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ABSTRACT

Ecological campuses aim to cultivate environmentally conscious individuals and to ensure that educational institutions operate through sustainable systems. One of the primary objectives of this approach is to foster environmental awareness among all campus users by applying a sustainability-based model on a micro scale. Although the existing literature indicates that ecological campus implementations have positive effects on students, how students evaluate these practices and which ones they prioritize remain insufficiently explored. This study aims to determine the awareness levels, attitudes, and priority rankings of landscape architecture students regarding ecological campus practices. The research followed a two-phase methodology: In the first phase, ecological campus applications were grouped and prioritized using the Analytic Hierarchy Process (AHP) based on expert evaluations. In the second phase, a survey was conducted with 210 landscape architecture students, and the data were analyzed using SPSS. According to the research findings, ecological campus practices were classified into three main categories: Green Infrastructure and Ecological Solutions ranked the highest in importance (51%), followed by Smart and Sustainable Urban Infrastructure (28%), and Water Management and Sustainable Transportation (21%). Among student evaluations, the most prominent practices were air quality monitoring, green roofs, and walking paths. Additionally, a strong correlation was found between natural rain gardens and green corridors. These striking findings demonstrate the decisive role of student preferences in sustainable campus design and provide concrete evidence for the necessity of a user-centered approach throughout all stages—from implementation to theory. The results of the study offer valuable guidance not only for the academia but also for practitioners and policymakers. In particular, incorporating student perspectives is of critical importance to ensure that policies to be developed remain user-oriented. With an approach that integrates both technical and user needs, the study aims to shed light on future ecological campus designs.

Keywords:
Landscape architecture,
Eco-campus,
Sustainable campuses.

Anahtar Kelimeler:
Peyzaj mimarlığı,
Ekolojik kampüsler,
Sürdürülebilir
kampüsler.

ÖZ

Ekolojik kampüsler, çevreye duyarlı bireyler yetiştirmeyi ve eğitim kurumlarının sürdürülebilir sistemlerle işlemesini amaçlamaktadır. Bu yaklaşımın temel hedeflerinden biri, sürdürülebilirlik temelli bir modeli mikro ölçekte uygulayarak tüm kampüs kullanıcılarında çevre bilinci oluşturmaktır. Mevcut literatür, ekolojik kampüs uygulamalarının öğrenciler üzerinde olumlu etkiler yarattığını ortaya koysa da, öğrencilerin bu uygulamaları nasıl değerlendirdiği ve hangi uygulamalara öncelik verdiği konusu henüz yeterince aydınlatılamamıştır. Bu çalışma, peyzaj mimarlığı öğrencilerinin ekolojik kampüs uygulamalarına ilişkin farkındalık düzeylerini, tutumlarını ve öncelik sıralamalarını belirlemeyi amaçlamaktadır. Araştırma iki aşamalı bir yöntem izlemiştir: İlk aşamada, Analitik Hiyerarşi Süreci (AHP) kullanılarak uzman grubunun değerlendirmeleriyle ekolojik kampüs uygulamaları gruplandırılmış ve önceliklendirilmiştir. İkinci aşamada ise 210 peyzaj mimarlığı öğrencisiyle anket çalışması yapılarak veriler SPSS ile analiz edilmiştir. Araştırma bulgularına göre, ekolojik kampüs uygulamaları üç ana kategoride sınıflandırılmıştır: En yüksek önemi Yeşil Altyapı ve Ekolojik Çözümler (%51) almış, bunu Akıllı ve Sürdürülebilir Kentsel Altyapı (%28) ve Su Yönetimi ile Sürdürülebilir Ulaşım (%21) izlemiştir. Öğrenci değerlendirmelerinde en çok öne çıkan uygulamalar hava kalitesi izleme, yeşil çatılar ve yürüyüş yolları olmuştur. Ayrıca, doğal yağmur bahçeleri ile yeşil koridorlar arasında güçlü bir ilişki tespit edilmiştir. Bu çarpıcı bulgular, sürdürülebilir kampüs tasarımlarında öğrenci tercihlerinin belirleyici rolünü ortaya koyarak, uygulamadan teoriye kadar tüm süreçlerde kullanıcı odaklı bir yaklaşımın benimsenmesi gerektiğini kesin verilerle kanıtlamaktadır. Çalışmanın sonuçları, sadece akademik çevreler için değil, aynı zamanda uygulayıcılar ve politika yapıcılar için de dönüm noktası niteliğinde rehber bilgiler sunmaktadır. Özellikle öğrenci görüşlerinin alınması, oluşturulacak politikaların kullanıcı odaklı olması açısından kritik önem taşımaktadır. Çalışma, hem teknik hem de kullanıcı ihtiyaçlarını bütünleştiren bir yaklaşımla, gelecekteki ekolojik kampüs tasarımlarına ışık tutmayı hedeflemektedir.

