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Landscape Design for Educational Campuses: The Case of Bakrajo Technical Institute

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ABSTRACT

This study investigates the landscape design at Bakrajo Technical Institute by surveying key stakeholders, including administrative staff, academic staff, and students, to understand their preferences and perceptions. The survey carefully designed and validated by multidisciplinary experts, collected 100 responses that were statistically analyzed to ensure significance.

The results highlight a clear demand for increasing green spaces, shaded and comfortable seating areas, improved lighting, accessible walkways, and clear directional signage. Most respondents (72%) emphasized the importance of incorporating sustainable environmental elements into the design. Accessibility for people with disabilities was also strongly prioritized by 85% of participants.

User preferences showed a strong inclination toward natural and environmental landscape styles (60%) and modern designs (50%), with a notable demand for flowering plants, shade trees, and drought-resistant species. The majority of users frequently visit the institute's outdoor areas, using them primarily for walking, social interaction, studying, and gatherings.

Key shortcomings identified include inadequate wayfinding, insufficient facilities, and a lack of inclusive design features. Participants expressed a need for multifunctional outdoor spaces that support social, academic, and physical activities. The findings suggest adopting a holistic design approach that integrates aesthetic, social, and ecological considerations, actively involving users to ensure the landscape meets their diverse needs.

Overall, the study underlines the vital role of landscape design in enhancing psychological comfort, promoting active campus life, and fostering a sustainable, inclusive educational environment.

Keywords: Landscape Design, Educational Spaces, Outdoor Learning Environments, Green Infrastructure, Environmental Enhancement, Campus Planning, Student Wellbeing, Ecological Design.

1 INTRODUCTION

Bakrajo Technical Institute is situated in the Bakrajo district, a rapidly developing suburban area southwest of Sulaymaniyah city in the Kurdistan Region of Iraq. The institute was established to meet the growing demand for vocational and technical education in the region. As part of the Sulaymaniyah Polytechnic University system, it produces skilled professionals in various technical fields. Despite its educational significance, the campus landscape has not kept pace with environmental and functional needs, prompting growing attention to the quality of its outdoor spaces. This makes the site an ideal subject for research focused on sustainable and user-centred landscape design in educational contexts.

Educational institutions are increasingly expected to create well-designed outdoor environments that promote student well-being. These open spaces serve not only to improve campus aesthetics but also to foster social interaction and informal learning. With growing attention to the environmental and visual quality of educational settings, landscape architecture has become essential in the design of these areas. This design aims to evaluate user satisfaction, identify

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areas for improvement, and explore future preferences, particularly in terms of environmental considerations and design strategies. A key aspect of this study is its emphasis on practical needs in managing natural aesthetics, setting priorities for future upgrades, and incorporating user input in the design process to achieve meaningful, functional results. In this light, landscape design transcends visual appeal and becomes fundamental to academic engagement and community vitality [1]. Simultaneously, modern urban development faces challenges posed by rising populations, migration, cultural changes, and natural disasters, all of which intensify the need for housing and strain residential zones. Traffic congestion and air pollution significantly affect educational buildings, especially those in densely populated urban areas. Therefore, planning for educational infrastructure must consider its position within the broader city-wide green space system. High-quality outdoor environments in these areas are vital to counter the adverse effects on public health [2].

Given that students represent a life stage defined by energy, growth, and engagement, outdoor environments at educational institutions must be tailored to their needs. However, research concerning the design of these spaces has largely focused on fields like health sciences, medicine, and sports, often overlooking the landscape architecture perspective. Studies demonstrate that when students use their senses and interact with their surroundings, they integrate academic concepts, such as math, science, and grammar, more effectively [3]. Furthermore, school environments have been linked to improved creativity and social development [4]. Outdoor experiences are most effective when seamlessly integrated into the broader educational framework.

Educational activities inherently involve both indoor and outdoor elements. For many students, school gardens offer essential spaces for physical activity and play. Addressing these spaces is urgent, as sedentary lifestyles and obesity are increasingly common among university-aged populations [5]. To address this, environmental awareness should be fostered by incorporating natural elements into school design. However, current approaches to environmental education in school settings often lack real-world application and fail to use the outdoor environment effectively [6].

Studies have placed emphasis on school spaces that reflect the needs and recreational opportunities of the students. The rhythm of the school day, i.e., the scheduling and location of recess, is a critical element in student overall well-being [7]. The design process, thus, should involve the most pertinent stakeholders, i.e., the students, teachers, school councils, policy makers, and specialists to make sure that outdoor space meets diverse user needs [8]. Evidence has shown that green open spaces, such as natural playgrounds and sensory gardens, provide a vital input to the learning, social and emotional development, and general health of children [9][10].

They promote play-based pedagogy, experiential learning, and interaction with nature [10]. Further, learning spaces indoors also contain a focal point, where color, lighting, and ergonomic furniture impact students' performance and well-being directly. Student and school community participatory design practices enhance the effectiveness of such spaces, and they make contributions towards pedagogy as well as well-being [10]. Further, research has revealed that spaces that facilitate student well-being promote engagement and foster deeper learning [11].

Besides, specifications for the spatial requirements of school gardens also need to be followed. Ersoy (1994) [12] had suggested that land developed in school gardens would occupy a very small part of the total land, while Bakan and Konuk (1987) [13] had proposed that no less than 5 square meters of green space should be provided per child. That is not sufficient. Good planning should take into account numerous criteria such as the education level, education program, functionality, social conditions around it, and recreational value [14].

