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"Warning in Spaces: Blending Heritage, Nature and Design"

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"Harmony in Spaces : Blending Heritage, Nature and Design"

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Emotional Responses to Plant Attributes: Investigating Restorative Effects Among Campus Students at UiTM Seri Iskandar, Perak

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Abstract

Mental health among university students has become an increasing concern, as academic pressure and psychological stress can negatively affect emotional well-being and cognitive performance. Previous studies have shown that exposure to natural environments, particularly campus greenery, can support mental restoration and emotional recovery. However, limited research has examined which specific plant attributes contribute most to these restorative effects in university settings. Guided by Attention Restoration Theory (ART), which emphasizes being away, extent, fascination, and compatibility as key components of restorative experiences, this study investigates the influence of plant attributes on students' restorative emotional responses at UiTM Seri Iskandar, Perak. The study focuses on four plant attributes: plant colour, plant shape, spatial arrangement, and shade. A mixed-method approach was employed, comprising site observations to identify existing plant attributes across selected campus areas, followed by a structured questionnaire using Likert-scale items to assess students' emotional responses, including calmness, comfort, relaxation, and mental refreshment. Descriptive statistical analysis was used to determine which plant attributes contribute most strongly to restorative emotional effects. The findings indicate that plant color and plant form are the most positively perceived visual attributes by students, while shade plays a critical functional role in supporting the restorative experience. However, the uneven distribution of shade and its limited presence on campus areas have led to a high demand among students for additional shade. This need is clearly reflected in student recommendations that emphasize the addition of more shaded seating areas, increased plant color diversity, more natural landscape layouts, and more frequent landscape maintenance. This study provides evidence-based insights for campus planting design, highlighting the importance of balancing visual quality and thermal comfort to enhance the restorative quality of outdoor learning environments and support students' overall well-being.

Keyword: Plant attributes, Emotional Well-being, University Student, Campus landscape, Restorative environment

INTRODUCTION

Mental health among university students has become a pressing concern, as academic demands, social pressure, and psychological stress contribute to emotional fatigue and diminished cognitive capacity (Aghabozorgi et al., 2024). In response to the increasing academic pressure and mental fatigue among university students, campus landscapes have the potential to function as restorative environments that support emotional well-being. Although green spaces are present on many university campuses, the specific

plant attributes that contribute to emotional restoration are often not clearly identified or evaluated. Numerous studies suggest that exposure to natural environments can help students recover from mental fatigue and restore emotional equilibrium (Syed Othman Thani & Salleh, 2024). These efforts align with UN Sustainable Development Goals (SDGs), particularly SDG 3 Good Health and Well-Being, by supporting psychological health in learning environments.

Therefore, this study aims to investigate emotional responses to plant attributes and their restorative effects among campus students at UiTM Seri Iskandar, Perak. The research is structured to first identify the existing plant attributes within selected campus landscapes area, followed by determining which plant attribute contributes the most to restorative emotional effects among students. The findings are then used to inform planting design recommendations that enhance the restorative quality of campus outdoor spaces. Based on these objectives, specific research questions are developed to guide the data collection and analysis process, ensuring that the study systematically addresses both the physical characteristics of campus vegetation and students' emotional perceptions. This study is guided by Attention Restoration Theory (ART) proposed by (Rachel Kaplan, 1989) which posits that environments featuring being away, extent, soft fascination, and compatibility facilitate the recovery of attention and reduce mental fatigue. These ART components align strongly with specific plant attributes that can shape restorative experiences.

In this research, we focus on four key plant attributes, colour, plant shape, spatial arrangement, and shade. Colour and plant shape contribute to soft fascination, gently capturing attention through visual variety and form. Spatial arrangement and shade signal extent and coherence, creating a sense of connectedness with the environment. Shade provides compatibility, offering comfort, refuge, and a place to relax. These considerations also align with SDG 11 Sustainable Cities and Communities and SDG 15 Life on Land, by promoting sustainable, plant-rich campus environments that enhance both ecological and human well-being. Empirical evidence suggests that campus landscapes with varied biophilic features significantly contribute to student well-being. For example, biophilic design on a Malaysian university campus was found to reduce stress and improve emotional outcomes (Syed Othman Thani & Salleh, 2024a). Moreover, spatial configuration and “naturalness” of campus greenery are strongly associated with perceived restorativeness and emotional recovery among students (Gao et al., 2025). Overall, the results help guide practical recommendations for campus planting design, showing that the use of appropriate plant attributes can improve ecological quality while also supporting students' mental recovery and overall well-being, in line with the goals of SDGs 3, 11, and 15.

LITERATURE REVIEW

Nature, campuses and student well-being

University students today face rising levels of stress, anxiety, and emotional fatigue due to academic demands, social pressures, and lifestyle changes (Aghabozorgi et al., 2024). In Malaysia, studies during and post-pandemic found 66.2% of students experienced moderate to severe anxiety, 53.9% moderate to severe depression, and 44.6% moderate to severe stress (Paiva et al., 2025). Another study reported 48.8% of students experienced suicidal thoughts, emphasizing the urgent need for interventions that support student mental health (Azwan et al., n.d.). According to the World Health Organization (2023), the most prevalent mental health disorders worldwide are depression and anxiety, both of which significantly affect daily

functioning and emotional well-being. Depression commonly manifests persistent sadness, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, fatigue, and reduced concentration. Anxiety disorders, on the other hand, involve symptoms such as excessive worry, fear, panic, phobias, obsessive–compulsive tendencies, and post-traumatic stress reactions. These conditions are particularly concerning among university students, who face academic pressure, social stressors, and environmental changes that may exacerbate these symptoms.(Depression and Other Common Mental Disorders Global Health Estimates, n.d.)

