



# Planting Design Expression on Students Perceiving Campus Landscape Quality

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**Abstract:** Planting design plays a vital role in evaluating and enhancing landscapes by deliberately arranging and selecting plants within a given area. It encompasses various elements, including plant types, arrangement, density, colour, texture, and composition, all contributing to the visual appeal and aesthetics of green spaces, creating harmonious and visually pleasing environments. Beyond environmental sustainability, planting design also holds significance in promoting aesthetical value for certain spaces. This study focuses on exploring how different planting design approaches impact the students' expression when perceiving quality of campus green spaces. The objectives are to identify preferences for planting design scenes and investigate the influencing criteria. A Likert-scale questionnaire utilizing 51 planting images from Universiti Putra Malaysia is employed to collect data. The gathered preferences are analysed using IBM SPSS Statistics 23 to determine significant criteria and expression on preferences. The findings emphasize students' preferences for coherent and balance plant arrangements, naturalness with moderate density and maintenance. The implications of this study will aid campus designers in developing future landscape designs that incorporate preferred planting design characteristics.

**Keywords:** Planting design, campus, expression, preferences, composition

## 1. Introduction

The attribute of planting design holds great significance in attracting and influencing the visual quality of specific environments. Scholarly research has confirmed that certain attributes of landscape planting, such as openness (Wang, Rodiek, Wu, Chen, & Li, 2016; Wartmann et al., 2021), colour contrast (Polat & Akay, 2015), naturalness (Gungor & Polat, 2018; Wang & Zhao, 2017), and species richness (Southon et al., 2018), play a significant role in assessing landscape quality through visual perception. Substantial evidence suggests that interacting with plants contributes to improved emotional states and cognitive performance (Van Den Bogerd, Coosje Dijkstra, Seidell, & Maas, 2018), making it reasonable to predict that university students would benefit from well-designed planting in the campus

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environment. The campus landscape serves a specific purpose for students and influences their utilization of green spaces.

Extensive studies have explored the benefits associated with connecting to plants, including stress reduction, improved health and well-being, and increased awareness (Hanan, 2013; Li & Sullivan, 2016; Miller, 2014; Stepan et al., 2014). Scholars have also found positive impacts on behaviour (Benfield et al., 2015; Hussein, 2017) as well as enhanced social, economic, and aesthetic aspects of a place (Miller, 2014). The visibility of planting spaces also influences their utilization rates (Stepan et al., 2014). Understanding what types of planting spaces can attract users to utilize them becomes essential. Hence, conducting a preference study on outdoor spaces, specifically on campus, is vital to determine the desired quality of planting spaces.

## 2. Planting Design Attributes Affecting Preference and Expression

The aesthetic value of landscape planting is often perceived by people, and it should not only serve ecological functions but also cater to people's preferences (Du, Jiang, Song, Zhan, & Bao, 2016). However, landscape designers often struggle to understand the planting design preferences of different users and determine which plant attributes contribute to high landscape quality (Du et al., 2016). Several studies have shown that the physical characteristics of plants, such as colour, shape, scale, and texture, can influence people's preferences (Rachel Kaplan & Kaplan, 1989; Polat & Akay, 2015; Ulrich, 1986; Yilmaz et al., 2018). Colour plays a significant role in visual expression, and although colourful leaves exist, colour in plants is usually associated with flowers. Research by Hoyle and colleagues found that people appreciate colourful flowering plants for their visual impact, but green plants are highly valued when outside the flowering season (Hoyle et al., 2017). This suggests that green plants also contribute to people's perception of visual landscape quality.

The shape of trees is also primary importance because it has a significant and immediate impact on visual impressions as the trees mature. Trees come in various forms, including vase-shaped, columnar, pyramidal, conical, rounded, oval, pendulous, spreading, or weeping (Leszczynski, 1999). These forms range from solitary plants to clustered masses, and they convey expressive qualities. For example, a cluster of weeping willows evokes a sense of water and graceful movement, while ferns represent lushness and moisture. Linear rows of tall palms create a formal atmosphere. The architectural forms of plants can provide viewers with clues about the geographical location. Additionally, plant forms are preferred due to the amount of shade they provide. The shape and dimensions of leaves affect the level of shading and, consequently, the temperature reduction (Hami et al., 2019). Heerwagen and Orians' analysis (1993), cited in Lothian (2012), found that the most attractive trees had canopies with moderate to high layering, lower trunks, and a higher canopy width-to-tree height ratio.