Natural environments have also proven to promote learning and cognitive growth, and therefore an acceptable and encouraging alternative to traditional playgrounds [15]. Therefore, the ideal school garden should comprise varied areas such as courtyards, celebration spaces, sporting grounds, botanical and animal gardens, hobbying grounds, outdoor classrooms or amphitheaters, parking spaces, and private gardens [14][16][17][18].

2 MATERIALS AND METHODS

This study employed a descriptive-analytical approach to evaluate the current landscape conditions of the Bakrajo Technical Institute and to investigate user preferences for future landscape enhancements. The methodology was structured into several key stages to ensure comprehensive data collection, rigorous analysis, and contextually appropriate design proposals.

2.1 QUESTIONNAIRE DESIGN AND VALIDATION

A structured questionnaire was developed to gather insights from key stakeholders, including administrative staff, academic personnel, and students. The questionnaire was meticulously designed and validated by a multidisciplinary panel of experts to ensure its relevance, clarity, and reliability. It included items related to user satisfaction, preferences for outdoor usage, landscape aesthetics, and priorities for environmental sustainability and accessibility.

2.2 DATA COLLECTION

Quantitative and qualitative data were collected through the following methods:

- **Survey Administration**: A total of 100 completed responses were obtained and statistically analyzed using basic tools such as frequencies and percentages to identify significant patterns in user perceptions.
- **Environmental Site Analysis**: Comprehensive on-site data were gathered regarding the **location**, **topography**, **soil type**, **climate**, **vegetation**, and **water resources**. This data informed the ecological feasibility of landscape interventions.
- **Field Observation**: Direct field assessments were conducted to document the existing physical condition of outdoor areas, including seating, pathways, shade, drainage, lighting, signage, and green space availability.

2.3 STATISTICAL ANALYSIS

Survey results were processed using descriptive statistics to interpret stakeholder feedback. Percentages were used to highlight consensus on key issues, such as dissatisfaction with the current landscape, demand for more greenery, and the importance of inclusivity and environmental sustainability in design.

2.4 PARTICIPATORY AND CONTEXTUAL Design

User feedback was integrated with contextual environmental data to inform the development of a preliminary landscape concept. This design phase emphasized:

- **Accessibility**, particularly for individuals with disabilities
- **Sustainability**, by prioritizing drought-resistant and native plant species
- **Functionality**, by identifying preferred user activities such as walking, resting, and social interaction
- **Aesthetics**, aligning with preferences for natural and modern landscape styles.

2.5 REVIEW AND FINALIZATION

The proposed design was reviewed against the goals of visual appeal, environmental responsibility, and social functionality. A final review stage was conducted to ensure that the design addressed observed shortcomings, such as inadequate shading, poor signage, and drainage issues, while promoting usability and comfort. This mixed-method strategy provided a well-rounded basis for understanding both the existing landscape limitations and the aspirations of its users, supporting a holistic and inclusive approach to campus landscape transformation.

MAP 1. Location of the Study Area, Sulaymaniyah, Kurdistan Region, Iraq

3 FINDINGS

Based on the survey data and analysis, there was clear user dissatisfaction with the current outdoor spaces of Bakrajo Technical Institute's landscape architecture. Approximately 57% of the participants ranked the current outdoor spaces as poor or moderate, reflecting a critical need for extreme improvement. Furthermore, 68% called for increasing greenery and vegetation in line with research that has shown that green school spaces like sensory gardens and natural playgrounds contribute positively towards students' cognitive attainment, social skills, and health [9][10]. Outdoor areas were predominantly passive usage, such as resting (40%) and walking (28%). These findings support research suggesting that well-planned outdoor spaces facilitate informal learning and pedagogy through play by creating engaging and secure areas for young people and children [10]. Members also loudly advocated for the addition of tree-shaded sitting areas and water elements (75%) that not only provide comfort but also enable mental recharge and socialization, key motivators of increasing student engagement and learning success [11]. A strong 89% of respondents were in favor of incorporating environmentally responsible features to the landscape design, a growing environmental consciousness in schools. The incorporation of shade trees and natural, modern aesthetics is consistent with the psychological outcomes of nature experience, such as increased concentration and reduced stress, noted elsewhere [19] [20]. This implies the necessity for reconciling aesthetics and ecological function in design. Accessibility was emphasized as a top priority, with an urgent requirement for accessible outdoor spaces that are accessible to people with disabilities, providing for equity and social inclusion among the campus community. As the semi-arid continental

climate of the site implies, the application of drought-tolerant plant species tolerant of heat and drought with restricted water supply was emphasized, with a strengthened mandate for sustainable landscape design and management responsive to local environmental needs [21]. Environmental site analysis determined significant problems lowering usability and comfort present. The middle courtyard lacks suitable shade and seating, limiting its use in warm weather. Paths were found to be confusing and lacking signs, lowering accessibility and security. Additionally, inadequate drainage in certain areas causes water to pool and potential harm to plant health and dissuasion of outdoor activity during and after rain. These observations call for design approaches that consider solar orientation, winds, soil quality, water supply, and entry points in order to achieve maximum microclimate and sustainability. The findings also highlight the importance of participatory design processes involving students, staff, and other stakeholders to ensure the ultimate outdoor environments meet diverse needs and desires. The collaborative approach has been effective in other schools, creating ownership and improving the usability and appeal of campus spaces [8][10].In conclusion, results underscore the critical need for a comprehensive landscape transformation that not only promotes beauty and functionality but also increases students' well-being, learning, and social interaction through leveraging sustainable and inclusive design principles informed by empirical data as well as user input.