Campus green spaces are increasingly recognized as important contributors to student well-being. Exposure to greenery has been shown to reduce stress, enhance mood, and support cognitive and emotional restoration. For example, (Xu et al., 2024) found that visiting campus green spaces significantly increased students' positive emotions, reduced negative emotions, and improved cognitive recovery, demonstrating the restorative benefits of natural environments within university settings. Green spaces act as everyday restorative environments that provide opportunities for relaxation, reflection, social interaction, and mental recovery functions that are especially valuable within high-pressure academic environments.

Moreover, place attachment and perceived social acceptance have been identified as psychological pathways through which campus landscapes affect student well-being. A recent study using structural equation modeling (SEM) and explainable machine learning in Chinese universities found that landscape perception was the strongest predictor of well-being, mediated by these social-emotional variables (Chang et al., 2025). This highlights that green space design should consider not just size or quantity, but how students emotionally relate to the campus environment. Qualitative evidence also supports these findings. In a Malaysian study, students reported that nature provided a refuge from academic stress, improved mood, and mental clarity (Ahmad et al., 2025). These first-person experiences align with theoretical perspectives that natural environments act as restorative resources.

Theoretical Alignment: Attention Restoration Theory (ART)

The Attention Restoration Theory (ART), introduced by (Rachel Kaplan, 1989), provides a foundational framework for understanding how natural environments support psychological restoration. ART proposes that directed attention a cognitive resource required for concentration and academic tasks becomes fatigued after prolonged use. Exposure to nature helps replenish this capacity, resulting in improved emotional stability and mental clarity (Ohly et al., 2016; Stephen Kaplan, 1995). This theory is especially relevant for university students, who frequently face mental fatigue, academic stress, and emotional strain. ART identifies four essential components that make an environment restorative: being away, extent, fascination, and compatibility. Being away refers to a sense of psychological or physical escape from daily routines or stressors. Even small natural spaces or landscaped elements within a campus can simulate this feeling by creating a mental break from academic demands (Hartig et al., 2001; Rachel Kaplan, 1989). Extent describes the richness and coherence of an environment, offering enough visual or spatial depth to engage the mind. Landscapes that feel immersive such as shaded walkways, layered planting, and structured vegetation patterns support the sense of being part of a larger, interconnected natural setting (Payne et al., 2020). Fascination, particularly soft fascination, involves effortless attention drawn by natural stimuli such as plant colour, leaf movement, textures, or shade patterns. These qualities allow the mind to rest while maintaining engagement, making them essential contributors to emotional restoration (Rita

Berto, 2005; Stephen Kaplan, 1995). Finally, compatibility refers to the alignment between the environment and the individual's intentions. Spaces that support relaxation, contemplation, or comfort such as shaded seating areas or visually pleasing plant arrangements enhance restorative outcomes (Hartig et al., 2001)

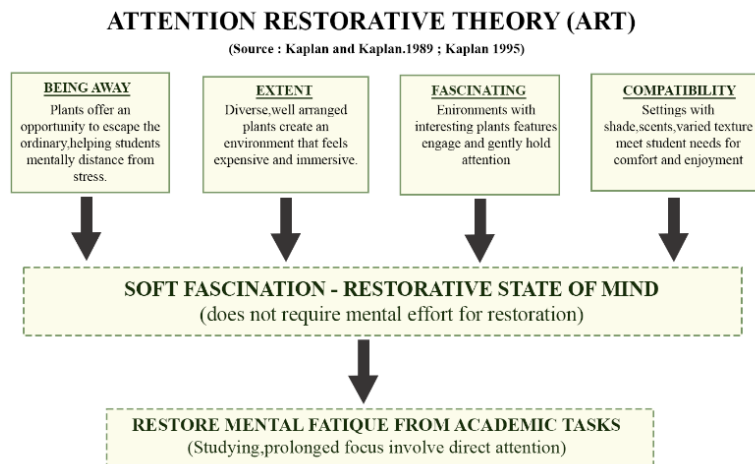


Figure 1: Conceptual model diagram: component of a restorative environment
Source : (Rachel Kaplan, 1989; Stephen Kaplan, 1995)

Figure 1 shows how within a campus context, plant attributes such as colour, shape, spatial arrangement, and shade can be interpreted as environmental cues that trigger the four ART components. Therefore, ART provides strong theoretical justification for examining how specific plant attributes influence emotional responses such as calmness, comfort, and reduced mental fatigue.

Plant Attributes in Campus Landscape

Plants play a crucial role in shaping the quality of campus landscapes, contributing not only to ecological functions but also to the psychological and emotional well-being of students. In recent years, growing attention has been directed toward understanding how specific plant attributes such as colour, form, canopy density, shade, and spatial arrangement affect human experiences within educational environments. Plant characteristics influence perception, comfort, mobility, and emotional responses, making them significant components in designing restorative and student-friendly campuses (Lee et al., 2015; Nordh et al., 2009)

Plant colour, whether expressed through foliage, flowers, or seasonal changes, is one of the most influential attributes in shaping emotional responses. Studies indicate that green hues are generally associated with calmness, relaxation, and stress reduction, aligning with restorative experiences described in ART (Elsadek et al., 2019; Jiang et al., 2015). In contrast, warm floral colours such as yellow, orange, and red can evoke

feelings of energy or visual excitement, enhancing fascination, an essential ART component. Colour diversity in planting design also contributes to visual richness, making spaces more engaging and aesthetically satisfying for campus users.