Size or scale and proportion are additional important properties of plants. Robinson (2004) demonstrated the significance of considering plant size in relation to human dimensions when designing spaces for people. The size factor is typically associated with the mature form of the plant. To achieve balance in planting design, plants with similar forms and textures should exhibit a continuous hierarchical gradation and repetition. Coherence can be achieved through the repetition of identical sizes. For instance, a row of palms combined with low hedges creates a distinct transitional line that meets proportionate needs. Research has shown that people generally prefer well-maintained, tidy landscapes (Hoyle et al., 2017). Varying sizes can also create a rhythmic space, with small trees intermingling with larger trees and shrubs blending with groundcovers. This combination can result in a dynamic composition that breaks the monotony of landscape planting (Leszczynski, 1999).

Texture contrast, such as the leaves or bark of a tree, enhances aesthetic appreciation. When observing plants in a scene, individuals visually analyse their texture. Plant texture refers to the visual and tactile qualities of plants, primarily influenced by foliage size. Plants may have a fine texture with many small leaves or a coarse texture with large leaves (Booth & Hiss, 2012). Foliage shape, growth habit, and the distance from which a plant is viewed also impact its texture. Pointed leaves create a sharp texture, round leaves produce a neutral texture, and small needle-like foliage creates a fine texture. Foliage texture has a longer-lasting visual impact compared to flowers or fruits. Contrasting foliage textures add visual interest and help distinguish between different plant types. Without contrast in foliage texture, a plant composition can become monotonous and lack excitement (Booth & Hiss, 2012).

### 2.1 Planting Density

The density of foliage and the number of trees or bushes can have both positive and negative influences on visual preference. Research by Ulrich (1986) suggests that dense foliage and a high density of trees or bushes tend to have a negative impact on visual preference, while low density has a positive influence. In a study on plant density and stress reduction, Jiang, Chang, and Sullivan (2014) found that moderate tree cover density resulted in greater stress reduction compared to both low and high levels of tree cover density. Similarly, Du et al. (2016) acknowledged that higher planting density does not always lead to higher landscape preference. The preference for density depends on the specific type of landscape being studied. Their research on visual quality of plant density in urban green spaces revealed that in some spaces, high density was preferred, possibly due to the presence of abrupt architectural corners. However, it is recommended to maintain a slightly open planting density to provide a proper perspective landscape for

visitors and a better field of vision for drivers. Excessive density is not recommended in terms of security and visual appearance. Another previous study suggests that humans may prefer openness in addition to greenness. Wang, et al., (2016) conducted a study comparing scenes with green lawns (nature-based) and plaza scenes (hardscape) that had similar degrees of openness. They found that the green lawn scene was more effective in stress reduction than the plaza scene. Places with moderate tree cover may be more preferred for recreational activities compared to landscapes with dense tree cover. It is possible that the mechanisms through which green landscapes mitigate stress vary for different types of places (Du et al., 2016). Therefore, future research should focus on replicating this study in various settings where people typically spend time, such as schools, campuses, workplaces, and urban streets, to determine if there are different results based on different settings and tree cover densities (Jiang et al., 2014).

## 2.2 Planting Arrangement

Preferences for trees are also influenced by their placement, selection, and maintenance. The positioning of trees in a space can create various spatial definitions. Single trees planted in parks and yards grow differently compared to trees in a forest setting. According to Booth and Hiss (1991), the placement of trees can establish different organizing geometries, such as straight lines, angled arrangements, soft curved lines, or clusters. Kaplan and Talbot (1988) found that urban dwellers highly value a sense of order in natural settings. They generally showed less preference for outdoor urban settings with dense vegetation. However, the same participants responded positively to scenes with a high complexity of trees when the trees were widely spaced and the scenes offered greater visibility and openness. In contrast, Kuo et al. (1998) discovered that tree placement had little effect on the sense of safety and no effect on preference. Surprisingly, tree density and grass maintenance increased both preference and the sense of safety.

