

EXPLORING THE RESTORATIVE SPACES OF BIOPHILIC CAMPUS LANDSCAPES IN MITIGATING STUDENT STRESS

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ABSTRACT

Stress and mental illness among university students have reached alarming levels in recent times, leading to undesirable behaviours such as substance abuse, aggression, and suicidal thoughts. This study aims to explore the potential benefits of biophilic and restorative landscapes in campus design. Biophilic design incorporates natural elements like plants, water, and natural light both indoors and outdoors, which can positively impact individuals' mental health. This research focused on Universiti Teknologi MARA (UiTM) Puncak Alam, selecting five study locations: Tasik Alam Bina, Tasik Denai Cadamba, Perpustakaan Tun Abdul Razak, the Alam Bina Amphitheater, and the residential college Vista. The study examined how these locations with a biophilic design influenced people's well-being. The study showed that environments with a highly biophilic design can indeed enhance people's mental well-being. Tasik Alam Bina, with its water presence and natural environment, emerges as a key location for restorative use, bringing serenity to the landscape architecture students of UiTM Puncak Alam. This study highlights that adopting biophilic designs creates supportive environments for students and enhances their mental health on campus.

Keywords: Restorative landscape design, Campus design, Biophilic landscape, Stress mitigation



INTRODUCTION

The transition from high school to university is a critical period in a young person's life, as it is marked by new challenges and opportunities for the person's personal growth. University students are usually immersed in a rigorous academic environment. An increasing number of college or graduate students are experiencing elevated levels of stress, resulting in adverse impacts on their emotions, academic performance, and overall health (Yusufov et al., 2019). There are various factors that contribute to this emotional distress, including academic competition, technology-induced isolation, rejection, conflicts in relationships, depression, low self-esteem, and significant financial pressures (Vasugi, 2019). Additionally, anxiety, stress, and depression can negatively affect cognitive and attention abilities of the students (Richards, 2023). Especially for first-year students, this transition can be particularly daunting, as they encounter a variety of difficulties as they try to navigate their new academic and social environment. Karyotaki et al. (2020) emphasize that these challenges are not universal and can vary greatly depending on the psychological resilience of the individual. For some students, the adjustment to university life can be seamless, while others face significant obstacles. Research indicates that a significant proportion of college students experience overwhelming levels of stress during their academic journey. Surprisingly, despite being susceptible to stress-related and mental health challenges, these students demonstrate a notable reluctance to seek professional help (Hubbard, 2018).

Understanding the complex interplay between academic transitions, stress, and help-seeking behaviour among university students is of paramount importance as it provides the basis for developing targeted interventions and support systems, especially for first-year students who face challenges in adjusting to their new environment. A crucial aspect that educational institutions should consider is the role of the campus environment, especially outdoor spaces, in relation to students' stress levels. Research has shown that the campus environment can have a significant impact on student's psychological well-being. Access to well-designed outdoor spaces such as green spaces, parks, and recreational facilities has been linked to a reduction in stress and an improvement in overall mental health (Ismail et al., 2022). Besides, spending time with nature and outdoor activities has been shown to have a positive impact on stress reduction, emotional regulation, and

cognitive functioning (Thani et al., 2022).

In addition, previous research on the potential of biophilia for mental stress alleviation indicated that nature-based environments contributed to the most restorative effects on human well-being. Exposure to serene natural settings like vegetation or water can evoke positive emotional responses, reducing blood pressure and heart rate (Ulrich, 1991). Frederick Law Olmsted, a prominent landscape architect, echoed this idea in the 19th century, advocating that spending time in nature restores the mind, calms it, and revitalizes the entire system, making it an effective stress recovery method. Furthermore, biophilic design is a concept that incorporates natural elements, such as plants, water, and natural light, into built environments to create spaces that mimic the natural world. Based on this concept, this study aims to investigate the potentially restorative effects of biophilic campus landscapes in alleviating student stress, using a preference study approach.