Plant shape and form significantly influence how individuals perceive and emotionally respond to campus

landscapes, as different morphologies create distinct visual and spatial experiences. Rounded and naturally spreading forms are often associated with comfort and relaxation because they create softer, more inviting environments that align with restorative landscape qualities (Chen, 2023). Weeping forms, which display gentle, downward foliage, enhance feelings of tranquility and support soft fascination by offering subtle visual movement that captures attention without mental strain (Wang et al., 2016). The diversity of plant shapes also contributes to visual richness, and when this complexity remains coherent, it enhances aesthetic appreciation and emotional well-being among users (Southon et al., 2018). Therefore, plant form is not merely an aesthetic choice, it shapes users' emotional responses, supports attentional restoration, and enhances the restorative potential of campus environments.

Spatial arrangement refers to how plants are distributed and organized within a landscape, influencing movement patterns, visibility, and environmental coherence. Well-organized vegetation structures such as layered planting, tree-lined paths, or defined green pockets improve extent by creating immersive and coherent spatial experiences (Nordh & Østby, 2013). In particular, (Mt Akhir et al., 2024) found that arrangement was the most significant fundamental planting design element affecting students' preferences and perceived well-being, highlighting the importance of spatial configuration in campus landscape planning.

Shade provided by trees moderates microclimate conditions, reducing heat stress and improving outdoor comfort. In campus settings, shaded zones become preferred areas for resting, studying, or informal socializing (Ward Thompson, 2008). Shade quality, whether dappled or fully covered, also influences the aesthetic and sensory experience of space. Comfortable microclimates enhance compatibility, making spaces more supportive of the activity's students wish to undertake, including relaxation and restoration.

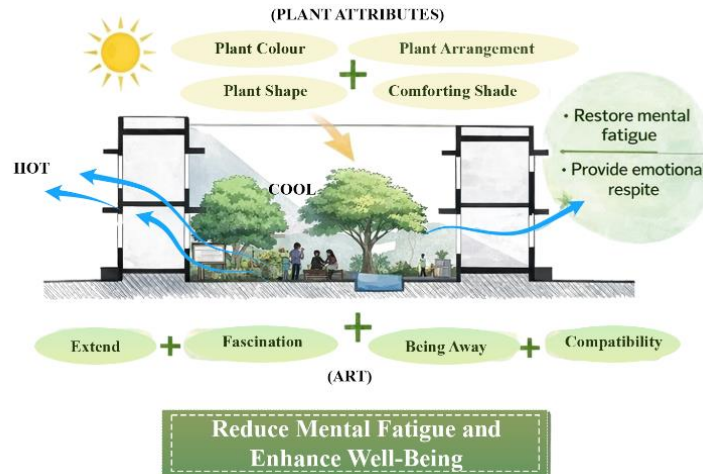


Figure 2: Illustration indicates the criteria for a restorative environment with existing Plant Attribute at the campus area.

Adapted from:(Mat Idris et al., 2021)

Collectively, figure 2 shows how this plant attributes influence how campus landscapes are perceived, used, and emotionally experienced. When attributes such as colour variation, pleasant forms, adequate canopy coverage, and coherent spatial arrangements are present together, they create environments that support the restorative experiences posited by ART (Stephen Kaplan, 1995). Research shows that campuses with thoughtfully designed plantings report higher student satisfaction, reduced stress, and increased usage of

outdoor learning spaces (McFarland et al., 2008). Therefore, understanding plant attributes is essential for creating restorative campus landscapes that enhance students' mental well-being and daily academic functioning.

Although numerous studies support ART in explaining the mental health benefits of natural environments, several gaps remain. Many existing studies examine broad landscape features or compare natural versus urban settings (Berman et al., 2008; Ohly et al., 2016), but few have isolated specific plant attributes such as colour, plant shape, shade, or spatial arrangement as independent variables that influence emotional restoration. Additionally, research focusing on university campuses in Malaysia, remains limited, despite increasing concern for student mental health. Previous studies often generalize plant benefits without identifying which visual or spatial qualities are most restorative for campus students. (Lottrup et al., 2013; Won Sop Shin, 2007). Therefore, there is a need to examine how distinct plant attributes contribute individually and collectively to emotional responses and restorative experiences within a campus setting. This study addresses this gap by linking measurable plant characteristics to perceive emotional and cognitive restoration using the ART framework.

RESEARCH METHODOLOGY

This study adopts a mixed-method approach that combines both quantitative and qualitative elements using observation and questionnaire surveys. According to (Gläser-Zikuda et al., 2024), mixed-method research allows researchers to collect complementary data using different techniques, giving a more complete and reliable understanding of the research topic. By integrating structured questionnaires (quantitative) with direct field observation (qualitative), researchers can compare how people perceive and how they interact with their surroundings.

In this study, observation is used to identify and record existing plant attributes within campus green spaces such as colour, plant shape, spatial arrangement, and shade using a structured checklist. This provides contextual data about the environmental setting. The questionnaire survey, on the other hand, collects students' emotional responses toward those same plant attributes, offering measurable insights into how these features influence their well-being. Combining both methods strengthens the validity of the findings and allows the study to connect real physical conditions with subjective emotional experiences (Gläser-Zikuda et al., 2024).