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INTRODUCTION

Ecological campuses are living spaces that are compatible with natural systems, prioritize resource efficiency, and aim for environmental sustainability. Especially with the National Education Strategy approved in 2017; Ecological campuses have come to the fore with the concept of "Circular Economy" (Pardal et. al. 2020). The fact that campus sustainability has become a global concern is based on the 1972 Stockholm Declaration (Aksoy, 2022). These campuses include many components such as green infrastructure systems, energy-efficient buildings, sustainable transportation networks, and ecological landscape designs. The discipline of landscape architecture plays a key role in the design and implementation of ecological campuses. Topics such as the protection of biodiversity, the development of designs compatible with climate change, the planning of water management systems, and the creation of spaces that increase users' interaction with nature are within the expertise of landscape architects.

In a truly green campus, natural and artificial green areas are protected and developed; energy consumption is reduced with smart and green building elements; renewable resources are preferred; carbon footprint is reduced with programs to reduce greenhouse gas emissions; recycling systems and waste separation processes are operated within the scope of waste management; water saving and reuse programs are implemented within the scope of water management (Safarkhani, Ornek 2022).

Global warming, increasing air pollution, water pollution and health problems are frequently seen today, making it necessary for people to have a healthy and comfortable environment (Li et. al., 2024). Universities should continue these studies by determining their goals and then with policies, strategies and projects that can achieve these goals and objectives (Velazquez et. al., 2006). In such an environment or campus area, building a learning culture expands the scope of learning in terms of vision. This design area contributes to the development of future skills and supports more effective learning opportunities (Fachrudin et., al. 2019). Landscape architecture students, as future designers and implementers of ecological campuses, play a decisive role in the creation of sustainable environments with their awareness and knowledge of this subject. Therefore, researching students' attitudes and preferences towards ecological campus applications is of great importance in terms of both developing educational curricula and improving campus design standards. Green campuses and sustainable campuses are implemented with many different approaches around the world and in Turkey. UI Green Metric, Biophilic Design, STARS (Sustainability Tracking Assessment Rating System) and LEED certification systems integrated with these approaches are among the most commonly used approaches (Onur, 2023). There are different metric systems that measure these methods. Some of these include Green League, Environmental and Social Responsibility Index and UI Green Metric evaluations (Günerhan & Günerhan 2016). The discipline of architecture is a dynamic discipline. It is affected by current developments and integrates with changes. Architectural education also keeps up with innovation and must maintain its universality thanks to this movement and differences. Students, as the architects and designers of the future, must keep up with this dynamic process. “Sustainability” comes first among these issues. Being knowledgeable about this issue is very important for sustainability to achieve its targeted goals (İsmailoğlu & Çavdar 2024). Universities are at the center of this process as they serve as a bridge between science and education (Guerra et. al. 2018; Zhao et. al. 2021). There are six basic criteria that should be taken into consideration and considered in green building design: ecological factors, waste management, energy efficiency, water use, material selection and human health. These are the 6 basic factors (Fachrudin, 2020).

Ensuring sustainability on university campuses, adapting ecological features, and especially the increasing power of sustainability studies have become a topic of interest worldwide (Ribeiro et. al. 2021). Over time, universities and educational institutions have started green campus studies almost everywhere in the world (Tiyarattanachai & Hollmann 2016). Many scientific studies and academics have stated that a green campus has many benefits. Some of these are as follows;

- • Energy saving and effective management play a

critical role in creating a sustainable green campus (Anthony, 2020; Sugiarto et al., 2022).

- • The integration of smart building systems in green campuses into planning improves resource management (Anthony, 2020; Rebelatto et al., 2019).
- • Green campuses support renewable energy systems and contribute to the formation of clean air (Onur, 2023; Radosevic et al., 2022).
- • It makes users feel better mentally and physically due to the greener and more natural environment offered to them (Bratman et al., 2019, Choe et al., 2020; Martin et al., 2020; Onur, 2023).
- • Contributes to the preservation of biodiversity – Green areas and wildlife corridors support the sustainability of local flora and fauna
- • Improves water management – Water resources are used more efficiently thanks to rainwater harvesting and permeable surfaces (Jim, Chen 2006; Bekar et. al. 2020).The importance of university administration and decision-makers is quite great for the development of a greener campus (İsa et., al. 2021).