Figure 1. Site Plan

Figure 1 shows the entire location plan for the Bakrajo Technical Institute, showing exactly how buildings and other areas are distributed within the boundaries of the laboratory. The main features of the card include external boundaries of websites marked with specific red lines mentioned by officially recognized agencies. Various colors are used to present different classifications of buildings and spaces. Yellow designated management building, parking space, or other service structure. Blue usually represents a school or technical workshop. Green means a green space or a play area.

The main street, Ring Street, is prominently displayed along the east side of the laboratory, providing direct access to the main road network and easy access from other parts of the city. The map also shows the network of streets near the location. Students and guests can easily walk around campus thanks to a network of internal corridors that combine different buildings within the boundaries of the institute. Additionally, the cards show the distribution of black dots. This indicates the location of the inner lighting rod or tree, according to the architectural location.

The design includes a scale at the bottom of the card (1:500) to convey more accurate knowledge of the lab's size and separation between components. Even if there are already some green open spaces, additional work is needed to expand the natural area and provide a better place for students. The main town of the institute, near the main entrance to Sulaymaniyah, is an ideal choice for the eco-friendly landscape initiative. Those near nearby highways can create green spaces lined with trees to reduce dust and pollution and improve the quality of the local environment. A key part of the area is provided in the Institute's educational and mission-based academic and service buildings. Geographically speaking, the Baklajo Institute of Technology is located in the Baklajo region, one of the districts of Sulaymaniyah city in the Kurdistan region of Iraq. Approximate coordinates are based on the street and landmark locations, with longitudes of 45.383°E and latitudes of 35.553°N. The dual feature of the location as a pedagogical environment that integrates urban and rural aspects is enhanced by its proximity to the Ring Expressways, adjacent residential areas, and open agricultural land. The institute’s proximity to major transportation hubs also facilitates improving its reputation as an important education center serving a diverse range of student organizations and faculty.

Table 1. Summary of Site Plan Features for Bakrajo Technical Institute

Aspect	Details
General Description	General site plan showing distribution of buildings and spaces within the institute boundaries.
Site Boundaries	Outlined with a clear red line indicating the officially registered area.
Building/Space Classification	- Blue: Classrooms or technical workshops - Green: Green areas or playgrounds - Yellow: Administrative buildings, parking, services
Road Network	Major ring road along the eastern side; direct access to the main road network; easy connectivity to city parts.
Internal Pathways	Network of pathways linking buildings, facilitating movement for students and visitors.
Special Features	Black dots indicate trees or internal lighting poles.
Scale	Map scale 1:500 for precise understanding of dimensions and distances.
Green Areas	Existing green spaces are limited (~870 m²); require development for natural rest areas [31]
Strategic Location	Near Sulaymaniyah's main entrances, ideal for sustainable landscape development; near highways requiring green belts [38]
Total Site Area	Approximately 12,701 m².
Current Green Area	About 870 m² only.
Land Use	A large portion is used for academic and service buildings.
Geographic Location	Bakrajo area, Sulaymaniyah city, Kurdistan Region, Iraq.
Coordinates	Approximately 35.553° N, 45.383° E.
Surroundings	Residential neighborhoods and open agricultural lands enhance a dual urban-rural environment.
Accessibility	Close to a major traffic interchange, improving accessibility citywide [32].

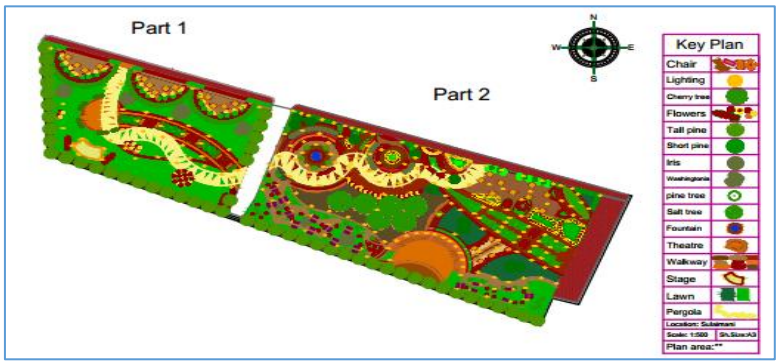

Figure 2. Suggested Design

Figure 2 provides a preliminary site plan for the suggested landscape makeover. Shaded lounging places are placed close to the academic and administrative buildings, while green spaces are thoughtfully arranged around the corridors and perimeters. There are well-marked walking trails included, and a little fountain is positioned in the middle courtyard. Additionally, the plan calls for the placement of paths and seating places strategically, directional signage at entrances, accessibility routes for people with disabilities, shade structures and canopy trees, and designated outdoor study zones.

Table 2. SWOT Analysis of the Bakrajo Technical Institute Site

Strengths	Weaknesses
- Easy access to the site	- Poor distribution of green spaces
- Availability of open areas suitable for redesign	- Lack of shaded zones and adequate seating areas
- Relatively quiet educational environment	- Insufficient signage and nighttime lighting
- Active participation of students and staff in improving the design	- Unorganized and disconnected pathway layout
Opportunities	**Threats**
- Potential to implement sustainable landscape designs	- Arid climate conditions negatively affect vegetation
- Support from the administration for development projects	- Absence of a dedicated budget for landscape improvement
- Possibility of using drought-resistant plant species	- Risk of design deterioration due to neglect or misuse
- Opportunity to host outdoor events and activities in the future	- Urban expansion may limit available open space

A comprehensive vision for improving site design, with a focus on environmental sustainability, comfort, and aesthetics, is reflected in the list of requirements. This list places great emphasis on enhancing green spaces and developing a comprehensive recreational and educational environment that meets the needs of all users.