Complexity is a crucial aspect of visual character expression and has been used to explain landscape preference. It refers to the richness and diversity of visual formations perceived by people, serving as a measure of how much visual interest and elements there are to observe in a particular scenario (Shen, 2023). Kuper (2017) suggested that complexity and coherence, which have been explored as potential predictors of landscape preference, are closely related concepts in planting arrangements.

## 2.3 Planting Naturalness

The naturalness of a planting scene is an important factor to consider when assessing landscape quality. Perceptions of naturalness are primarily influenced by the quantity and type of vegetation present (Chen et al., 2020). The level of naturalness can impact the visual beauty of a landscape, and most people appreciate a sense of normal nature and complexity in the landscape (Hami & Abdi, 2019). Natural landscapes, which grow organically, are perceived to have positive effects on stress reduction (Hartig et al., 1991). They are also considered more scenic than man-made landscapes (Zube et al., 1974). The presence of natural elements enhances the perceived quality of a non-natural scene, whereas the presence of man-made elements diminishes the perceived quality of a natural scene (Real et al., 2000). Interestingly, even labelling a natural landscape as if it were man-made, such as referring to a palm oil plantation as a 'forest,' significantly decreases the perceived scenic quality. Bulut and Yilmaz (2008) utilized the measurement of naturalness in their landscape photograph survey to assess public preferences and expressions. Considering naturalness and the emotional connection to the environment can be important criteria for evaluating landscape aesthetics (Daniel, 2001).

## 2.4 Relationship Between Visual Landscape Quality and Planting Expression

The relationship between visual quality and planting expression is significant to determine the aesthetic quality preferred on landscape planting. One study by Yilmaz et al. (2018) has examined that planting design provides a visual analysis of aesthetics for park and green areas which impact on human preference. Recent evidence also suggests that the composition between trees and grasses also should be included in landscape preferences study (Hami & Abdi, 2019) to identify the people expression. The quality of landscape planting preferred, as well as how the preferred settings affect students' expression, were assessed in this study utilising planting design photographs to evaluate preferences. Since plants have very important visual role in landscape planting design, the findings by Rašković & Decker (2015) and Yilmaz et al. (2018) studies, showed that when plants are combined with some principles, visual profiles with a high level of formal aesthetics can be established. Yilmaz et al. (2018) further points out that planting design affect not only people's aesthetic quality, but also the aesthetic quality of entire landscapes. Other characteristics such as arrangement, naturalness and diversity also the most important planting design attributes of the increasing visual quality (Gungor & Polat, 2018) and expressing the feeling towards planting scenes.

The relationship of visual landscape quality and planting design also been studied by (Jiang, Larsen, Deal, & Sullivan, 2015; Suppakittpaisarn et al., 2019). Both studies measured the density of planting composition in determine people preference. The relationship found in their studies, overall vegetation density and preference is consistent with findings that tree density and preference are positively and linearly related. Suppakittpaisarn et al. (2019) also found that preference for landscapes with green infrastructure result for the greater vegetation density lead higher the

preference rating. Compared to finding by Du et al. (2016), which they stated higher planting density does not always bring higher landscape preference. The actual effect depends on the type of landscape.

Another study done by Liu & Schroth (2019) relate that planting design to create enclosed and opened green spaces. They noted that visual enclosure and openness is measured by Kaplan and Kaplan preference variables; evaluations of coherence (pleasantness of the views), complexity (functional setting), and legibility (orientation) are also helpful at the planting design stage. Therefore, there is strongly believed that the relationship of visual landscape quality and planting design will have significant relationship and expression towards preferable planting design scene on campus.