LITERATURE REVIEW

Stress Reduction through Connectedness to Nature: The Biophilia Hypothesis

People who have an emotional attachment to nature tend to have a low social dominance orientation, show empathy towards non-human life, and are more willing to form relationships and support marginalized groups (Shing, 2022). Consequently, a sense of connectedness to nature plays a crucial role in fostering psychological development, and this connectedness goes beyond simply spending time in nature (Pritchard, 2019). Connectedness, defined as the extent of a “meaningful, shared, and significant personal relationship with another person, a spiritual being, nature, or an aspect of oneself” (Restall, 2015). This can be examined in students on green campuses at three levels: Connectedness with nature, connectedness with other people, and connectedness with self (Alves, 2022). A personal disposition known as connectedness to nature has been investigated as being essential to human health, environmental health, and intergroup attitudes and behaviour. This disposition encompasses both direct and indirect contact with the natural world and its activities (Shing,

2022). Thus, understanding which spatial designs could foster community formation and a sense of connectedness to individuals and places is crucial since the physical and non-physical campus dimensions compose a community. Besides, green places that give pupils a chance to meet with different peers regularly are more likely to improve connectivity (Salingaros, 2020). As a result, societal spatial layouts in green spaces on campuses may strengthen connections with others by facilitating productive breaks, which in turn may improve opportunities for social interaction.

The concept of connectedness with nature has been studied extensively for its impact on human health, environmental health, and intergroup attitudes and behaviours. This disposition encompasses both direct and indirect interactions with the natural world and its activities (Shing, 2022). Considering connectedness with others, it is crucial to find spatial designs that promote community building and a sense of connectedness between individuals and places, as the physical and non-physical dimensions of the campus together form a community. Besides, green spaces that facilitate regular interactions between students are more likely to promote better connectivity (Salingaros, 2020). The strategic spatial design of green spaces on campus can strengthen social connections by promoting productive breaks and enhancing opportunities for social interactions. The campus as a social-ecological system provides new opportunities for individuals to connect with nature, making it a crucial aspect to foster a sense of connectedness. Therefore, understanding this dynamic relationship between the campus and its users, including students, faculty, and staff, can help university stakeholders make informed design decisions that enhance the campus experience.

Biophilic Design

The concept of biophilia, introduced by Wilson (1984), refers to man's inherent attachment to the natural environment and has been studied in depth in psychology and sociology since the 1980s. In recent years, there has been an increased interest in the impact of nature on humans in buildings, which has also received attention in architecture and design. The number of published peer-reviewed research papers on biophilic design has increased significantly in the last decade. At the same time, both architects and academics have shown a greater interest in how buildings and interiors

affect human health and well-being (Peters, 2020).

“Biophilic design” is a design philosophy that promotes the integration of natural systems and processes into the built environment. It is based on the biophilia hypothesis, which states that human well-being is enhanced when people are exposed to the natural world because of their innate connectedness to it. Biophilic design promotes the use of natural elements and processes as sources of inspiration for architectural design. This concept, supported by a wealth of research, highlights the positive effects of the natural environment on human health and well-being. The benefits of spending time in nature stem from the biological connection between humans and the natural world, as proposed in the biophilia hypothesis (Gillis, 2015).

Attributes of Biophilic Landscapes

Biophilic design has received considerable attention in the fields of architecture and urban planning as a holistic approach to creating environments that foster a deep connection with the natural world. In the context of campus landscapes, the integration of biophilic elements holds immense potential to positively impact student well-being and academic performance. Table 1 outlines the essential attributes of biophilic campus landscapes. These attributes encompass a range of design elements that contribute to the creation of a nature-inspired environment on a higher education campus. By understanding and implementing these attributes, educational institutions can create vibrant, restorative spaces that benefit the entire campus community.

Table 1. The Biophilic Design Attributes

Attributes	Characteristics
Natural Elements	Incorporation of vegetation, water features, and natural light both indoors and outdoors to mimic the natural environment.
Sensory Diversity	Offering a variety of sensory experiences, such as the sound of flowing water, the scent of plants, and the touch of natural textures.
Biomorphic Forms and Biophilic Pattern	Incorporating organic, nature-inspired shapes and patterns in architecture and design.
Prospect of Water	Incorporating water elements, like fountains or ponds, to provide visual and auditory interest and promote relaxation.

Connection to Living Systems	Incorporating elements that foster interactions with living organisms, such as bird feeders or butterfly gardens.
Cultural and Ecological Expression	Integrating elements that reflect the local culture and natural ecosystems of the campus area.
Prospect and Refuge	Providing spaces that offer both open views (prospect) and enclosed areas (refuge) to cater to individuals' preferences for safety and exploration.