This study aims to evaluate ecological campus applications from the perspective of landscape architecture students. The reason for selecting landscape architecture students is that they are future professionals equipped with sustainable design principles that establish the critical connection between the natural and built environment of this discipline. Within the scope of this study, the objectives of the study were determined as follows;

- It aims to evaluate ecological campus applications from a multi-dimensional perspective from the perspective of landscape architecture students. First, students' awareness levels and attitudes towards sustainable applications will be analyzed, thus user-oriented data will be obtained for campus planning.
- Ecological applications will be analyzed and prioritized in terms of environmental, economic and social dimensions using expert evaluations and the Analytical Hierarchy Process (AHP) method. These analyses will allow the determination of the most critical applications.
- To comparatively examine the effects of different ecological applications on students' educational processes, campus life quality and environmental awareness.
- In the light of the findings obtained, concrete suggestions for sustainable campus policies specific to Türkiye will be developed. These suggestions, which will be created by synthesizing expert and student opinions, will serve as an applicable guide.
- Finally, the study aims to reveal the transformative effects of ecological applications on students' academic, social and environmental experiences. The reason for selecting landscape architecture students is that this discipline focuses on sustainable design principles and that students will be the designers of ecological campuses in the future.

METHODOLOGY

The method consists of 2 stages. In the two-stage method, the first stage is based on the expert group and the second stage is based on the evaluations of landscape architecture students.

(i). Determination of Applications in Eco-Campuses with AHP Method; The first phase of the study includes an evaluation process to be carried out in cooperation with the expert group to systematically address eco-campus applications. In this process, current applications for sustainable campus policies will be determined and categorized in the light of literature. In the analysis to be made by the experts, each application will be prioritized, thus revealing with a scientific approach which applications should be implemented as a priority on university campuses.

(ii). Evaluation of Students' Eco-Campus Applications; In the second phase of the study, the perceptions, attitudes and expectations of students, who are one of the main stakeholders of the campuses, towards Eco-Campus applications will be examined in depth. In this context, the awareness levels of students about sustainability applications and which applications they find more useful and prioritized will be determined. The findings obtained will constitute a critical data source for the development of policies appropriate to the needs and expectations

of students, and will also provide suggestions for the formation of future sustainable campus strategies. The integrated results of these two phases will provide the basis for the creation of an Eco-Campus model that balances both technical and social dimensions.

First Stage; Determination of Applications in Eco-Campuses with AHP Method

AHP is an effective decision support mechanism that allows individuals or groups to systematically solve complex decision problems with multiple criteria. In studies requiring multi-dimensional evaluation, it is critical to consider various indicators with expert evaluations. The AHP technique is preferred because it produces more consistent results compared to alternative decision-making methods (Huang and Tang, 2012). In this context, the AHP method based on expert opinions was used in determining the importance levels of the indicators in our study.

Within the scope of AHP, decision modeling and criteria hierarchy were created. In the decision modeling presented in Figure 1 "Eco-Campus Application" is at the top level of the hierarchical structure. For this purpose, 20 criteria were determined as a result of the literature review and alternatives were created depending on these criteria (Saaty, 2010). The alternatives in question were classified into three groups in line with the literature reviews. The main finding aimed to be obtained with this analysis is to find an answer to the question "Which applications are priority for students in the context of ecological campus applications?" Within the scope of AHP analysis, the weights of 20 criteria obtained from the literature were calculated and it was evaluated whether certain criteria should be collected under the same group (Figure 1) (Liu et al., 2020; Onur & Altuntaş 2022; Khan & Ali, 2020; Onur, 2023; Bekar, 2023) (Figure 1).