Study Location

The study will be conducted at selected areas within the campus of Universiti Teknologi MARA (UiTM) Seri Iskandar, Perak, Malaysia, figure 1 which feature a variety of plant species and landscape settings. The research sites are divided into three main areas the college residential area, the faculty area, and the lake/recreational area. These areas were selected based on two key criteria, the level of greenery and presence of diverse plant species, and the frequency of student use or passage, as determined through preliminary site observations. This selection ensures that the study focuses on locations that are both visually rich in plant attributes and highly relevant to students'

daily experiences, thereby providing meaningful insights into how campus plantings influence

emotional and restorative responses.

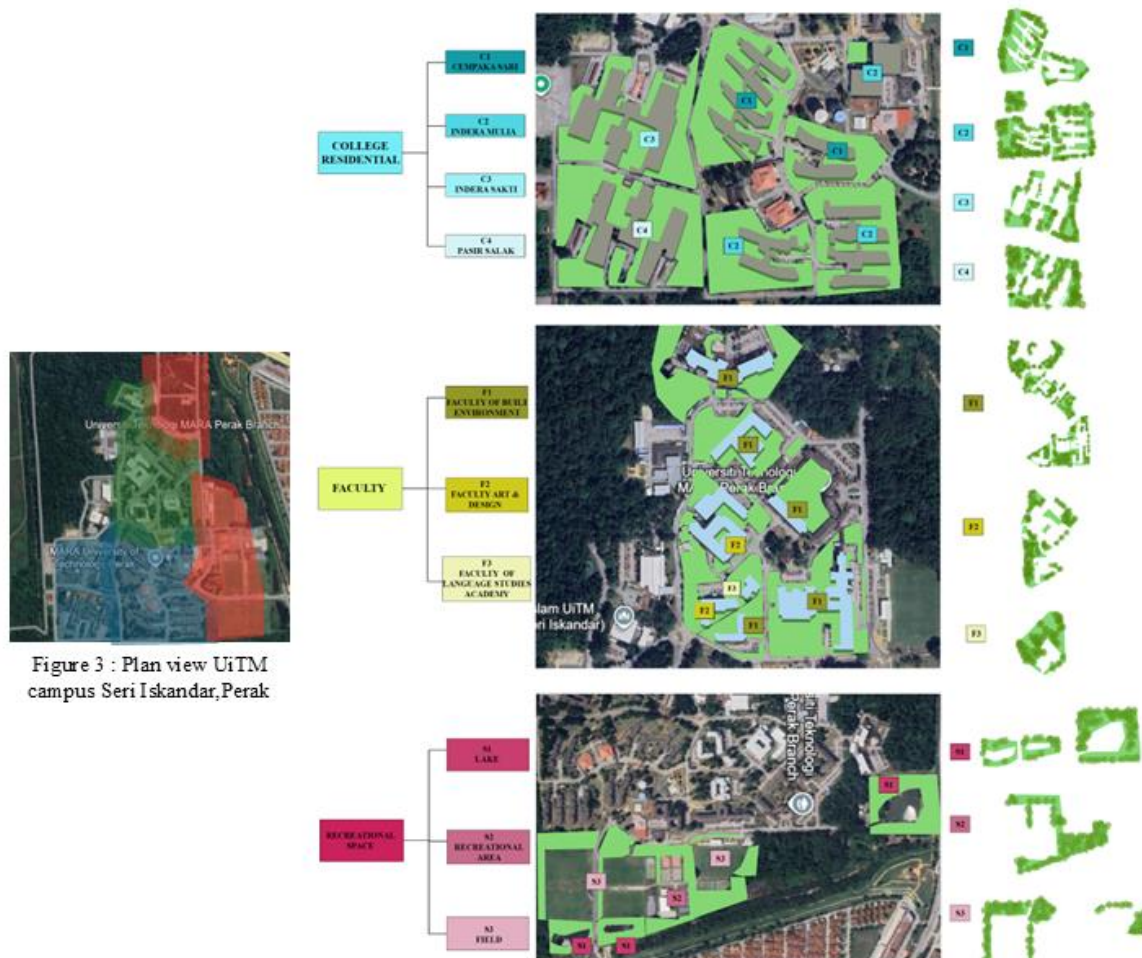


Figure 3 : Plan view UiTM campus Seri Iskandar, Perak

Figure 4 : The division in each selected space and its plant coverage for each green space at UiTM Seri Iskandar, Perak.

Adapted from : (Mca Idris et al., 2021)

The blue area is the college residential area, the red area is lake/recreational area, and the yellow area is the faculty area. The campus provides an ideal setting as students regularly interact with green spaces for learning, social, and recreational activities, making it possible to capture authentic emotional responses to plant attributes.

Respondents

The study population comprised undergraduate and postgraduate students enrolled at Universiti Teknologi MARA (UiTM) Seri Iskandar, Perak. Participants were engaged from three campus areas characterized by frequent student interaction with greenery which are the college residential area, faculties' green spaces, and the lake/recreational area. These locations were purposively selected to ensure regular exposure to the plant attributes under investigation. A convenience sampling strategy was employed, recruiting students who were accessible and willing to participate during the data collection period. This approach is widely used in campus-based environmental perception studies where probabilistic sampling is constrained by practical considerations (Memon et al., 2025). While convenience sampling may limit representativeness

and generalizability (Wild, 2022) , though, transparent reporting and contextual interpretation were used to mitigate these limitations. Eligibility criteria required respondents to be current UiTM Seri Iskandar students who regularly used or passed through the selected campus areas. The targeted sample size was 100–150 students, considered adequate for descriptive and inferential statistical analyses (Ali Memon et al., 2020). Participation was voluntary, informed consent was obtained prior to data collection, and respondent anonymity and confidentiality were maintained throughout the study.