Table 3. List of Requirement Details

Requirement	Details
Green Spaces	Increase green areas and plant coverage across the site.
	Use drought-resistant plants suitable for a semi-arid continental climate.
Seating Areas	Provide shaded and comfortable seating areas near administrative and academic buildings.
	Designate spaces for relaxation and social activities.
Walkways & Wayfinding	Enhance pathway organization and designate walking.
	Add directional signage at entrances and along pathways.
Shading	Introduce shade structures and trees that offer user comfort.
	Use shade trees in vital areas such as courtyards and pathways.
Accessibility	Ensure accessibility for individuals with disabilities through designated paths and seating.
Sustainable Environmental Elements	Incorporate sustainable environmental elements such as planting Drought-Tolerant plants, using native plants to enhance biodiversity, and using smart irrigation systems or solar energy.
	Install a small fountain in the central courtyard to enhance natural aesthetics.
Aesthetic Design	Apply a design style that blends natural and modern aesthetics.
	Create a visual identity in harmony with the institute's environment.
Infrastructure	Strengthen site infrastructure, including efficient layout of facilities and improved drainage.
	Develop a design that includes scheduled maintenance plans for long-term sustainability.
Social Interaction	Provide areas for studying and social interaction in outdoor settings.
	Enable future outdoor events and activities that encourage engagement between students and staff.

By fulfilling several needs that promote sustainability, comfort, and safety, the overall site design aims to improve the user experience. "Greening up" the property by expanding the amount of green space and vegetation is a basic necessity. Green spaces are definite elements that aid in the purification of air and offer consumers a peaceful natural setting [22]. Drought-resistant vegetation that best suits the semi-arid continental site's climate was selected to create a productive and functional green community in the development process [23]. Comfortable and shaded sitting areas are located near educational and administrative buildings in the development to encourage people to stay outdoors longer. To promote social interactivity within the premises, areas for recreational and social engagement have been created on the grounds [24]. To provide comfort and ease and ensure the safety of movement, the paths within the site were reconfigured with distinct walking pathways [25]. Besides this, directional signs were installed along walkways and entrances to guide users and make navigation easier. Trees and shading structures were positioned strategically across the site, like in courtyards and walkways, to shield people from the blistering sun, make users comfortable, and minimize summer heat. Through the incorporation of predetermined paths and relaxing spaces, the design ensures accessibility to individuals with disabilities and encourages an equitable environment for all users irrespective of their impairments [26]. The design also features several eco-friendly elements, including solar energy and intelligent irrigation systems. These initiatives are intended to preserve natural resources and lower energy and water use on the site. To bring out the natural beauty of the area and offer an aesthetically pleasing element that contributes to the user experience, a small fountain has been placed in the center courtyard. Aesthetically, the design attempts to merge modern and natural themes, reflecting the personality of the institute, but offering an aesthetically pleasing environment that harmonizes with its environment. Such an artistic direction is by modern comfort and design standards. The better overall facilities distribution, enhanced efficiency of storm water drainage facilities, and the adoption of maintenance schedules regularly to provide long-term sustainability also helped in upgrading the site infrastructure. The site included outdoor areas for study and socialization to facilitate social interaction among the users. The design further encompasses the possibility of planning future external events and activities, which facilitates communication among students and academics and improves social and educational services on campus.

3.1 STRUCTURAL DESIGN PHASE

An essential component of any building project is the structural design phase. During this stage, architectural ideas are converted into workable structural plans with an emphasis on affordability, longevity, and safety [27]. Structural engineers and architects must work closely together to design the building's structural system by engineering specifications and architectural function requirements [28].

1. Site Study and Foundation Assessment: The structural engineer first conducts a comprehensive site study, using the soil parameters to identify the type of soil and the necessary foundations [29]. Site conditions determine the best foundation techniques, such as shallow or deep foundations (National Building Code of India, 2016) [30].

2. Load Analysis: According to Ewing and Cervero (2010) [24], the structural engineer examines all anticipated loads on the structure or project, including dead loads (walls, surfaces), live loads (people, furniture), wind and earthquake loads, snow loads, and any other environmental effects. Specialized structural analysis software, such as SAP2000 or STAAD, is used to analyze these loads [26].

3. Design of Structural Members: The design of structural members, including beams, columns, bridges, and steel or concrete surfaces, is based on the earlier analysis [27]. According to engineering standards and national and international norms, each structural member's dimensions, composition, and permitted loads are established [24].

4. Material Selection: The project's materials are chosen at the structural design stage [31]. The type of project and the climatic and environmental criteria determine the choice of material [32].

5.Integrated Design with Architectural Design: In this stage, structural engineers and architects work together to make sure the building's structural design complements its architectural design [23]. The structural engineer makes sure that the structural solutions fit the building's movement flow and architectural space requirements [33].

6. Structural Drawings: Detailed drawings of the structural members, including all dimensions and materials utilized, are generated following the completion of the design [29]. Concerned parties, including contractors and municipal authorities, are asked to study and approve these drawings [21].

7. Force Calculations: This step involves precise computations of the tension, shear, and bending forces acting on the structural elements [27]. Based on dynamic and static load analysis, the engineer makes sure that every structural part can support the necessary loads [26].

8. Safety Review: To make sure safety regulations are being followed, the structural design is examined in this step [24]. In addition to making sure the structure can tolerate unfavorable environmental circumstances like earthquakes or high winds, this also entails calculating the material stress and its resistance to various loads (National Building Code of India, 2016) [30].

9. Cost Estimates: Based on the chosen materials and structural work, the engineer creates project cost estimates after finishing the structural design. To give a precise cost estimate, the building phase's entire budget is established [29]. According to Sayers and Preece (2016) [32], precise cost estimation guarantees that the project remains under budgetary limits while meeting structural criteria.