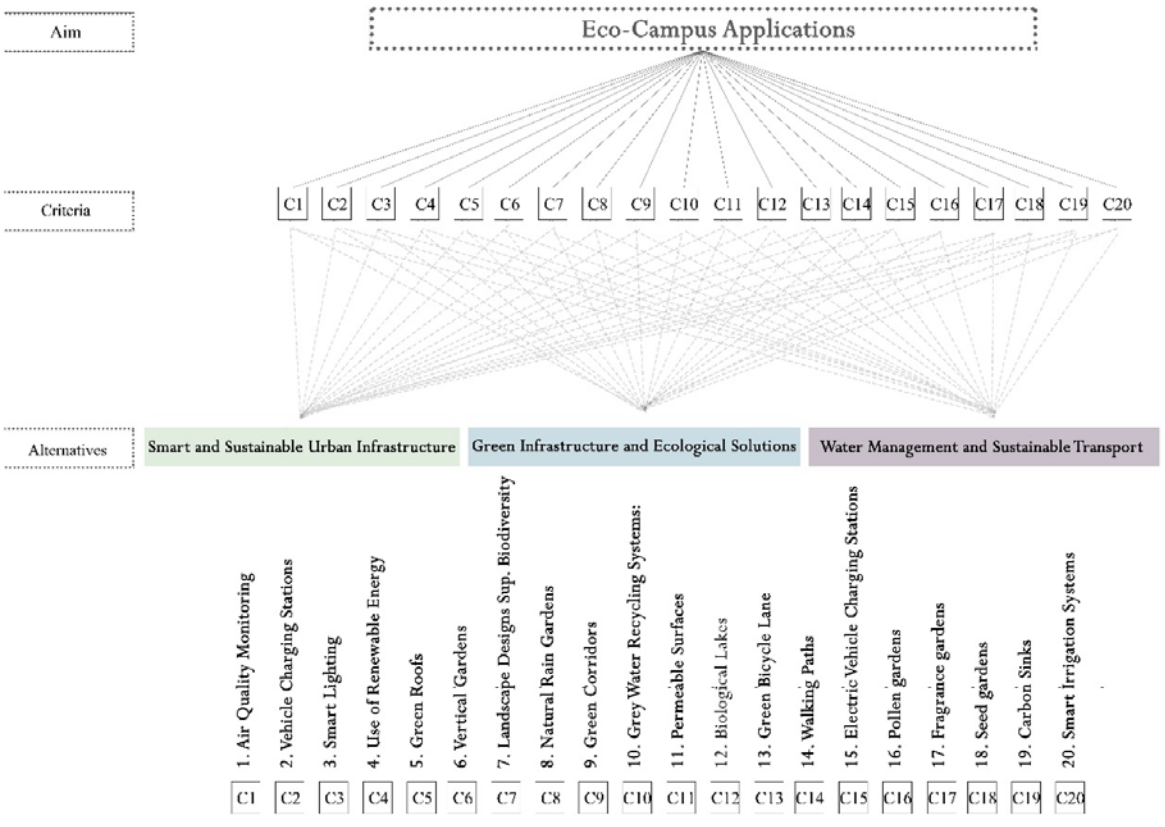


Figure 1. Criteria matrix

At this stage, pairwise comparisons were performed. This stage allowed for consistent prioritization between criteria and alternatives by quantifying the subjective judgments of decision makers. Thus, the relative importance levels of the criteria were expressed with numerical data. Pairwise comparisons were performed using Saaty's 1-9 scale and subjective evaluations were transformed into a systematic mathematical model. Within the scope of this scale, the values determined by the experts were defined as follows: 1 (Equal Importance): Two elements contribute equally to the determined goal. 3 (Moderately Important): One element is slightly more preferable than the other. 5 (Very Important): One element is a significantly stronger reason for preference than the other. 7 (Very Important): One element should be preferred much more strongly than the other. 9 (Extremely Important): One element is an extremely dominant and strong reason for preference compared to the other. 2, 4, 6, 8 (Intermediate Values): Used to express judgments at intermediate levels. The data obtained through this scale were transferred to the decision matrix and the relative importance levels between the criteria were calculated. Thus, the decision process was carried out in a more objective, consistent and systematic way (Table 1).