Research Instrument

Site Observation

Systematic site observations were conducted to document existing plant attributes within the selected campus areas. A structured checklist was used to record key visual and sensory characteristics, including colour, plant shape, spatial arrangement, and shade provision. Observations were categorized based on visibility, sensory quality, and potential contributions to comfort and aesthetic experience. The observational data provided an objective baseline of landscape conditions and informed the development of the questionnaire items. Additionally, the study integrates strategies to ensure trustworthiness, including repeated observations and systematic documentation aligned with qualitative research criteria (Sterrantino, 2024; White & Ronfeldt, 2024; Ahmed, 2024).

Questionnaire Survey

A bilingual (Malay–English) questionnaire were conducted to assess students’ emotional responses and perceived restorative effects associated with the identified plant attributes. The instrument included four sections: (1) demographic characteristics; (2) emotional responses (e.g., calmness, relaxation, comfort, reduced mental fatigue) to specific plant attributes; (3) perceived restorative effects based on Attention Restoration Theory (Kaplan & Kaplan, 1989); and (4) optional open-ended feedback. Most items were measured using a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree), enabling quantitative analysis of emotional and restorative perceptions. Questionnaire surveys are widely applied in green-space research to capture standardized self-reported measures of psychological well-being (Jabbar M, 2022.; Xingrui et al., 2024) The survey was administered via an online platform to facilitate broad access to the student population. Prior to participation, respondents were provided with clear instructions and an informed consent statement outlining the purpose of the study and their rights as participants. The questionnaire was designed to require approximately 10–15 minutes to complete. Data collection was conducted over a period of three to four weeks to ensure adequate response rates and representation across faculties and years of study.

Data Analysis

Data quantitative from the questionnaire which focused on Likert-scale items measuring students’ emotional responses (e.g., calmness, relaxation, comfort, and reduced mental fatigue) and perceived restorative effects of plant attributes analyzed using descriptive statistics (mean, standard deviation, and frequency) and comparative analyses across different campus zones. All data were processed using statistical SPSS software. Qualitative analysis involved thematic coding of open-ended responses to capture

in-depth perceptions and experiences. The integrated findings were interpreted through the lens of Attention Restoration Theory (ART) (Kaplan, 1989), linking plant attributes to the restorative components of being away, extent, fascination, and compatibility to explain their influence on student emotional restoration.

ANALYSIS AND FINDINGS

Site Observation

Site observation was conducted at three selected locations within UiTM Seri Iskandar campus Lake/Recreational Area /Field, Faculty area and College Residential area. The analysis focuses on identifying the four key plant attributes colour, plant shape, spatial arrangement, shade and overall visual quality that exist in the campus landscape and interprets their potential contribution to restorative experiences based on Attention Restoration Theory (ART).



Figure 5 : Lake/Recreational Area



Figure 6 : Faculty Area



Figure 7 : College Residential

Table 1: Site observation on existing plant attributes at the selected area

Plant Attribute	Lake / Recreational Area	Faculty Area	College Residential Area
Colour	Dominated by multiple shades of green from mature trees and shrubs; limited flowering colour, but strong visual calmness and natural character.	Mainly green vegetation with minimal flowering plants; limited colour accents reduce visual stimulation along walkways.	Predominantly green with some flowering shrubs (e.g., <i>Tabebuia rosea</i> , <i>Ixora siamensis</i>) providing limited but pleasant colour highlights.
Plant Shape	Spreading and rounded mature canopy trees with broad leaves; dense foliage creates visual softness and enclosure.	Rounded canopy trees and low groundcovers; moderate variety of forms with some leafless trees affecting visual continuity.	Mix of spreading, rounded, and some upright forms; varied shapes contribute to visual interest within residential settings.
Spatial Arrangement	Informal, naturalistic arrangement with clear vertical layering (trees–shrubs–groundcovers); strong visual harmony and coherence.	Mostly formal planting and least informal planting following site contours; moderate layering and scattered pockets reduce spatial continuity.	Combination of formal planting near buildings and informal planting in open spaces; clear layering creates balanced composition.
Shade	Moderate to high canopy coverage, especially along paths and seating; effective shading provides strong thermal comfort.	Moderate and uneven shade; walkways partially shaded but open lawns remain exposed to heat	Moderate shade concentrated along pedestrian routes and near buildings; some open spaces remain exposed

Based on the site observation shown in Figures 5–7 and summarized in Table 1, clear differences in plant attributes are evident across the Lake/Recreational Area, Faculty Area, and College Residential Area. As illustrated in Figure 5, the Lake/Recreational Area is characterized by mature canopy trees, dense foliage,

and a naturalistic spatial arrangement, which contributes to strong visual calmness, enclosure, and effective shade provision. This area demonstrates the highest level of spatial coherence and thermal comfort, particularly along pathways and seating areas, as reflected in Table 1. In contrast, the Faculty Area shown in Figure 6 is dominated by predominantly green vegetation with limited flowering colour and a more formal planting layout. The spatial arrangement is less continuous, with scattered planting pockets and uneven shade distribution, resulting in exposed open lawns and reduced thermal comfort. Meanwhile, the College Residential Area in Figure 7 exhibits a balanced combination of formal and informal planting, with some flowering shrubs providing colour accents and varied plant shapes enhancing visual interest. However, as indicated in Table 1, shade in this area remains moderate and concentrated mainly along pedestrian routes, leaving some open spaces exposed. Overall, the site observation analysis indicates that the Lake/Recreational Area performs best in terms of natural spatial arrangement and shade, while the Faculty Area shows limitations in colour variation and shade continuity, and the College Residential Area offers moderate visual quality but uneven thermal comfort.