Source: Adapted from Wilson, 1984; Kaplan. & Kaplan, 187; Ulrich, 1991; Salingaros, 2014

Theories Related to Restorative Environment

Attention Restoration Theory (ART)

The attention restoration theory (ART) theory is pertinent to biophilic design in academic settings because it addresses attention fatigue and cognitive resource exhaustion that frequently occur in learning contexts (Kaplan & Kaplan, 1989). Studies have demonstrated that being in nature may both calm and stimulate the mind, enhancing wellness and performance. It has been demonstrated that exposure to the outdoors encourages positive daydreaming and creativity. For instance, in one study, participants who spent four days immersed in nature and cut off from technology and multimedia performed 50% better on tests of creativity and problem-solving than a control group (Atchley et al., 2012). Although urban university settings cannot offer nature immersion on campus, it is important to note that participants in research about nature and creativity gave higher marks for natural surroundings, in addition to their preferences. Thus, biophilic design is a useful tool for addressing the critical problem of enhancing the environment to promote creativity.

Stress Reduction Theory (SRT)

The stress reduction theory (SRT) relates to restoration and identifies the benefits of natural outdoor environments after excessive psychological and physiological arousal, or excessively low arousal. Additionally, exposure to nature has been found to have a positive impact on physiologic processes, behaviour, emotional states, and cognitive functioning. This notion laid the foundation for following research that examined the anti-stress effects of different aspects of nature, including sights, sounds, and vistas of natural settings (Ulrich et al., 1991).

METHODOLOGY

This study employed a quantitative research approach to investigate the restorative potential of biophilic campus landscapes on student well-being. Specifically, an online survey conducted through Google Forms serves as the primary data collection method. The survey aims to gather insights from landscape architecture students regarding their perceptions and experiences of biophilic design elements within campus environments.

Sampling Population

The population that the survey targeted comprised all current landscape architecture students at Universiti Teknologi MARA (UiTM) Puncak Alam. The survey included 398 landscape architecture students who are studying in UiTM. This is because this group of population is exposed to design elements and have a greater sensitivity about natural integration within built environment which falls in line with the study objectives in Biophilic Design. From the survey distributed, 201 students responded to the questionnaire through Google Form were 108 females, which represent 53.7% from the total number of respondents, while 93 males constituted the remaining 46.3% of the total number of respondents. This response ensures that demographic distribution, relaxation, attention restoration, and mental clarity among respondents can be considered reliable.






Respondents

This study concentrates on those UiTM Puncak Alam landscape architecture learners whose experience elevated stress levels due to peer influence. An online survey was used to measure preferences for biophilic campus landscapes as a means of reducing stress. With reference to environmental psychology, it explored how individuals relate to their physical surroundings with emphasis on principles of biophilic design. As such, this research targeted a group known for their knowledge in design and space organization as the study aims at evaluating how biophilic elements enhance the students' well-being.

Site Studies

The study at Universiti Teknologi MARA (UiTM) Puncak Alam focuses on biophilic landscapes, specifically at locations in Tasik Alam Bina, Tasik Denai Cadamba, Perpustakaan Tun Abdul Razak, the amphitheatre Alam Bina, and residential college vistas. These sites were chosen for their favourable visual and acoustic environments that include water elements. However, acknowledging potential bias towards water elements in restorative assessments should also be included particularly in future research. A suggestion to compare spaces with and without water features for more accurate evaluations.

Table 2. The Chosen Areas in Universiti Teknologi MARA (UiTM) Puncak Alam

Location and Biophilic Attributes	
<p>Tasik Alam Bina</p>  <p>Natural elements, prospect of water, cultural and ecological expression, prospect and refuge</p>	<p>Tasik Denai Cadamba</p>  <p>Natural elements, prospect of water, connection to living systems, sensory diversity</p>
<p>Perpustakaan Tun Abdul Razak (Outdoor)</p>  <p>Biomorphic forms and biophilic patterns, prospect and refuge, sensory diversity</p>	 <p>Biomorphic forms and biophilic patterns, prospect and refuge, sensory diversity, cultural and ecological expression</p>
<p>College Residential View</p>  <p>Natural elements, prospect and refuge, sensory diversity</p>	

Site Observation

A checklist to observe biophilic design attributes in the chosen areas was developed. This checklist identifies restorative landscapes by evaluating qualities that form a "condensed story" involving people, nature, and their interactions, based on research. This highlights the importance of biophilic design in creating restorative environments.

