light	3,4	3,3	3,2	2,9	3,6	2,2	3	3	3,4	2,5	3,6	3,7	3,5	3,4
P7. Connection with Natural Systems	3,2						3						3,3	
P8. Biomorphic Forms & Patterns	3,2						3,3						3,2	
P9. Material Connection with Nature	interior			exterior			interior			exterior			interior	exterior
	3			3,4			3,2			3,5			3,2	3,2
P10. Complexity and Order	3,4						3,4						3,4	
P11. Prospect	3,2						3						3,4	
P12. Refuge	interior			exterior			interior			exterior			interior	exterior
	3,7			2,9			3,6			2,7			3,6	2,9
P13. Mystery	3,2						2,8						3	
P14. Risk/Peril	3						2,6						2,8	

DOI: 10.15320/ICONARP.2023.260

P3 Since the score is above 3 in the "classrooms" in the steel building and the lab building, natural sounds, and smells were evaluated positively. "Offices" were below 3 points, and offices in the steel building and storehouse building were weak in terms of the P3 pattern. "Corridors" were evaluated as being more than 3 in the storehouse building and the lab building. "Meeting rooms" were rated negative below 3 points. "Library", on the other hand, was evaluated as positive with a score of 3.3. "Conference rooms" were rated negative for P3 in both buildings.

P4 It was evaluated above 3 only in the "classrooms" in the lab building. In other words, the classrooms where thermal comfort is best felt are in the lab building. In the "offices", the thermal comfort for the steel and storehouse building was evaluated as equal to three points. The thermal comfort of the "corridors" was evaluated more than 3 times for all three buildings. For the meeting room, this pattern remained below 3. Thermal comfort for "library" scored above 3 and was rated comfortable. In the "conference rooms", the value was again below 3 and thermal comfort was not found to be sufficient. Thermal comfort for the "dining hall" was evaluated positively over 3 times. Thermal comfort was evaluated positively for "labs".

P6 In all three buildings, dynamic and diffusing light is sufficient for "classroom", "office" and "corridor" spaces. Light comfort is insufficient for "meeting rooms" and "conference rooms". Light was also evaluated as comfortable for "dining halls" and "labs".

The evaluation of the interior volumes, which are separated according to their spatial functions in terms of 5 patterns, is as follows:

"Classes" in steel buildings are positive for 3 of 5 patterns. It is positive for 1 of 5 patterns in the storehouse building. It is also positive for 5 of 5 patterns in the lab building. Therefore, the most suitable classroom spaces in terms of biophilic design are in the research laboratory building. "Offices" are positive in steel buildings for three of 5 patterns. In the storehouse building, it is positive for 2 of them. The offices in the steel building can be interpreted as being more suitable than those in the storehouse building in terms of biophilic design criteria. In "corridors", steel building is positive for 4 patterns. 5 patterns are positive for storehouse and laboratory buildings. Therefore, it can be said that the corridors in the storehouse and lab building are more biophilic.

P5 There is no water element in the interior of all three buildings. The survey results confirm this. As for P5 and P7, the following patterns were evaluated for the whole building in general instead of separating them according to different functions.

P7, P8, P9, P10, and P11 patterns were rated 3 and above 3 for all three buildings. All three buildings were evaluated positively in terms of their connection with natural systems, biomorphic forms and patterns, use of natural materials, complexity, and order and prospect.

P12 For P12, the existence of individual workspaces indoors was verified with a value above 3 in all three buildings, while all three buildings were rated below 3 for outdoor spaces.

P13 For P13, the steel building was rated positive with a score of 3.2. Then, the laboratory building was evaluated positively with 3. However, the storehouse building remained below 3.

P14 For P14, only the steel building reached the value of 3. This means that according to occupant risk factor is mostly belonged to steel building.

Results

In accordance with the results of the survey, 37 of the 103 units scored below 3 points and 66 of them scored above 3 points. On a building basis, steel building was below 3 points out of 4 of 14 patterns. Great storehouse building is below 3 points from 6 and research laboratory building is below 3 points for 2 patterns. In other words, on the building scale, all buildings were rated above 3 points for most patterns. This shows that biophilic design patterns mostly exist in educational buildings.

In the study comparing three university campuses in Poznan, they were evaluated according to 14 criteria. Metrics were determined for the patterns, and their results are listed. The presence of green spaces in some of the campuses, and the presence of water elements and other patterns in some of them, led them to be defined as biophilic campuses (Modrzewski & Szkolut, 2016). In the study examining the Ozyegin University campus, it is argued that there are 6 patterns, and the campus and buildings are a good example of biophilic design (Elmashharawi, 2019).