10. Final Approval and Implementation: The structural design is sent for final approval by the relevant authorities, such as the client or municipal authorities, following a review of all technical aspects and an assurance that engineering standards are being followed. Following approval, contractors are given the design to start the building process [28]. For a project to be implemented smoothly, structural engineers, architects, and contractors must work together [27].

11. Monitoring of Implementation: After construction starts, the structural engineer keeps an eye on how things are being carried out to make sure everything is going as planned. The design needs to be modified and resubmitted for approval if anything changes [25]. Throughout construction, preserving structural integrity and adhering to safety regulations requires constant monitoring [33].

3.2 CONSTRUCTION DETAILS

Construction details play a vital role in executing a project successfully. They clarify how both structural and architectural elements are to be built, ensuring alignment with engineering standards. These details typically include technical drawings, material installation methods, site-specific conditions, and the equipment to be used.

1. Foundation Basics: Based on the type of soil and the surrounding conditions, foundations disperse the weight to the earth. Types include deep foundations (piles) and shallow foundations (concrete pads), with diameters and depths modified for load distribution. The project determines whether to use steel or reinforced concrete.

2. Wall and Column Details: Designed with particular materials (steel, concrete, or brick) and dimensions, walls and columns support loads. Structural stability is guaranteed by the positioning of columns and reinforcement [27].

3. Roof and Surface Information: Roofs provide weatherproof and thermal insulation. To endure climatic conditions, materials such as concrete or metal are used with the proper insulation.

4. Details of Windows and Doors: The architecture of the building informs the design of windows and doors, which are made of wood, steel, or aluminum and include specific types of glass for insulation. Thermal and acoustic efficiency are guaranteed by proper installation [28].

5. Installation of Electrical and Mechanical Systems Details: For comfort and safety, ventilation, air conditioning, and electrical wiring are planned. Equipment placement and installation routes are maximized for effectiveness [29].

6. Flooring Specifications: The appropriate flooring materials are selected for the application, whether wood, ceramic, or tile. With various finish options, durability and comfort are ensured through installation and material thickness.

7. Staircase and Walkway Details: The design of staircases and walkways priorities comfort and safety. Precise connections are made between components made of materials such as steel or concrete.

8. Sanitation and Plumbing Details: Toilets, drains, and water lines are positioned according to building requirements. Durability is a key factor in the selection of materials, such as steel or plastic, to ensure good drainage.

9. Thermal and Sound Insulation Details: Insulating materials such as fiberglass or polyethylene improve comfort and energy efficiency by reducing heat and sound transmission.

10. Exterior Facade Cladding Details: To represent the building's style and protect it from weathering, facades are made of materials such as brick, stone, glass, and metal. Installation techniques are designed to maximize ventilation and natural light [33].

3.3 PLANTING DESIGN PHASE

In architectural and urban planning designs, there is a call to improve building beauty and the environment. It aims to develop green spaces that enhance biodiversity, landscape beauty, and improve the quality of life. It entails the choice of proper plants, positioning them in beautiful and functional plans, and adopting appropriate watering and maintenance systems [34] [38].

1. Site study: To comprehend the local environmental conditions needed, such as climate, type of soil, and water content, a thorough site study is the first step involved. Taking into account factors like the pH of the soil, temperature, methods of irrigation, wind directions, and shade, this assists in deciding what will grow in the given conditions [35].

2. Plant Choice: Plant choice is based on various factors, including soil type, local climate, light availability, and environmental objectives. Heat-tolerant plants are planted in hot climates, while aesthetically valued plants and pest- and disease-resistant plants are prioritized. Locally adapted and sustainable plants are chosen to reduce water consumption and offer summer shade [31][36].

Table 4. Drought-Resistant and Ornamental Plants for Landscaping

Plant Name (Scientific)	Common Name	Type	Features
Olea europaea	Olive Tree	Tree	Evergreen, fruit-bearing, drought-tolerant
Morus alba	White Mulberry	Tree	Fast-growing, provides good shade
Albizia julibrissin	Silk Tree	Tree	Ornamental flowers, heat-resistant
Melia azedarach	Chinaberry Tree	Tree	Hardy, tolerant to poor soil
Cercis siliquastrum	Judas Tree	Tree	Spring flowers, attractive appearance
Nerium oleander	Oleander	Shrub	Evergreen, flowering, drought-tolerant
Pyracantha coccinea	Firethorn	Shrub	Evergreen, berries, security planting
Lantana camara	Lantana	Shrub	Colorful flowers, thrives in heat
Bougainvillea spp.	Bougainvillea	Shrub/Vine	Vibrant flowers, good for walls/fences
Rosmarinus officinalis	Rosemary	Shrub/Herb	Fragrant, edible, drought-tolerant
Gazania rigens	Gazania	Ground Cover	Low-growing, colourful flowers
Lavandula angustifolia	Lavender	Perennial	Fragrant, pollinator-friendly
Sedum spp.	Sedum	Ground Cover	Succulent, good for green roofs
Carpobrotus edulis	Ice Plant	Ground Cover	Colourful, very hardy
Achillea millefolium	Yarrow	Perennial	Medicinal, flowering
Vitis vinifera	Grapevine	Climber/Vine	Provides fruit and shade
Campsis radicans	Trumpet Vine	Climber/Vine	Bright flowers, attracts pollinators
Wisteria sinensis	Wisteria	Climber/Vine	Cascading flowers, good for pergolas [36]

3. Plant Arrangement and Spatial Distribution: The goal of this stage is to arrange plants according to their size and kind. While smaller shrubs are employed along edges or in smaller places, larger trees are planted to give shade in crowded regions. The environment is improved by fragrant plants and seasonal flowers [21].