Table 1. AHP comparison matrices

Eco-Campus	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20
C1	1																			
C2		1																		
C3			1																	
C4				1																
C5					1															
C6						1														
C7							1													
C8								1												
C9									1											
C10										1										
C11											1									
C12												1								
C13													1							
C14														1						
C15															1					
C16																1				
C17																	1			
C18																		1		
C19																			1	
C20																				1

Second Stage: Evaluation of Students' Eco-Campus Applications

The parameters determined in the first stage were evaluated with landscape architecture students in the second stage. The main purpose of this evaluation is to determine the importance and priority order of the criteria for landscape architecture students, who are the main users of the campus. Within the scope of the study, a survey was conducted with 210 landscape architecture students and the obtained data were analyzed using SPSS software. The main reason for this analysis is to determine the priorities of students among the applications and to determine the preferences of these students who are the main users of the campus. For this reason, a survey study was conducted. As a result of the literature studies, 20 different green campus application studies were obtained within the scope of the study. In order to determine the priorities among these studies with the users; 20 different parameters were converted into 20 questions. These questions were directed to the users with a 5-point Likert attitude scale. The criteria in the survey questions were converted into question sentences. The question sentences were formed as follows; "I think …….. is important for green campuses". The answers to the questions were questioned with a 5-point Likert scale in the survey as strongly agree, agree, no idea, disagree, strongly disagree. Factor analysis was applied to determine which criteria were more weighted for the students. Factor loadings between the criteria were examined using Principal Component Analysis – PCA. In addition, this analysis was used to reduce a large number of criterion variables into a small number of significant and independent factors (Kalaycı, 2009). In addition, correlation analysis was performed to examine the relationships between the criteria. The direction and strength of the relationship between the variables were determined with the Pearson correlation coefficient, positive correlations showed that certain criteria increased together, and negative correlations showed that the increase in one criterion was related to the decrease in the other. Thanks to this analysis, it was determined whether the determined criteria were related and which criteria were related. The obtained findings were supported by numerical data and analyzed using scientific methods.

FINDINGS

First Analysis: Eco-Campus Uygulamalarının Uzman Grup Tarafından Gruplanması

In line with the findings obtained from expert opinions, when the criteria weights were examined with AHP, the Smart and Sustainable Urban Infrastructure category achieved 28%, the Green Infrastructure and Ecological Solutions category achieved 51%, and the Water Management and Sustainable Transport category achieved 21% (Figure 2). The better comparison of the results obtained with the balanced scorecard facilitates weighting by converting it into a criterion-subcriterion scheme. Therefore, the balanced score card is given in Figure 2.

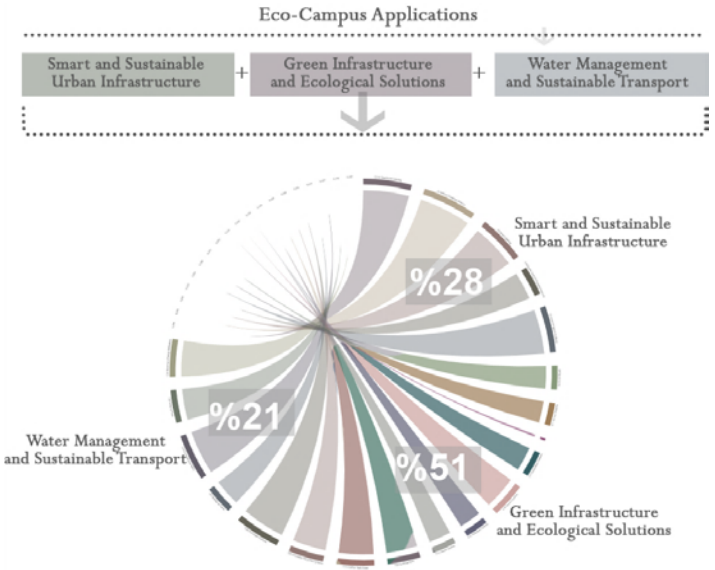


Figure 2. Overall balanced scorecard

In the Smart and Sustainable Urban Infrastructure category, C1. Air Quality Monitoring, C2. Vehicle Charging Stations, C3. Smart Lighting, C4. Use of Renewable Energy and C5. Smart Irrigation Systems applications have high importance with a rate of 28%. The Green Infrastructure and Ecological Solutions category has been determined as having the highest importance with a rate of 51%. The sub-applications of this category have been defined as C6. Green Roofs, C7. Vertical Gardens, C8. Biodiversity-Supporting Landscape Designs, C9. Natural Rain Gardens, C10. Green Corridors, C11. Pollinator Gardens, C12. Scent Gardens, C13. Seed Gardens and C14. Carbon Sink Areas.

On the other hand, the Water Management and Sustainable Transport category has been determined as the category with the lowest weight with 21%. The criteria within the scope of this category are C15. Greywater Recycling Systems, C16. Permeable Surfaces, C17. They are listed as Biological Ponds, C18. Green Bicycle Paths, C19. Walking Trails and C20. Renewable Energy Utilization (Table 2). The highest results of the parameters in the results obtained with AHP analysis are given in Table 2 and all the results of each criterion are given in Table 3.