CONCLUSION

The interaction between the built environment and people is becoming increasingly important today. Therefore, in urban planning and design, there is a transition from the Anthropocene to a more environmentally sensitive period. Biophilic design, which is one of the design principles that supports this, is an area that designers are responsible for and can increase the quality of the environment and building.

This study is expected to reveal the importance of biophilic design to support sustainable development goals. The use of biophilic elements in university campuses and educational buildings in the city of Kayseri will both increase human-nature interaction for user efficiency and thus contribute to sustainability by preventing constructions consisting of only concrete, with the increase in the use of natural elements in built environments.

It may be the right choice to start from university campuses, which are part of the city, to implement biophilic design at the city scale. University campuses are one of the practical environments where success will be tested when applying biophilic design elements.

DOI: 10.15320/ICONARP.2023.260

This study on the future projection of the study can also be evaluated in other university campuses in Kayseri city and compare the results. Strategic planning can be prepared by determining the contribution of the study to economic, social, and environmental sustainability. In addition, from another perspective, how to analyze the city of Kayseri with biophilic design factors can be investigated.

In this context, this research also sets an example for the analysis of biophilic design elements on a campus in the restoration process. Because of the case study, it is understood that biophilic elements based on 14 patterns increase the spatial quality of this campus and educational buildings.

In conclusion, the fact that AGU is a biophilic campus also reveals the benefits it brings to the urban environment and people. Considering the AGU campus, the results show that it meets the definition of a biophilic campus in almost all the patterns. Thus, it seems correct to describe the AGU campus as a "biophilic campus". Consequently, the analyses confirm that AGU is a biophilic campus. The potentials, shortcomings, and recommendations determined because of these analyses are also listed in Table 10.

Table 10. This table presents potentials, shortcomings, and recommendations.

Potentials	Shortcomings	Recommendations
✓ It can make a positive contribution to the environmental impact of built environments.	✓ Implementation of biophilic patterns can be challenging due to their historical value for the AGU campus. Implementation of some items may be difficult as the restoration process continues on campus.	✓ Because biophilic elements will increase the comfort and efficiency of the users in AGU, they should be considered by the managers.
✓ It can contribute to increasing the mental and work efficiency of its users.		✓ The relationship between biophilic elements and occupants should be investigated and new suggestions should be developed.
✓ The concept of a biophilic campus may become widespread. In this way, the application area can be expanded to other university campuses.	✓ Biophilic design patterns can be costly regarding decorative elements in the interior.	✓ Benefits of biophilic urbanism should be revealed and cost efficiency should be investigated.
✓ It can set an example for biophilic urbanism.	✓ After the application of biophilic design elements, the conditions required for their maintenance and control may be difficult.	✓ Considering the AGU campus as a biophilic campus should encourage the city of Kayseri, its municipalities,, and administrators to cooperate in terms of biophilic urbanism and campus.
✓ It can support sustainable development goals.		
✓ It can contribute to the literature for future biophilic design studies.	✓ Because two educational buildings (steel building and greatstorehouse building)	

✓ The AGU campus can offer different potentials for human-nature interaction with the rich green space it offers.	on the AGU campus were used as adaptive reuses at the end of the restoration process, they may have been weak in terms of some biophilic criteria.	

REFERENCES

Abdelaal, M. S. (2019). Biophilic campus: An emerging planning approach for a sustainable innovation-conducive university. *Journal of Cleaner Production*, *215*, 1445–1456. https://doi.org/10.1016/j.jclepro.2019.01.185

Açmaz Özden, M. (2019). *Yaşanabilir Kentler İçin Yeni Bir Yaklaşım Olarak Biyofilik Tasarim - Teoriden Uygulamaya Bir Değerlendirme*.