Restorative Outcome Scale (ROS)

The Restorative Outcome Scale (ROS) was utilized in this study to measure the perceived restorative outcomes among students. Developed by Hartig et al. (1998), Staats et al. (2003), and refined by Korpela et al. (2008), the ROS includes six items focusing on relaxation and calmness, attention restoration, and mental clarity. These elements align with the Attention Restoration Theory (ART) and Stress Reduction Theory (SRT) discussed in this research, as they emphasize the cognitive and emotional benefits of natural environments.

Data Analysis: Descriptive Statistics

Descriptive statistics were used to summarize a set of observations and to communicate the largest amount of information as simply as possible. They included three types of measurements: measures of frequency (frequency, percent), measures of central tendency (mean, median, mode), and measures of dispersion (variance, percentile, range) (Anaesth, 2019).

RESULT AND DISCUSSION

Perceived Restorative Outcome

Relaxation and calmness

There were three questions related to the relaxation and calmness factor in the questionnaire items. The figure below shows responses to the question "I feel calmer after being here" at various locations: Tasik Alam Bina, Tasik Denai Cadamba, Perpustakaan Tun Abdul Razak, amphitheatre

Alam Bina, and college residential views.

•Survey: I feel calmer after being here

The graph as shown in Figure 1 displays the total number of respondents who chose the location that after visiting, made them feel more at ease. The place with the highest number of respondents was Tasik Alam Bina, with 88 respondents agreeing that Tasik Alam Bina was their preferred location for calmness and relaxation. However, college residential was the location that was least frequently chosen by the respondents. Apart from that, the second highest chosen area was the amphitheatre Alam Bina, followed by Perpustakaan Tun Abdul Razak and Tasik Denai Cadamba.

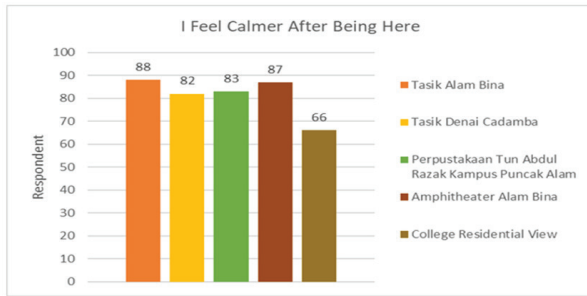


Figure 1. The Graph Shows the Places which “I feel calmer after being here”

Source: Author

•Survey: I feel restored and relaxed

Figure 2 displays respondents' preferences for locations that made them feel restored and relaxed. The amphitheatre Alam Bina was most favored, with 74 respondents indicating it provided a sense of restoration. Perpustakaan Tun Abdul Razak was the least chosen for this feeling. Tasik Alam Bina followed closely as the second most preferred location, followed by Tasik Denai Cadamba and the college residential view.

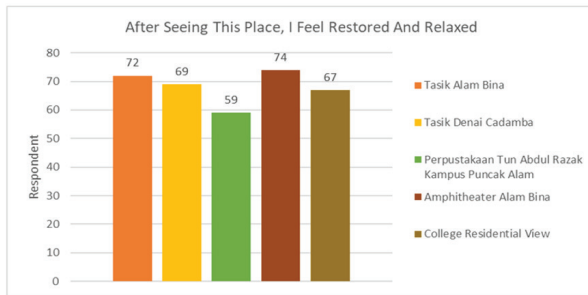


Figure 2. The Graph Shows the Places which “I feel restored and relaxed after being here”

Source: Author

•Survey: I get new enthusiasm and briskness to my everyday routines from here

The graph as shown in Figure 3 displays the total number of respondents who chose the location that after visiting made them enthusiastic and liveliness. The place with the highest number of respondents was the Tasik Alam Bina, with 75 respondents agreed that the Tasik Alam Bina was their preferred location to feel enthusiastic and liveliness in their everyday routines. Amphitheatre Alam Bina was the location that was the least frequently chosen by the respondents. Apart from that, the second highest chosen area was the Perpustakaan Tun Abdul Razak followed by Tasik Denai Cadamba and college residential view.