4. Requirements for Irrigation and Drainage: Plant success depends on irrigation and drainage systems. Using drip irrigation and other techniques, irrigation designs make sure water reaches plants efficiently. Sensitive plants and other areas that need regular watering are noted. The purpose of drainage systems is to keep water from building up and damaging plant roots [32].

5. Aesthetic Design: To produce a harmonious landscape, aesthetic considerations balance plant color, shape, and arrangement. Trees and seasonal flowers are arranged to create beauty all year round [37].

6. Sustainability: Low-water-use plants and native species that promote biodiversity are among the sustainable design features incorporated. Environmental protection is thought to be achieved by chemical-free cultivation and sustainable farming methods [36].

7. Design for Comfort and Recreation: Trees that provide shade and cozy sitting are features of parks and public areas intended for leisure. These areas provide guests with a comfortable setting in which to unwind and take in the scenery [38].

8. Pathways and Orientation: With materials like grass or tiles that enable pleasant strolls among trees and flowers, pathways make it simple for guests to navigate through green areas. With picturesque, adventurous pathways, the design seeks to improve the experience [34].

9. upkeep: Watering, fertilizing, trimming, and pest management are all part of post-design upkeep. Plant health is guaranteed by a maintenance plan, which also modifies irrigation systems in response to seasonal demands and weather variations [39].

4 DESIGNING AND DISTRIBUTING THE QUESTIONNAIRE

Design studies require tools tailored to the research site's social and environmental characteristics for accurate data collection. Field visits are crucial for direct information. A questionnaire was designed for target groups, reviewed by specialists, and distributed electronically. 100 responses were manually entered into Excel and subjected to advanced statistical analysis.

Table 5. General information

Gender	Number	Percentage (%)
Male	53	53%
Female	47	47%
Total	100	100%
Chi-Square Value (χ^2):	**2.9**	**($p < 0.05$)**

The study found that 53% of men and 47% of women were somewhat balanced among 100 people tested, despite the majority tendency. Statistical analysis using the Chi Square test revealed a significant difference between the two groups, highlighting the importance of gender in explaining social dynamics and environmental perception in the study.

Table 6. Age

Category	Count	Percentage (%)
18–25	41	41%
25–40	37	37%
Over 40	22	22%
Total	100	100%
Chi-Square Value (χ^2):	**4.8**	**($p < 0.05$)**

The study examines the distribution of samples across different age groups, finding that 41% followed the 18-25 age category, with 37% at 25 and 22% exceeding 40%. For sample sizes of 100, the data shows a clear offset to the youth population. The chi-square test confirms that the distribution is not contingent, but rather represents significant age-related variation that may affect participants' attitudes and responses to the study.

Table 7. Distribution of Participants by Role at the Institute

Role/Position at the Institute	Number	Percentage (%)
Student	58	58%
Employee	22	22%
Teacher	20	20%
Total	**100**	**100%**
Chi-Square Value (χ^2):	**14.2 ($p < 0.01$)**	

This part of the analysis refers to the proportion of respondents who work in the lab. The largest proportion of students consisted of 58% of the entire sample, followed by 22% of the institute's employees and 20% of teachers. Student advantage can be explained by greater exposure to the campus environment and increased interest in daily requirements. This provides a clear indication of very important differences between groups.

Table 8. Frequency of Visits to the Institute's Outdoor Spaces

Visit Frequency	Number	Percentage (%)
Daily	39	39%
Several times a week	32	32%
Occasionally	21	21%
Rarely	8	8%
Total	**100**	**100%**
Chi-Square Value (χ^2):	**11.6**	**($p < 0.01$)**

The study shows that 39% of participants visit the institute daily, 32% multiple times a week, 21% periodically, and only 8% rarely visit. This indicates constant feedback on campus conditions and potential improvements. A Chi-Square test confirms these differences, indicating that frequency affects how individuals use the space, crucial for designing spaces, planning services, and allocating funds for campus activities.

Table 9. Preferred Activities in the Institute's Outdoor Spaces

Category	Count	Percentage (%)
Comfort	24	24%
Study	19	19%
Walking	37	37%
Meetings and Gatherings	20	20%
Total	**100**	**100%**
Chi-Square Value (χ^2):	**9.4 ($p < 0.01$)**	

The study reveals that 37% of institute users primarily use the space for walking, emphasizing the importance of accessible paths and wide corridors. Other usage patterns include 24% for entertainment, 20% for gatherings and meetings, and 19% for study. A chi-squared test revealed that these differences are statistically significant, indicating that users' preferences are determined by routine habits rather than luck. Therefore, careful consideration of these trends is crucial in designing spatial planning to address the needs of a large number of users, ensuring that the institute's spaces are well-suited for their various needs.

Table 10. Participants' Evaluation of the Current Outdoor Space Design

Evaluation	Number	Percentage (%)
Very Good	18	18%
Good	42	42%
Moderate	28	28%
Poor	10	10%
Very Poor	2	2%
Chi-Square Value (χ^2):	**: 8.8 ($p < 0.01$)**	

The study evaluates the present outdoor environment of an institute, revealing that 42% of participants rate the landscape as "Good," indicating a moderate level of satisfaction. Other respondents rate it as "Moderate," 18% as "Very Good," and 10% as "Poor." The overall trend is positive. A Chi-Square test revealed a significant difference in participants' perceptions of the landscape, with attitudes being influenced by factors like usage frequency and working status. The results underscore the need for user perspectives in future landscape improvement plans to ensure design innovations reflect real needs and daily life.