Based on table 1, it concludes that the lake/recreational area performs best in shade and spatial coherence, the college area provides moderate visual quality and comfort, while the faculty area lacks sufficient colour variation and continuous shade. Overall, uneven shade distribution is the main limitation across campus areas. These patterns align with previous studies indicating that coherent planting, sufficient shade, and visually engaging vegetation are key factors influencing comfort, stress recovery, and restorative experiences in campus landscapes (Gao et al., 2025; Syed Othman Thani & Salleh, 2024a; Xu et al., 2024a).

Questionnaire Analysis

SECTION A: RESPONDENT PROFILE

Respondents profile describes the demographic and academic background of the respondents. The analysis includes gender, age, faculty, year of study, level of education, and current residential area. A total of 75 participants were collected for this study. Most participants were female (81.3%), followed by male participants (18.7%), which is prominently reflective of the gender composition in built environment programs. Most participants were in the 21-25 years category (54.7%), followed by 18-20 years (42.7%), suggesting that this study captured a large composition of university-age students. A large portion of the respondents came from the Faculty of Built Environment (82.7%). About academic development, the percentage distribution indicates that most of the respondents were from the Year 3 group (52.0%), followed by the Year 2 group (25.3%), which means the majority had extensive experience with the campus environment. Most of the academic groups were taking the Degree (54.7%) course, followed by the Diploma course (41.3%). Regarding the living status of the respondent groups, almost half of the groups lived in college residences (46.7%). Others resided in rental houses (32.0%) or family homes (21.3%).

SECTION B: EXPERIENCE IN CAMPUS GREEN AREAS

To ensure the validity of student engagement with the green area, a few questions were conducted to evaluate students' experiences when interacting with campus green areas, focusing on frequency of use, comfort, calmness, enjoyment, and mental refreshment.

Table 2 : Experience In Campus Green Areas

QUESTION	EXPERIENCE IN CAMPUS GREEN AREAS				
	College	Faculty	Lake/Recreational Area /Field	Mean	Std. Deviation
I often pass through or spend time at these areas on campus	26 (34.7%)	42 (56.0%)	7 (9.3%)	1.75	.617
I feel comfortable being in these areas.	27 (36.0)	23 (30.7%)	25 (33.3%)	1.97	.838
The greenery in these areas makes me feel calmer.	10 (13.3%)	14 (18.7%)	51 (68.0%)	2.55	.722
I enjoy spending time in these areas when I need a break.	33 (44.0%)	11 (14.7%)	31 (41.3%)	1.97	.930
This area helps to refresh my mind.	9 (12.0%)	9 (12.0%)	57 (76.0%)	2.64	.690

Table 2 shows that the Faculty Area is the most frequently used space (56.0%), followed by the College Residential Area (34.7%), while the Lake/Recreational Area is less frequently accessed (9.3%), indicating that daily movement patterns are largely academic-oriented .Despite lower visitation frequency, the Lake/Recreational Area recorded the strongest emotional responses, with 68.0% of respondents reporting increased calmness and 76.0% indicating mental refreshment, suggesting higher perceived emotional benefits. In contrast, comfort levels were more evenly distributed across the three areas, reflecting moderate satisfaction with existing campus greenery. Students also reported enjoying spending time in green areas during breaks, particularly in the College and Lake areas, highlighting their role as supportive environments outside academic routines. Overall, the findings indicate that while faculty spaces dominate daily use, recreational green areas provide stronger emotional and psychological benefits.

The findings suggest that students' use of campus green spaces is largely shaped by academic routines rather than restorative preference, as frequently used areas do not necessarily provide the strongest emotional benefits. Recreational green spaces, although accessed less often, appear to offer greater opportunities for calmness and mental recovery, indicating that restorative quality is driven more by landscape characteristics than by frequency of exposure. This aligns with previous research showing that environments with stronger natural features, such as coherent planting, shade, and visual softness, are more effective in supporting emotional restoration and stress recovery (Gao et al., 2025; Xu et al., 2024) The results also highlight the importance of green spaces as transitional environments that support psychological recovery during breaks from academic activities, reinforcing the role of campus landscapes as everyday restorative settings rather than merely circulation spaces. Overall, the discussion supports the view that well-designed recreational green areas play a critical role in promoting students' emotional well-being, even if they are not part of daily movement patterns, consistent with Attention Restoration Theory and recent campus landscape studies (Syed Othman Thani & Salleh, 2024).

SECTION C: PLANT ATTRIBUTES IN CAMPUS AREA

This section examines students' perceptions of plant attributes across three campus settings: college areas, faculty areas, and lake/recreational areas. The analysis is divided into four sub-sections: plant colour, shade, spatial arrangement, and plant shape.

Table 3: Plant Attributes in Campus Area

Plant Attribute	Lake / Recreational Area / Field	Faculty Area	College Residential Area
Colour	4.40	3.96	4.08
Plant Shape	4.24	4.09	4.12
Spatial Arrangement	4.03	3.87	3.88
Shade	4.11	3.77	3.69

From table 3, plant color and plant shape recorded the highest mean values for all three campus areas, demonstrating that these variables are the most positively perceived. Additionally, the Lake/Recreational Area recorded the highest scores, particularly for plant shape with a mean score of 4.24, plant color with a mean score of 4.40, demonstrating that these campus areas are attractive and relaxing. However, for the Faculty Area, there was moderate performance, with plant shape having the highest score with a mean value of 4.09, while shade recorded the lowest score with a mean value of 3.77, an indicator that there is inadequate thermal comfort in these areas. However, in the College Residential Area, plant shapes with a mean score of 4.12 and plant color with a mean score of 4.08 record high scores, while shade recorded the lowest score with a mean score of 3.69. Generally, while strongly contributing towards perception, shade is the least contributing factor towards all campus areas, an aspect that needs improvement in these campus areas.