Almusaed, A. (2011). Biophilic and Bioclimatic Architecture. In *Biophilic and Bioclimatic Architecture*. https://doi.org/10.1007/978-1-84996-534-7

Arof, K. Z. M., Ismail, S., Najib, N. H., Amat, R. C., & Ahmad, N. H. B. (2020). Exploring Opportunities of Adopting Biophilic Cities Concept into Mixed-Use Development Project in Malaysia. *IOP Conference Series: Earth and Environmental Science*, *409*(1). https://doi.org/10.1088/1755-1315/409/1/012054

Asiliskender, B. (2013). From Industrial Site to University Campus. Sümerbank Kayseri Textile Factory. *For an Architect's Training*, *49*, 86–89. https://doi.org/10.52200/49.a.wb2ak1zg

Ayten, A. M. (2017). *Journal of Current Researches on Social Sciences Sustainable Urban Living Pratiques in City : Sumerbank Kayseri Cloth Weaving Factory Kent içinde Sürdürülebilir Kentsel Yaşam Pratikleri Üzerine : Sümerbank Kayseri Bez Dokuma Fabrikası*. https://doi.org/10.26579/jocress-7.2.19

Barbiero, G., & Berto, R. (2021). Biophilia as Evolutionary Adaptation: An Onto- and Phylogenetic Framework for Biophilic Design. *Frontiers in Psychology*, *12*(July). https://doi.org/10.3389/fpsyg.2021.700709

Beatley, T. (2016). The Power of Urban Nature: The Essential Benefits of Biophilic Urbanism. *Handbook of Biophilic City Planning and Design*, 3–12. https://doi.org/10.5822/978-1-61091-621-9_1

Beatley, T. (2020). Biophilic cities. In *The Routledge Handbook of Urban Ecology*. https://doi.org/10.4324/9780429506758-9

Browning, W., Ryan, C., & Clancy, J. (2014). 14 Patterns of Biophilic Design. *Terrapin Bright Green,LLC*, 1–60.

Downton, P., Jones, D., & Zeunert, J. (2016). Biophilia in Urban Design: Patterns and principles for smart Australian cities. *IUDC 2016: Smart Cities for 21st Century Australia: Proceedings of the 9th International Urban Design Conference 2016*, *March 2017*, 168–182.

Downton, P., Jones, D., Zeunert, J., & Roös, P. (2017). Biophilic Design Applications: Putting Theory and Patterns into Built Environment Practice. *KnE Engineering*, *2*(2), 59. https://doi.org/10.18502/keg.v2i2.596

Elmashharawi, A. (2019). Biophilic Design for Bringing Educational Spaces to Life. *Journal of Design Studio*, *1*(July), 16–21.

Gautam, A. (2017). Biophilic Design in Architecture. *International Journal of Engineering Research And*, *V6*(03), 120–124. https://doi.org/10.17577/ijertv6is030153

Gillis, K., & Gatersleben, B. (2015). A review of psychological literature on the health and wellbeing benefits of biophilic design. *Buildings*, *5*(3), 948–963. https://doi.org/10.3390/buildings5030948

Grazuleviciute-Vileniske, I., Daugelaite, A., & Viliunas, G. (2022). Classification of Biophilic Buildings as Sustainable Environments. *Buildings*, *12*(10). https://doi.org/10.3390/buildings12101542

DOI: 10.15320/ICONARP.2023.260

Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology*, *15*(3), 169–182. https://doi.org/10.1016/0272-4944(95)90001-2

Kellert, S. (2016). Biophilic urbanism: the potential to transform. *Smart and Sustainable Built Environment*, *5*(1), 4–8. https://doi.org/10.1108/SASBE-10-2015-0035

Kellert, S. R. (2005). *Building for Life* (Vol. 148). Island Press.

Kellert, S. R., & Calabrese, E. F. (2015). The Practice of Biophilic Design. *Biophilic-Design.Com*, 1–20. www.biophilic-design.com

Kellert, S. R., H.Heerwagen, J., & Mador, M. L. (2008). *Biophilic Design- The Theory, Science and Practice of Bringing Buildings to Life* (Vol. 148).

Kısa, N., Uysal, F., & Kavak, Y. (2020). Student-Centered Learning Dimension of the Bologna Process: Its Reflections in Education Faculty Curricula. *Yuksekogretim Dergisi*, *10*(1), 85–95. https://doi.org/10.2399/yod.19.014

Makram, A. (2019). Nature-Based Framework for Sustainable Architectural Design - Biomimetic Design and Biophilic Design. *Architecture Research*, *9*(3), 74–81. https://doi.org/10.5923/j.arch.20190903.03

Mehaffy, M. W., Kryazheva, Y., Rudd, A., & Salingaros, N. A. (2020). A New Pattern Language for Growing Regions: Places, Networks, Processes. In *A New Pattern Language for Growing Regions: Places, Networks, Processes A Collection of 80 New Patterns for a New Generation of Urban Challenges A* (Issue 20).