### 3. Methodology

The objective of this paper is to investigate the preferred planting design spaces within the campus green areas. Identifying the most preferred planting design scenes will provide valuable insights for campus administrators to strategically plan and enhance their green spaces in the future. To analyse the preference of planting scenery, a psychophysical paradigm was employed, combining physical evaluations of campus planting design with perception-based methods relying on student ratings to assess well-being (Polat & Akay, 2015).

This study involved 292 undergraduate students from University Putra Malaysia (UPM), which was selected as the study location due to its abundant green space availability. UPM consistently ranks as one of the top universities in Malaysia, with a strong emphasis on providing green spaces, as indicated by its participation in the UI Greenmetric rankings. A photo-based questionnaire survey was conducted, utilizing 51 planting design images representing various faculties within UPM. The survey employed a five-point Likert-scale format to capture preference ratings (Gerstenberg & Hofmann, 2016; Polat & Akay, 2015).

During the face-to-face survey, participants were instructed to focus specifically on the landscape planting scenes depicted in the images. After rating all the images, participants were asked to select their most preferred or liked planting design image and provide reasons for their selection. This section aimed to identify the key criteria associated with students' preferences and their expression towards planting sceneries. The data collected were analysed using IBM SPSS Statistics 23 to interpret the findings, which will contribute valuable insights into the characteristics of preferred planting design. Ultimately, these findings can inform strategic campus landscape planning for sustainable design in the future.

### 4. Result and Discussion

The participants were instructed to rank the planting design scenes on a scale from strongly like to strongly dislike. After rating all the scenes, they were asked to select the most liked planting design images and the most dislike planting design images from the overall set and provide a reason for their choice. The frequency of scores for the both, mostly liked and mostly dislike planting design scenes was calculated, and the preference scores, along with the corresponding highest frequency values, are presented in Figure 1. Upon examining Figure 1, it is evident that planting scene 47 received the highest score, with 45 participants selecting it as the most preferable scene for the faculty green spaces. However, planting scene 25 received the highest dislike preference with 43 participants rated it as unfavourable planting scene.