The findings show that students' perceptions of plant attributes vary across campus areas and help explain how existing landscape characteristics influence emotional response. The consistently high mean values for plant colour and plant shape across all areas indicate that students are particularly responsive to green tones, flowering elements, and varied plant forms, supporting Objective 2 and aligning with studies showing that visually engaging vegetation enhances emotional comfort and restorative perception (Gao et al., 2025; Xu et al., 2024). These results also fulfil Objective 1, as they reflect the presence of these attributes on campus and correspond with site observations that identified visible colour variation and diverse plant forms. The Lake/Recreational Area recorded the highest scores, particularly for spatial arrangement, which can be attributed to its naturalistic, informal planting layout that resembles forest-like environments, a setting widely shown to promote stress reduction and comfort (Rachel Kaplan, 1989; Rita Berto, 2005; Ulrich et al., 1991). In contrast, the Faculty Area recorded lower mean values for spatial arrangement and shade, likely due to its formal, linear planting design that reflects a structured academic environment, as research suggests people generally prefer less rigid and more natural or visually complex landscapes over highly formal designs (Zhang et al., 2023). The College Residential Area showed moderate to high scores for colour and plant shape but lower scores for shade, which may be explained by exposed open spaces observed on site, as insufficient shade has been shown to reduce outdoor comfort in warm climates (Syed Othman Thani & Salleh, 2024). Overall, the findings indicate that students' perceptions of plant attributes are strongly shaped by the function and design character of each area, with naturalistic planting arrangements generating stronger positive emotional responses than formal layouts.

SECTION D: RESTORATIVE EMOTIONAL EFFECTS (ART FRAMEWORK)

Section D assesses the restorative emotional effects of campus green spaces based on Attention Restoration Theory (ART), encompassing the dimensions of Being Away, Fascination, Extent, and Compatibility as influenced by plant attributes.

Table 4 : Restorative emotional effects of campus green spaces based on ART dimensions

QUESTION	RESTORATIVE EMOTIONAL EFFECTS (ART)						
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Std. Deviation
BEING AWAY							
I feel relaxed and away from daily worries when I am in shaded areas with many plants.	0 (0 %)	0 (0 %)	4 (5.3%)	27 (36.0%)	44 (58.7%)	4.53	.600
I feel closer to nature in areas with tall trees, bushes, and ground plants.	0 (0 %)	0 (0 %)	6 (8.0 %)	25 (33.3%)	44 (58.7%)	4.51	.645
FASCINATION							
Colorful flowers and plants make me feel happy and interested.	0 (0 %)	1 (1.3%)	4 (5.3%)	27 (36.0%)	43 (57.3%)	4.49	.665
The shapes and forms of the plants (rounded, tall, drooping) naturally draw my interest.	0 (0 %)	1 (1.3%)	13 (17.3%)	25 (33.3%)	36 (48.0%)	4.28	.798
EXTENT							
The plant arrangement on campus feels coherent and connected.	3 (4.0%)	6 (8.0%)	25 (33.3%)	25 (33.3%)	16 (21.3%)	3.60	1.040
I enjoy being around areas with many different types of plants.	0 (0 %)	1 (1.3%)	11 (14.7%)	23 (30.7%)	40 (53.3%)	4.36	.782
COMPATIBILITY							
Shaded areas are suitable for resting, walking, or studying.	0 (0 %)	1 (1.3%)	6 (8.0%)	24 (32.0%)	44 (58.7%)	4.48	.702
The way plants are placed makes it easy and comfortable for me to do my activities.	0 (0 %)	1 (1.3%)	12 (16.0%)	30 (40.0%)	32 (42.7%)	4.24	.768

The findings show that campus green spaces provide strong restorative emotional effects across all ART dimensions. **Being Away recorded the highest mean scores (M = 4.51–4.53)**, indicating **that shaded, plant-rich areas help students relax and mentally disengage from academic stress**. Fascination and Compatibility also recorded high mean values (M = 4.24–4.49), showing that colourful plants, varied forms, and shaded spaces effectively support attention and daily activities. In contrast, Extent recorded the lowest mean score (M = 3.60), suggesting weaker perception of spatial coherence despite appreciation for plant diversity.

Although shade recorded comparatively lower mean scores in Section C, this reflects its uneven distribution and limited availability rather than a lack of importance. In the ART analysis, shaded areas still play a critical role in supporting the Being Away and Compatibility components by enabling students to rest, walk, and study comfortably, which is consistent with studies showing that shaded green spaces enhance perceived comfort and restorative potential in campus environments (Syed Othman Thani & Salleh, 2024; Xu et al., 2024) This indicates that while shade strongly contributes to restorative experiences when present, its current provision is insufficient to consistently support emotional restoration across campus spaces. Similar research has highlighted shade as a key functional landscape element in tropical settings, where inadequate canopy coverage limits prolonged outdoor use despite positive visual qualities (Gao et al., 2025)