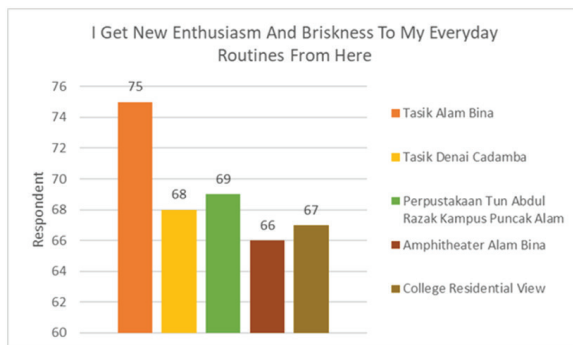


Figure 3. The Graph Shows the Places which “I get new enthusiasm and briskness to my everyday routines from here”

Source: Author

Attention Restoration

The questions focussed on the attention restoration factor, concentration improvement, and whether alertness had increased at various locations. The table below shows the respondents' reported improvements in concentration and alertness at each place (Tasik Alam Bina, Tasik Denai Cadamba, Perpustakaan Tun Abdul Razak Kampus Puncak Alam, Amphitheatre Alam Bina, and the college residential view).

●Survey: My concentration and alertness increase here

The graph as shown in Figure 4 displays the total number of respondents who chose the location that, after visiting, increased their concentration and alertness. The place with the highest number of respondents is the Tasik Alam Bina, with 76 respondents agreeing that the Tasik Alam Bina was their preferred location that could increase their concentration and alertness. The Perpustakaan Tun Abdul Razak was the location that was the least frequently chosen by respondents. Apart from that, the second highest chosen area was the college residential view followed by Tasik Denai Cadamba and amphitheatre Alam Bina.

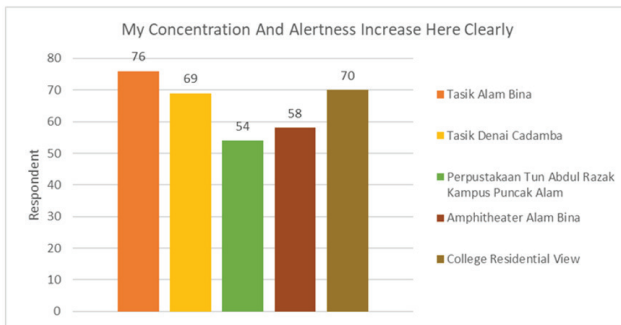


Figure 4. The Graph Shows the Places which “my concentration and alertness increase here clearly”

Source: Author

Clearing One’s Thought

Two questions were related to clearing one’s thoughts, which are i) I can forget everyday worries here, and ii) visiting here is a way of clearing and clarifying my thoughts. The table below represents the first question.

•Survey: I can forget everyday worries here

The graph as shown in Figure 5 displays the total number of respondents who chose the location that after visiting they could forget their everyday worries there. The place with the highest respondent was the Tasik Alam Bina, with 70 respondents agreed that Tasik Alam Bina was their preferred location where they could forget their everyday worries. The Perpustakaan Tun Abdul Razak was the location that was the least frequently chosen by the respondents as the place where they could forget their everyday worries. Apart from that, the second most chosen area was the Amphitheatre Alam Bina followed by Tasik Denai Cadamba and the college residential view.

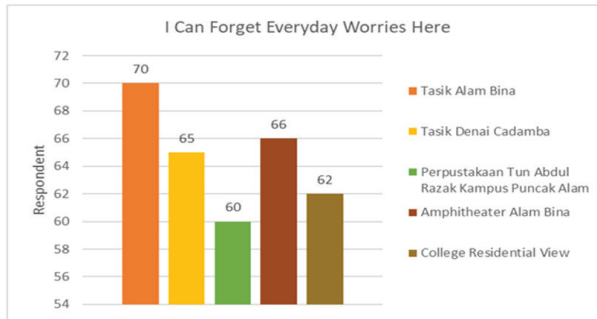


Figure 5. The Graph Shows the Places which “I can forget everyday worries here”

Source: Author

•Survey: Visiting here is a way of clearing and clarifying my thoughts

The graph as shown in Figure 6 displays the total number of respondents who chose the location for clearing and clarifying their thought. The place with the highest number of respondents was the Tasik Alam Bina, with 75 respondents agreed that Tasik Alam Bina was their preferred location where they could clear and clarify their thoughts. The college residential view was the location that was the least frequently chosen by the respondents as the place where they could clear and clarify their thoughts. Besides that, the second highest chosen area was the Tasik Denai Cadamba followed by Perpustakaan Tun Abdul Razak and the amphitheatre Alam Bina.