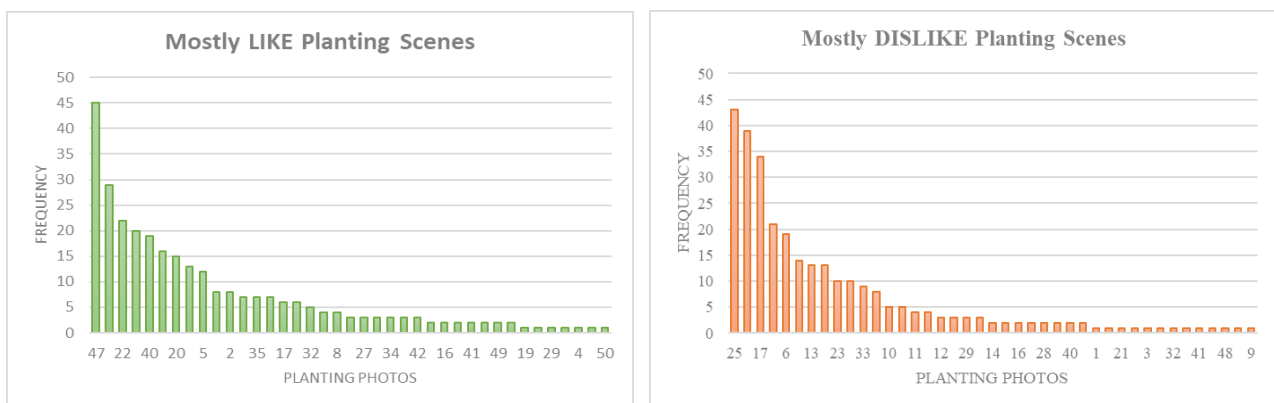
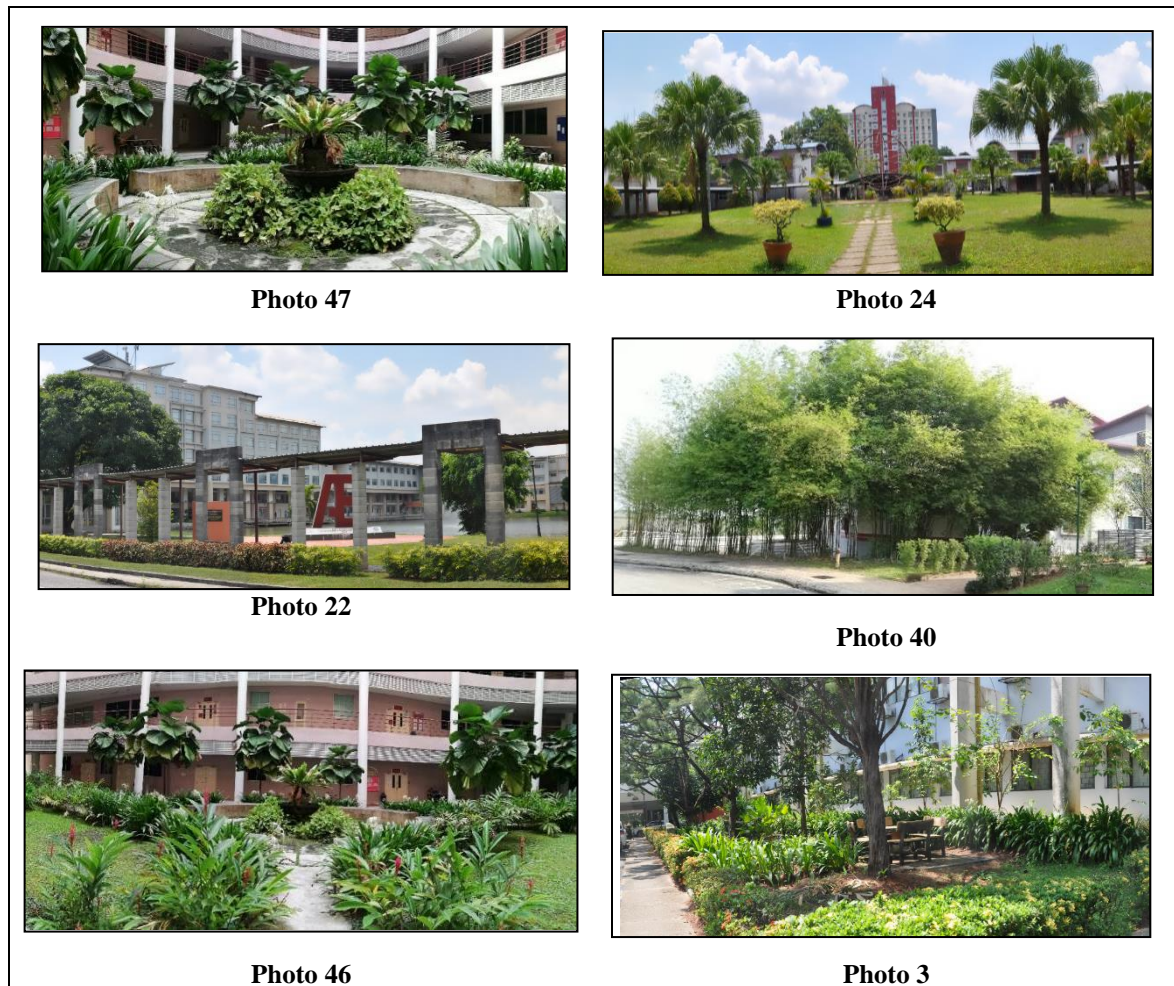


Fig. 1 - Preference results for mostly like and mostly dislike planting photos

Planting scene 47 (refer to Figure 2) demonstrated a diverse array of plants, including *Licuala grandis* with its broad palmate leaves, a mixture of shrubs and groundcover such as *Hymenocallis speciosa*, *Asplenium nidus*, and *Ipomea batatas* at the surrounding. The high preference for this landscape planting scene may be attributed to several factors, including the density of leaf structures, the orderly arrangement of solitary palm trunks surrounding the courtyard, and the distinctive shape of the plants compared to others. The combination of shrubs and palms enhances

the aesthetic appeal, creating a visually pleasing display of various shapes, forms, and textures. These characteristics of the planting design align with the reasons provided by participants for selecting this image. For instance, participants mentioned the uniqueness of the plant forms, the vibrant and fresh appearance, the balanced arrangement, the harmonious combination of plant species, and the well-maintained and structured plants.