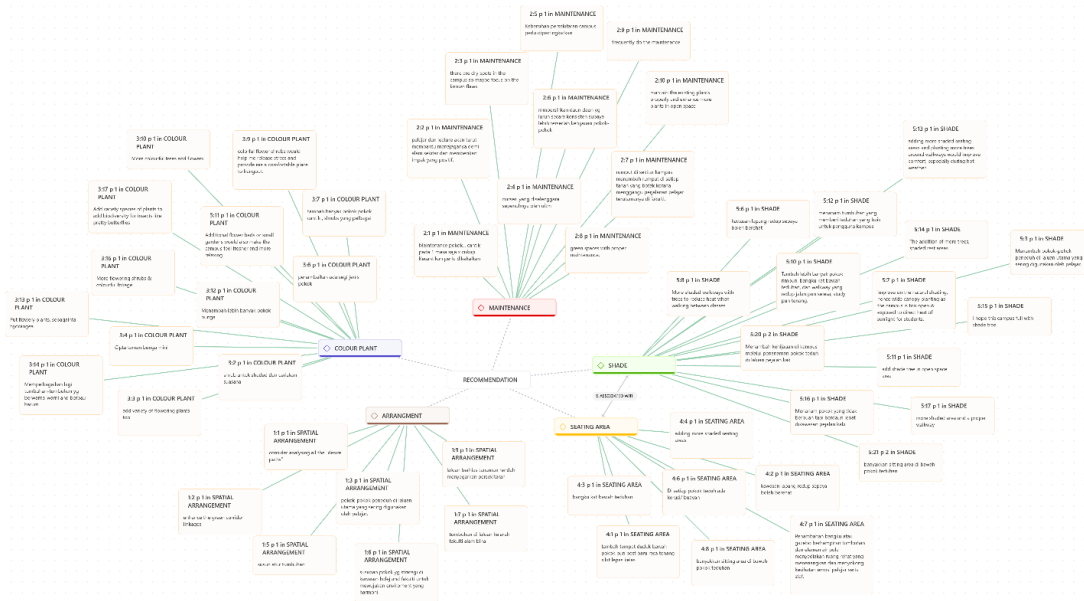


Figure 8 : Recommendation from student perception (Open-ended question)

The ATLAS.ti analysis of figure 8 indicates that shade is the most dominant recommendation theme, followed by plant colour, seating area, spatial arrangement, and maintenance, reflecting students' priority for functional comfort over purely visual quality. The strong clustering of codes around shade that students experience insufficient thermal comfort across campus, despite recognizing the emotional benefits of greenery. Recommendations related to plant colour focus on flowering trees, colourful shrubs, and visual enhancement, reinforcing earlier findings that colour contributes to positive mood and fascination. Suggestions on spatial arrangement emphasise more naturalistic, less rigid planting layouts and improved green corridors, indicating a preference for environments that feel more immersive and nature-like. The repeated linkage between seating and shade highlights the need for usable outdoor spaces that support resting, studying, and social interaction. Finally, maintenance emerges as a supporting theme, indicating that students perceive plant health, cleanliness, and upkeep as essential to sustaining comfort and restorative value. Overall, the recommendation data show that students prioritise practical, restorative landscape qualities especially shade and usability over aesthetics alone.

The recommendation patterns strongly reinforce the earlier quantitative findings and align closely with Attention Restoration Theory (ART). Although previous data showed that plant colour and plant shape recorded higher mean values, the dominance of shade in students' recommendations indicates that functional comfort is a more urgent unmet need than visual quality. This supports ART's Being Away and Compatibility components, where shaded environments allow users to rest, walk, and study comfortably, especially in hot climates, thereby supporting mental recovery (Hartig et al., 2001; Rachel Kaplan, 1989). The emphasis on plant colour and flowering vegetation corresponds with earlier Section C results and supports the Fascination component of ART, as visually engaging natural elements attract attention effortlessly and improve mood (Elliot & Maier, 2014; Xu et al., 2024a). Students' preference for naturalistic spatial arrangements aligns with both site observation and prior findings that informal, nature-like landscapes enhance immersion and restorative perception more effectively than rigid or formal designs, supporting the Extent component of ART (Zhang et al., 2023). The strong linkage between seating and shade further reflects the need for environments

that are not only visually pleasing but also usable for prolonged activities, reinforcing Compatibility. The recommendation analysis reveals that shade and usability are the key factors limiting restorative experiences, confirming that effective campus landscapes must balance aesthetic qualities with functional and ART-supportive design.

CONCLUSION

This study aims to investigate how certain plant attributes influence emotional recovery responses among university students based on Attention Recovery Theory (ART) namely fascination, extent, compatibility and being away, which provides a strong theoretical framework to explain emotional recovery in campus landscapes. Focusing on plant color, plant shape, spatial arrangement and shade, this study not only assesses green space but also explores design-relevant variables. The mixed methods approach used allows for a more comprehensive understanding by linking the physical conditions of the campus landscape with students' emotional perceptions. The findings showed that plant color and plant shape recorded the highest mean scores, indicating that students responded positively to visual elements such as green color, flowering plants, and a variety of plant shapes that created an attractive and calming atmosphere. Although the shade score was lower than the visual attributes, restorative emotion analysis based on Attention Restoration Theory (ART) showed that shade played the most important role in supporting students' sense of comfort, calmness, and mental recovery. The Lake/Recreation area showed the highest restorative potential due to its more natural plant layout and continuity of shade, while the faculty area recorded a more moderate performance due to its more formal landscape design and uneven shade. Student suggestions through open-ended questions emphasized the need for additional shade trees, covered seating areas, a variety of plant colors, a more natural layout, and consistent landscape maintenance. Overall, this study demonstrates that the combination of visual quality and functional comfort is essential for creating a campus environment that is restorative and supports students' emotional well-being. Further research is recommended to involve larger samples, additional measurement methods, and other theoretical perspectives to improve the accuracy of future study findings.

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