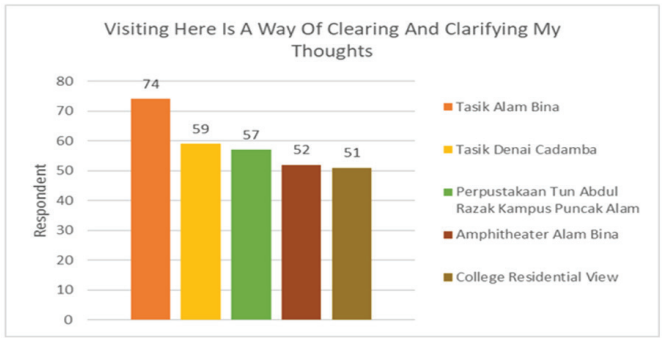


Figure 6. The Graph Shows the Places which “visiting here is a way of clearing and clarifying my thoughts”

Source: Author

Perceived Restorative Preferences

The graph as shown in Figure 7 displays the total number of respondents who chose the most preferable ambiance for them to feel relaxed for reducing stress. The place with the highest number of respondents was the Tasik Alam Bina, with 128 respondents agreed that Tasik Alam Bina was their preferred location where they could feel relaxed to reduce stress. The college residential view was the least frequently chosen by the respondents as the place where they could feel relaxed to reduce stress. Besides that, the second highest chosen area was the Tasik Denai Cadamba followed by Perpustakaan Tun Abdul Razak and the amphitheatre Alam Bina.

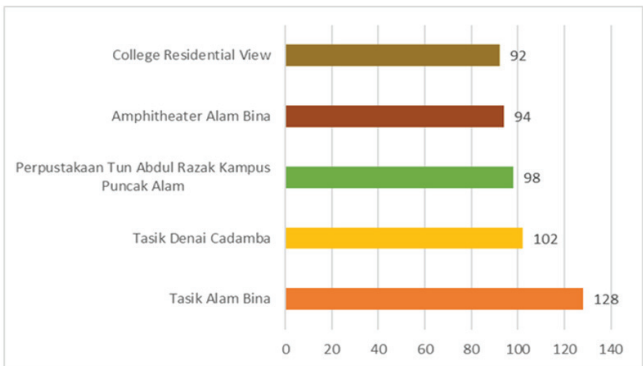


Figure 7. The Bar Chart Shows the Preferable Places for Restorative Design

Source: Author

Perceived Restorative in relation to Biophilic Campus Landscapes

The bar chart in Figure 8 shows the results of a survey conducted to determine the potential benefits of restorative landscapes to the university campus and the institution proper in terms of the impact of design on the well-being of the individuals. First, it seems that Tasik Alam Bina was the most frequently chosen place, with 74 respondents to the first question, 70 to the second, 76 to the third, 75 to the fourth, 72 to the fifth, and 88 to the last. It was chosen as the place students prefer for recreation. The reason for this preference was probably because the majority of the respondents live in hostels near Tasik Alam Bina. Therefore, Tasik Alam Bina became their preferred place which was close and convenient compared to other recreation places that are further away from the hostel.

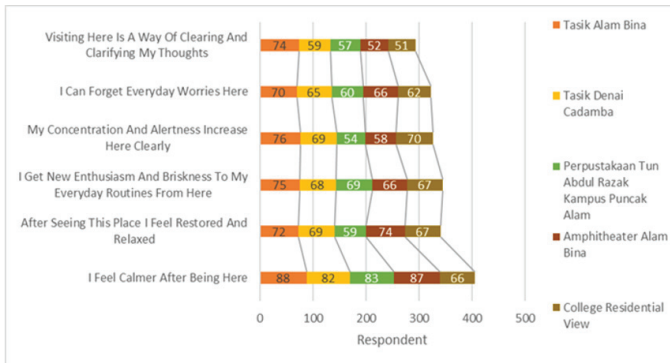


Figure 8. The Bar Chart Shows the Preferable Places in Relation to Biophilic Campus Landscapes