On the contrary, images such as photo 24, 22, 40, 46, and 3 have also received high scores as the most preferred planting design scenes. The stated reasons for selecting these images include the sense of openness, cleanliness, greenery, freshness, aesthetic appeal, absence of overcrowding, vivid and clear views, natural harmony, simplicity, uniformity, balance, well-arranged elements, pleasing texture, density, variety of plants, good combination, and a tropical ambiance. Despite the variety of reasons given, these photos exhibit similar preference characteristics. Visually, these photographs demonstrate clear pathways and clean ground, highlighting the importance of legibility in the planting design of campus green spaces. Additionally, the researchers believe that coherence contributes to the increased rating preferences of these images. This observation is supported by the consistently divided arrangement of planting spaces in all the photographs, which enhances a sense of cohesion. Furthermore, participants consistently mention that balance and arrangement are the reasons for choosing these images.



**Fig. 2 - The photographs of most like planting design scenes**

Meanwhile, In Figure 3, the planting scenes 25, 6, and 23 show extensively pruned shrubs that have been shaped into geometric forms. Some respondents expressed their dislike for these heavily pruned plants as they felt it distorted the original characteristics of the plants. In planting design, scale and proportion are critical principles that should be considered. Photos 17 and 33 appear to be disproportionate to the buildings. In Photo 33, the palm species seem lighter in comparison to the prominent building, resulting in building dominance. On the other hand, Photo 17 exhibits tree dominance as the mature tree crowns cover the entire building in the scene. While the trees provide ample shade, it can be argued that high density has a negative impact on visual preferences (Du et al., 2016).

Planting arrangement plays a significant role in visual landscape assessment. Improper organization can lead to scenes becoming monotonous or confusing. Photo 13 depicts a variety of plant species arranged in a dispersed configuration. Unorganized planting was also criticized for appearing cluttered and messy.