Table 11. Preferred Landscape Elements for Enhancement

Element	Number	Percentage (%)
Green areas	64	64%
Paths and walkways	52	52%
Seating areas	45	45%
Fountains or water features	30	30%
Institute gates and signs	37	37%
Other	15	15%
Chi-Square Value (χ^2):	**($p<0.01$)**	

The study explores the participants' perceptions of the university's outdoor surroundings, focusing on the role of vegetation in both visual appeal and psychological ambiance. Results show that 64% of respondents found green areas the most appealing feature, while 52% followed paths exactly and 45% sat in areas with comfort and ease of mobility. Thirty percent preferred water features, while 30% chose entrances and signs. 15% valued other natural elements not covered in the poll. The Chi-Square test revealed that participants' choices were based on personal experience with the institute's terrain, suggesting that these preferences should guide future design decisions to ensure the most loved features remain and grow.

Table 12. Priority Aspects for Landscape Improvement at the Institute

Aspect	Number	Percentage (%)
More plants and greenery	58	58%
Better paths and walkways	51	51%
Shaded and comfortable seating areas	47	47%
Lighting	36	36%
Accessibility for people with disabilities	42	42%
Water elements (fountains)	39	39%
Clear directional signs	44	44%
Other	10	-
Chi-Square Value (χ^2):	**11.9 ($p < 0.01$)**	

A poll revealed that 58% of respondents believe the outdoor surroundings of the institute are lacking. They are particularly interested in improving the natural landscape with more vegetation and plant life. 51% also mention the need for better paths and walkways for efficient and safer movement. 47% want comfortable shaded seating areas for rest areas. 44% need clear directional signs, and 39% want water features and fountains for simpler navigation. 42% mention accessibility issues for disabled individuals, and 36% need improved lighting for inclusivity, safety, and spatial

equity. These varied priorities reflect a complex understanding of what makes for an effective campus space. A Chi-Square test confirmed the reliability of the results, showing significant variation in participant priorities. These suggestions are a product of lived experience and thoughtful assessment of the current environment.

Table 13. Preferred Activities in the Institute's Outdoor Spaces

Activity	Number	Percentage (%)
Social interaction	60	60%
Quiet spaces for studying or relaxation	55	55%
Exercising or physical activities	45	45%
Public events or outdoor lessons	38	38%
Comfortable pathways and walkways	50	50%
Other	12	12%
Chi-Square Value (χ^2):	**16.5 ($p < 0.01$)**	

The study explores the importance of the natural environment in an institute's functioning. A survey revealed that 60% of respondents believe that the environment should facilitate social interaction, while 55% desire quiet spaces for study and relaxation. 45% prefer spaces for physical activity and well-being, while 38% are interested in funding outdoor education or public events. Access to different sections should be simple, and specific needs could influence the use of these areas. The Chi-Square test revealed significant differences in the types of activities that the natural environment should contain, with 16.5 being the most valued. This highlights the importance of the natural environment in improving social, intellectual, and physical activity.

Table 14. Perceived Importance of Improving Outdoor Spaces

Answer	Number	Percentage (%)
Very Important	72	72%
Somewhat Important	25	25%
Not Important	3	3%
Chi-Square Value (χ^2):	**14.4 ($p < 0.01$)**	

The survey reveals that 72% of respondents believe it's essential to incorporate sustainable environmental aspects into the design of an institute. This indicates a high awareness of the need to protect the environment in outdoor spaces, gardens, and building developments. 25% consider this element relatively important, suggesting some flexibility in implementation based on environmental limitations. However, the majority of participants appreciate the usefulness of sustainability in environmental designs, with only 3% stating these components are unimportant. The Chi-Square test confirms the importance of sustainability in public perception.

Table 15. Consideration of Accessibility for People with Disabilities in Design

Answer	Number	Percentage (%)
Yes	85	85%
No	5	5%
Not sure	10	
Chi-Square Value (χ^2):	**7.5 ($p < 0.01$)**	

This section of the survey asks if accessibility for individuals with impairments should be taken into account in the design. According to the findings, 85% of participants think that a design's accessibility should be a top priority. This demonstrates the broad support for inclusive design that takes people with impairments into account. However, 10% of individuals were unsure, and only 5% disagreed. According to these comments, there is a definite preference for inclusive design, whereas a tiny minority has differing opinions or is unsure. According to the majority of participants, accessibility in design is important. This is supported by the results of a Chi-Square test, which showed a statistically significant difference in participant replies with a value of 7.5 at a significance level of ($p<0.01$).

Table 16. Preferred Types of Plants for Landscape Design

Type of Plants	Number	Percentage (%)
Flowering plants (flowers and herbs)	70	70%
Shade or ornamental trees	60	60%
Hanging plants	30	30%
Edible plants	40	40%
Drought-resistant plants	45	45%
Other	10	10%
Chi-Square Value (χ^2):	**14.4 ($p < 0.01$)**	

The survey reveals that 70% of participants prefer flowering plants for vibrant green areas, while 60% prefer shaded areas for leisure. 45% prefer drought-resistant plants, indicating environmental adaptability and sustainability. 30% prefer hanging plants for vertical gardening, and 40% favor eating plants for functional green areas. A chi-squared test confirmed these preferences, with a value of 14.4, indicating a significant difference in plant preferences. This information can help inform future design choices, as it helps to understand the preferences of different plant varieties among respondents.