Table 2. Distribution of criteria according to stages

Main criterias	Weighting score	Sub-criterias	Weighting score
Smart and Sustainable Urban Infrastructure	 **%28**	C1 Air Quality Monitoring	**0,242**
		C2 Vehicle Charging Stations	**0,214**
		C3 Smart Lighting	0,209
		C4 Use of Renewable Energy	0,129
		C5 Smart Irrigation Systems	0,206
Green Infrastructure and Ecological Solutions	 **%51**	C6 Green Roofs	0,106
		C7 Vertical Gardens	0,101
		C8 Biodiversity-Supporting Landscape Designs	0,009
		C9 Natural Rain Gardens	0,112
		C10 Green Corridors	0,154
		C11 Pollinator Gardens	0,103
		C12 Scent Gardens	0,103
		C13 Seed Gardens	0,149
		C14 Carbon Sink Areas	0,163
Water Management and Sustainable Transport	 **%21**	C15 Greywater Recycling Systems	0,156
		C16 Permeable Surfaces	0,201
		C17 Biological Ponds	0,124
		C18 Green Bicycle Paths	0,207
		C19 Walking Trails	0,145
		C20 Renewable Energy Utilization	0,167

When we examine the grouping results of the applications from the findings obtained from the expert group, C1 Air Quality Monitoring (0.242), C2 Vehicle Charging Stations (0.214), C3 Smart Lighting (0.209), C4 Use of Renewable Energy (0.129), C5 Smart Irrigation Systems (0.206) gained weight under Smart and Sustainable Urban Infrastructure applications. When we look at these results, C1. Air Quality Monitoring (0.242) applications gained more weight than other applications for Smart and Sustainable Urban Infrastructure. This result shows that this application is more important than others. The purpose of conducting the AHP analysis for this study was to determine the degree of importance among the Green Infrastructure and Ecological Solutions applications. When the results are examined, C6 Green Roofs (0.106), C7 Vertical Gardens (0.101), C8 Biodiversity-Supporting Landscape Designs (0.009), C9 Natural Rain Gardens (0.112), C10 Green Corridors (0.154), C11 Pollinator Gardens (0.103), C12 Scent Gardens (0.103), C13 Seed Gardens (0.149), C14 Carbon Sink Areas (0.163) applications got the highest results under Green Infrastructure and Ecological Solutions applications. The third group of eco-campus applications is Water Management and Sustainable Transport. There are 6 sub-criteria under this application. C15 Greywater Recycling Systems (0.156), C16 Permeable Surfaces (0.201), C17 Biological Ponds (0.124), C18 Green Bicycle Paths (0.207), C19 Walking Trails (0.145), C20 Renewable Energy Utilization (0.167) (Table 3).

Table 3. Normalized AHP table and dimensional weights

Total weights	Sub-criterias	Score weights of alternatives			
		Score weights	C1*	C2*	C3*
Smart and Sustainable Urban Infrastructure	C1 Air Quality Monitoring	0,012	**0,242**	0,014	0,011
	C2 Vehicle Charging Stations	0,014	**0,214**	0,011	0,009
	C3 Smart Lighting	0,017	**0,209**	0,021	0,021
	C4 Use of Renewable Energy	0,014	**0,129**	0,012	0,017
	C5 Smart Irrigation Systems	0,011	**0,206**	0,014	0,011
Green Infrastructure and Ecological Solutions	C6 Green Roofs	0,011	0,008	**0,106**	0,015
	C7 Vertical Gardens	0,013	0,004	**0,101**	0,011
	C8 Biodiversity-Supporting Landscape Designs	0,014	0,014	**0,009**	0,009
	C9 Natural Rain Gardens	0,011	0,011	**0,112**	0,014
	C10 Green Corridors	0,007	0,013	**0,154**	0,013
	C11 Pollinator Gardens	0,006	0,013	**0,103**	0,014
	C12 Scent Gardens	0,015	0,011	**0,103**	0,017
	C13 Seed Gardens	0,021	0,009	**0,149**	0,014
	C14 Carbon Sink Areas	0,014	0,015	**0,163**	0,016
Water Management and Sustainable Transport	C15 Greywater Recycling Systems	0,011	0,014	0,011	**0,156**
	C16 Permeable Surfaces	0,013	0,015	0,019	**0,201**
	C17 Biological Ponds	0,014	0,013	0,016	**0,124**
	C18 Green Bicycle Paths	0,017	0,016	0,011	**0,207**
	C19 Walking Trails	0,016	0,017	0,005	**0,145**
	C20 Renewable Energy Utilization	0,009	0,017	0,014	**0,167**