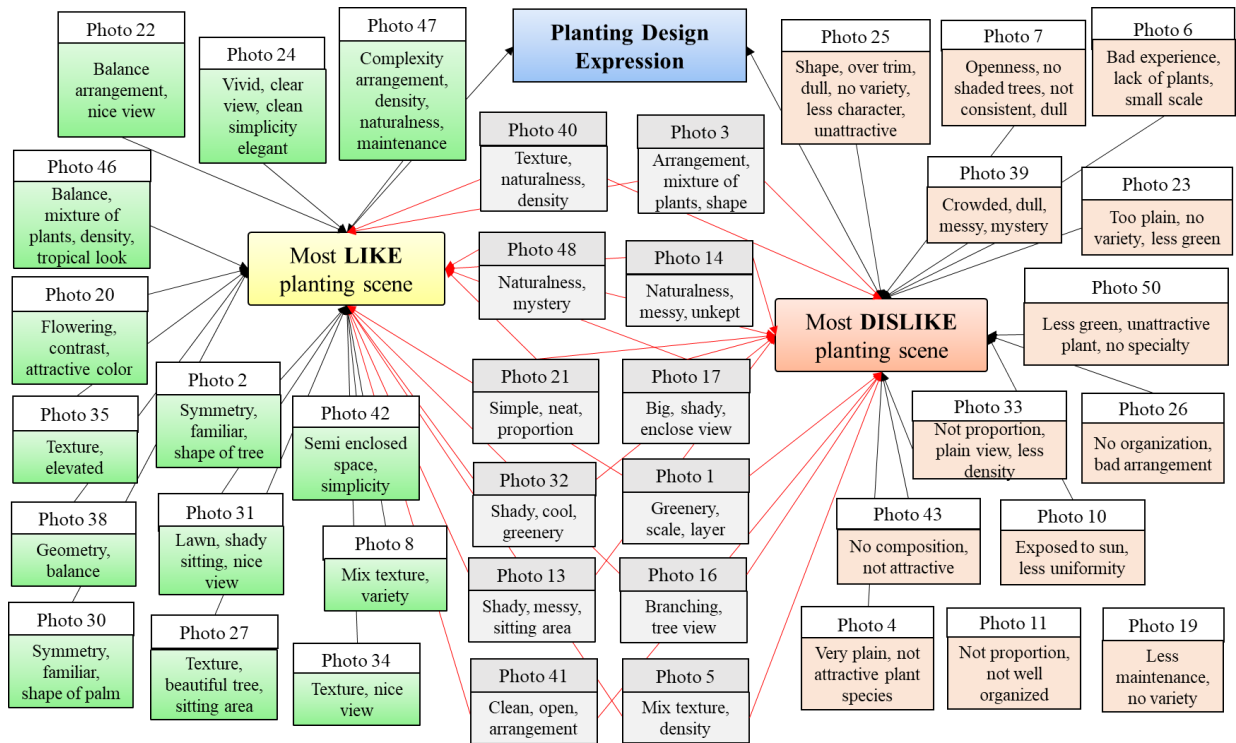


**Fig. 3 - The photographs of most dislike planting design scenes**

The low preference for these landscape planting scenes can be attributed to various factors, including a lack of complexity, unappealing plant species, and potentially the scale of plants in the scenery. The presence of few to no trees leads to the least preferred landscape planting scenes. Boredom may arise from unattractive plant species and a lack of intricacy. Furthermore, incorrect scaling of structures and vegetation creates imbalance and an inability to harmonize with the green space.

The expressions of students regarding their views and feelings when rating the most liked and disliked planting scenes reveal that the arrangement of planting design is of utmost importance, followed by naturalness, density, and visual properties of plants such as texture, colour, form, and scale. Figure 4 displays several photographs that were responded to by students. The most liked planting scenes were mostly mentioned to have symmetrical balance in planting arrangement and a mixture of plant species with diverse forms and textures, which were the main reasons for the students' selection. Naturalness was also a preferred characteristic, influencing the complexity and level of density in the landscape spaces.

In contrast, the expressions for the most disliked planting images were more focused on aesthetic appeal, composition and arrangement, lack of vegetation, and maintenance aspects. Students mostly preferred cohesive designs that exhibited vibrancy while also providing shade and a cool environment. The choice of plant species influenced the aesthetic value of a particular space. However, without proper maintenance, a well-designed planting arrangement can quickly deteriorate. Therefore, maintenance is a vital aspect in preserving visual quality. Additionally, some planting images received mixed ratings (red link in Figure 4), indicating that some students liked the scenes while others did not. This situation may be attributed to the maintenance aspect, which can make the surroundings appear unkempt despite an attractive design. Moreover, background knowledge and familiarity with planting can influence students' expressions toward the planting scenes. It is important to note that conducting preference studies can be challenging for researchers due to variations in demographic profiles and surrounding factors, which can lead to differing results.



**Fig. 4 - The expression towards most like and most dislike planting scene on campus**

## 5. Conclusions

While this research and its findings may not provide a comprehensive solution to all university-related challenges, it does offer a valuable strategy for designing the campus landscape in the right direction. Previous studies on campus landscapes have already highlighted the significance of green spaces in outdoor campus areas. However, this study goes a step further by presenting evidence of the most preferred criteria for planting design in campus landscapes and vice versa. The arrangement of planting design including enhanced balance and coherence patterns in campus green space. These findings have the potential to inspire necessary changes in similar areas.

By incorporating the identified planting design criteria and implementing improved arrangement patterns, universities can take a significant step towards planning sustainable and visually appealing campus landscapes. These landscapes have the potential to promote well-being and engagement among students, faculty, and staff, while also contributing to environmental sustainability and reflecting the campus's commitment to a greener and more aesthetically pleasing environment.

In summary, this research serves as a valuable guide for future landscape planning, emphasizing the significance of incorporating green spaces and proper planting design criteria in university campuses. By applying these findings, universities can create vibrant and sustainable campus environments that positively influence the well-being and satisfaction of the campus community.

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