Modrzewski, B., & Szkolut, A. (2016). *Poznan Campuses – Are They Biophilic ? November*.

Newman, P. (2014). Biophilic urbanism: a case study on Singapore. *Australian Planner*, *51*(1), 47–65. https://doi.org/10.1080/07293682.2013.790832

Pedersen Zari, M. (2019). Understanding and designing nature experiences in cities: a framework for biophilic urbanism. *Cities & Health*, *00*(00), 1–12. https://doi.org/10.1080/23748834.2019.1695511

Roös, P. B. (2021). *SUSTAINABLE URBAN FUTURES A Biophilic Pattern Language for Cities Environments*.

Rosenbaum, M. S., Ramirez, G. C., & Camino, J. R. (2018). A dose of nature and shopping: The restorative potential of biophilic lifestyle center designs. *Journal of Retailing and Consumer Services*, *40*(February 2017), 66–73. https://doi.org/10.1016/j.jretconser.2017.08.018

Russo, A., & Cirella, G. T. (2017). Biophilic Cities : Planning for Sustainable and Smart Urban Environments. *Smart Cities Movement in BRICS*, *2018*(March), 153–159.

Santamouris, M., Haddad, S., Saliari, M., Vasilakopoulou, K., Synnefa, A., Paolini, R., Ulpiani, G., Garshasbi, S., & Fiorito, F. (2018). On the energy impact of urban heat island in Sydney: Climate and energy potential of mitigation technologies. *Energy and Buildings*, *166*, 154–164. https://doi.org/10.1016/J.ENBUILD.2018.02.007

Siebring, E. (2020). *Biophilic Urbanism in the Netherlands*. 1–23.

Soderlund, J. (2019). The Emergence of Biophilic Design. In *Cities and Nature*. http://link.springer.com/10.1007/978-3-030-29813-5

Soderlund, J., & Newman, P. (2015). Biophilic architecture: a review of the rationale and outcomes. *AIMS Environmental Science*, *2*(4), 950–969. https://doi.org/10.3934/environsci.2015.4.950

Tabb, P. J. (2020). Biophilic Urbanism. In *Biophilic Urbanism*. https://doi.org/10.4324/9781003034896

URL-1. (2018). *UN*. https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html

URL-2. (n.d.). *THE List 2*.
https://sustainability.agu.edu.tr/recognition-rankings

URL-3. (n.d.). *THE List*. https://aguinternational.wordpress.com/2020/04/23/abdullah-gul-university-ranks-101-200-in-the-impact-rankings/

URL-4. (n.d.). *EAA-Kayseri Sümerbank Bez Fabrikası'ndan Kent Kampüsüne*.

URL-5. (n.d.). *Havadan Kayseri*. http://www.havadankayseri.net/portfolio/sumer-tesisleri/

URL-6. (n.d.). *Veritas*.
http://www.veritastr.com/tr/detay/28994-agu-labs

URL-7. (n.d.). *Mimarlar ve Han Tümertekin*. http://www.mimarlar.com/tr-TR/Work/agu-laboratuvar-binasi/141

Wilson, E. O. (1984). *Biophilia*.

Zhong, W., Schröder, T., & Bekkering, J. (2022). Biophilic design in architecture and its contributions to health, well-being, and sustainability: A critical review. *Frontiers of Architectural Research*, *11*(1), 114–141. https://doi.org/10.1016/j.foar.2021.07.006

Resume

Şeyma Ezgi YILMAZ graduated from Nuh Naci Yazgan University, Department of Architecture in 2017. During her undergraduate studies, she studied with Erasmus at the University of Pecs, Hungary, (2015). In 2018 she started the integrated PhD program at Abdullah Gül University. She has participated in many national and international workshops and has oral presentations at several conferences. She continues her Ph.D. research on building facades, facade technologies and biomimetic design.

Assoc. Prof. Dr. Asım Mustafa AYTEN received the B.Sc. degree in Urban and Regional Planning, METU, Faculty of Architecture 1991. He got his M.Sc. from Gazi University, the Faculty of Engineering and Architecture in 1996 and Ph.D. degrees, from Ankara University Political Science and Public Administration Department in 2002. Prior to joining Abdullah Gül University as a faculty of Engineering and Architecture of Bozok University in February of 2012. His research focuses on the urban planning and Urban Design, Environmental Sciences and Sustainability, Urban Renewal and Transformation, Urban politics and Healthy Cities and Planning.

DOI: 10.15320/ICONARP.2023.260