In order to make sure that the restorative landscape is beneficial for the respondents, it is vital to consider other factors outside only the presence of greenery and water, such as environments for interaction with others and connectivity. Tasik Alam Bina, Tasik Denai Cadamba, Tun Abdul Razak Library (outdoor lobby), Alam Bina amphitheater, and college residential vista are in comparison to these five locations. The location that best embodies the virtues of a good biophilic design was Tasik Alam Bina. Societal spatial layouts in green campus spaces have the potential to enhance social connections by facilitating rejuvenating breaks, ultimately leading to improved opportunities for social interaction. The biophilic design and pleasant atmosphere of Tasik Alam Bina create an environment conducive

to meetings and conversations in societal open spaces, simultaneously providing fresh air for individuals experiencing anxiety. Within nurturing campus environments, students can cultivate connections with peers, broaden their social circles, and establish a sense of belonging through intimate-scaled, casual, and inviting areas (Gehl, 1987).

The area difference between Tasik Alam Bina, the most preferred location, and Tasik Denai Cadamba, the second most preferred location for respondents was restorative facilities. Tasik Alam Bina features public facilities such as shelters, open spaces, seats, an outdoor gym, and e-scooters, which are the newest attractions. These facilities at Tasik Alam Bina can assist students in spending their time in beneficial activities with friends while using the existing facilities. However, Tasik Denai Cadamba, which represents a lovely vista area surrounded by green landscape, forest area, and tranquil lake water, lacks open space for people to relax, rest, or interact with others. Due to this, most respondents preferred Tasik Alam Bina to Tasik Denai Cadamba. This is because effective biophilic design promotes not only greenery and the presence of water but also social-spatial design, which is especially important in the campus area.

The comparison was conducted between the greenery and the presence of water between the two locations, namely Tasik Alam Bina and the outdoor lobby of Perpustakaan Tun Abdul Razak as the third preferred location. We can note that Tasik Alam Bina has a lake where respondents can spend time with friends and relax, while Tun Abdul Razak Library has only a round shape with a green area in the middle. The location at Alam Bina Lake was chosen because biophilic designs include the presence of water and trees. This can help students relieve stress.

As compared to the amphitheatre area, the Tasik Alam Bina area has green connectivity that allows respondents to walk and feel comfortable in Tasik Alam Bina, while the amphitheatre area only has an open space that connects the open area to the edge of the lake. The Tasik Alam Bina area features a recreational green space, where respondents can engage in leisure activities with friends, and enjoy the picturesque lakeside scenery. This finding supported the observation made by Wi and Abdul Samad (2022), where they found that scenic landscape attributes greatly to heal the body and mind whilst promote positive human behaviour. Conversely,

within the confines of the college rooms, movement is constrained, and only a selected few rooms permit views of the hillside or Tasik Alam Bina. Due to the spatial limitations within the college premises, a notable preference is observed for Tasik Alam Bina. This preference is attributed to its encompassing green areas, tranquil lake waters, seamless connectivity between the green space and other zones, and its suitability to foster social bonds between humans and nature.

CONCLUSION

This study concluded that biophilia is rooted in an inherent need for connectedness, which is activated through affordances expressed in a pattern of campus settings. The study revealed that respondents prefer nature-connected places with integration of sensory diversity and social cohesion as the best restorative area for stress mitigation. The survey established that highly biophilic environments contribute to enhancing people's mental well-being. Notably, the Tasik Alam Bina region stands out as a key area for restorative use due to its biophilic design elements, including water features and a natural environment. Incorporating natural elements in all campus areas is essential to create a serene atmosphere for the respondents. By replicating the natural element throughout the campus, a supportive and restorative environment can be fostered for the well-being of the students. Biophilic design in the campus landscape draws inspiration from natural components and processes. This is based on the theory that exposure to nature benefits the health and well-being of the campus community.

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AUTHOR CONTRIBUTIONS

Nurul Batrisyia Salleh is the main author and had carried out the data collection and analysis. Sharifah Khalizah Syed Othman Thani supervised the research progress and co-authored the writing of the article.

CONFLICT OF INTEREST

The authors declared there is no conflict of interest.

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