Table 17. Preferred Features for Landscape Design

Feature	Number	Percentage (%)
Seating areas (chairs and tables)	80	80%
Shaded areas (umbrellas, pergolas)	70	70%
Water features (fountains, ponds)	65	65%
Bicycle paths	40	40%
Night lighting	55	55%
Signage	60	60%
Other	12	12%
Chi-Square Value (χ^2):	**8.8 ($p < 0.01$)**	

The survey reveals that 80% of respondents prefer sitting spaces with chairs and tables, indicating a need for restful or socializing spaces. Covered spaces, like pergolas and umbrellas, are preferred for protection from sunlight and comfort. Water features, like fountains and ponds, are favored for beauty and peace. Night lighting is also a significant preference, with 55% of respondents expressing interest in making the area welcoming at night. Additionally, 60% support the installation of signage for tourists. A significant percentage of respondents chose bike paths, indicating a preference for car-free travel. The Chi-Square test indicates significant differences in preferences, highlighting the need for tailored design.

Table 18. Preferred Style for Landscape Design

Style	Number	Percentage (%)
Modern / Contemporary	50	50%
Traditional	20	20%
Natural / Environmental	60	60%
Minimal (Simple)	25	25%
Historical / Classic	30	30%
Other	10	10%
Chi-Square Value (χ^2):	**7.3 ($p < 0.01$)**	

The survey revealed that 60% of respondents preferred "Natural / Environmental" designs, indicating a preference for environmentally friendly designs. 50% preferred "Modern / Contemporary" designs, while 30% preferred "Historical / Classic" designs. 25% preferred "Minimal (Simple)" designs, while 20% preferred "Traditional" designs. 10% chose "Other," possibly referring to other design philosophies. A chi-squared test showed significant variations in preferences among participants, indicating that these preferences should be considered when selecting designs. This suggests that considering the varying preferences of participants is crucial when selecting landscape design styles.

Table 19. Suggestions for Enhancing Outdoor Spaces at the Institute

No.	Suggestions / Opinions
1	Add more green spaces, especially in barren areas.
2	Improve night lighting in outdoor areas to ensure safety.
3	Designate outdoor study areas, ensuring adequate shade.
4	Create outdoor sports areas to promote physical activity.
5	Provide designated relaxation areas with comfortable seating and green spaces.
6	Add fountains and water features to enhance the aesthetics of outdoor areas.
7	Improve walking paths to make them more comfortable and less crowded.
8	Create shaded areas where students can sit during break times.
9	Improve accessibility to the institute for people with disabilities.
10	Increase the number of flowers and flowering plants to create a beautiful atmosphere.

Recommendations made by research participants reflect unmistakable and consistent patterns of increasing the beauty and functionality of the institute's outdoor spaces, and meeting students' and teachers' needs. Providing more green space was among the most commonly referred suggestions. One visitor highlighted the importance of expanding plantings, especially where the ground is dry or rocky and where cover is sparse. Green space was considered key to the quality of the environment and inducing comfort and restfulness. Greater night-time outdoor lighting was also on the list, high up the popularity stakes. Extra lighting, the users felt, would significantly increase the safety and visibility of the area in the evenings, most particularly for those individuals who are still on campus late at night. Also of interest was the desire to create a study and leisure area in an outdoor space accessible to students and teachers alike to recline in a warm and sheltered setting. This shows that there is a demand for using outdoor space as an extension of social and academic life on campus. Lastly, many participants suggested making walking corridors less crowded and more serene. This underscores the importance of proper planning that facilitates easy and convenient campus mobility. The necessity for providing shaded spaces as well as improving access for people with disabilities was the most highlighted necessity. These recommendations illustrate growing awareness regarding the necessity of providing inclusive spaces, which are of universal benefit. Finally, the members were very keen on incorporating water features such as ponds and fountains and areas for sports and physical recreation. This suggests an absolute preference for a multifunctional outdoor space that fosters both beauty and active engagement. Overall, these plans show a considered vision for enhancing the

appearance of the institute's external spaces, making them usable and convenient areas that enhance the experience and quality of life for everyone on campus.

CONCLUSION AND RECOMMENDATIONS

Survey results showed that study participants placed green spaces, shaded spaces, and comfortable seating highly as far as the institute landscape design was concerned. It also shows that there is a definite preference to offer space for study and recreation outside, with consideration towards sustainable environmental aspects like water features and drought-resistant plants. The Chi-Square test data indicate that the people's attitudes towards these items are statistically significant, which means that there are identifiable, non-random tendencies in their views.

Sports and social participation are becoming more significant, as was discovered through a review of the visit patterns and what kind of activities people are interested in. This indicates that there needs to be space that allows for both physical and social engagement. Additionally, it was discovered that most participants find people with impairments prefer outdoor spaces, evidence of the need for this group to be included in the design process. More trees and plants, particularly flowering plants for improved visual comfort and aesthetics, can be introduced in desert or green space-deficient areas according to the key requirements. For night safety, outdoor space requires better lighting. Guided lighting along public spaces and pedestrian paths can improve safety and ease mobility. Quiet areas are advised to be booked for relaxation or studying in open spaces, with adequate shade and comfortable seating like sofas and chairs to make the activity enjoyable for both the teachers and students. Outdoor spaces are reserved for physical exercise and sports for the general health of workers and students. To fulfill disability criteria for accessibility, the layout should be made legible with labeled corridors and wide walkways for convenient movement. The addition of ponds and fountains can make the overall look of the outdoor areas more aesthetically pleasing and add a peaceful and calming atmosphere. Additionally, enhancing the institute's routes to make them more accessible and convenient to use for activities like cycling, jogging, and walking is also worth considering. To allow for the free movement of visitors and users, there must be clear signs throughout the institute. To ensure minimal environmental impact of the institute, the design must incorporate environmentally friendly features like drought-resistant plants and water-wise wisely.

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