C1* : Smart and Sustainable Urban Infrastructure
C2* : Green Infrastructure and Ecological Solutions
C3* : Water Management and Sustainable Transport

Second Analysis: Evaluation of the criteria

In another stage of the evaluation, factor analysis was performed on the data set containing 20 criteria to obtain findings with principal component analysis. As a result of the analysis, 8 components were identified, which constituted approximately 57.138% of the variance (Table 4).

The highest results of the total variance were 8th Factor loading with a weight of 57.138%, 7th Factor loading with 51.934% and 6th Factor loading with 46.443% (Onur, 2023; Güneroglu, 2017; Shrestha, 2021).When the distributions of variance and weights were examined, the highest weights in the 6th Factor loading were C1 Air Quality Monitoring (0.376), C15 Greywater Recycling Systems (0.343), C16 Permeable Surfaces (0.302), C19 Walking Trails (0.489) and C20 Renewable Energy Utilization (0.404). In the 7th Factor loading, which took 51.934% of the total variance, the highest weights were C1 Air Quality Monitoring (0.411), C3 Smart Lighting (0.469) and C18 Green Bicycle Paths (0.454). The 8th Factor loading, which took the highest rate of the total variance (57.138%), was C3 Smart Lighting (0.370), C6 Green Roofs (0.414) and C19 Walking Trails (0.418). It was determined by the results that these criteria were more important than the others (Table 5, Figure 3).

Table 4. Total variance of Factor Analyses

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,174	10,870	10,870	2,174	10,870	10,870
2	1,799	8,994	19,864	1,799	8,994	19,864
3	1,424	7,118	26,982	1,424	7,118	26,982
4	1,351	6,755	33,737	1,351	6,755	33,737
5	1,287	6,435	40,172	1,287	6,435	40,172
6	1,254	6,271	46,443	1,254	6,271	46,443
7	1,098	5,491	51,934	1,098	5,491	51,934
8	1,041	5,204	57,138	1,041	5,204	57,138

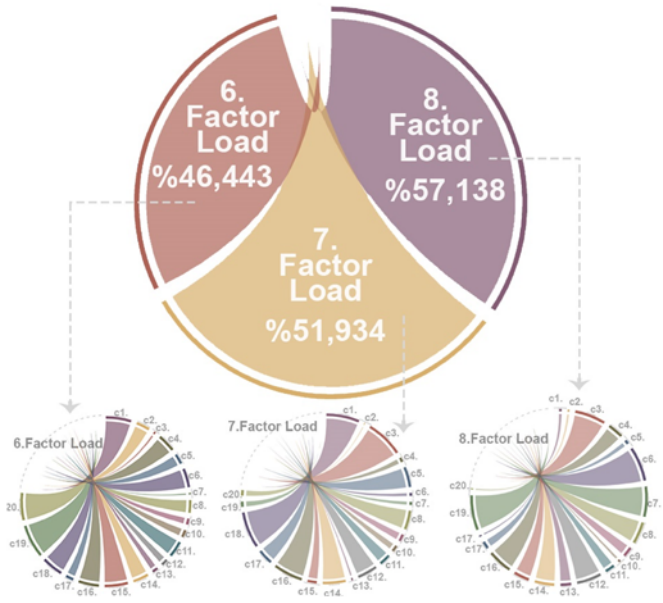


Figure 3. Factor loading distribution of criteria

Tablo 5. Criteria weight distribution

Variables	Component							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
C1 Air Quality Monitoring	,150	-,208	-,266	,254	-,001	,376	-,411	-,031
C2 Vehicle Charging Stations	,032	,240	-,425	,326	,080	-,199	,009	,020
C3 Smart Lighting	-,134	,393	-,055	,237	,094	-,026	,469	,370
C4 Use of Renewable Energy	-,135	,311	,171	,286	,297	,264	-,058	,186
C5 Smart Irrigation Systems	,175	,240	-,098	-,082	,602	-,151	-,254	,048
C6 Green Roofs	,212	,040	-,450	-,082	,281	,280	-,039	,414
C7 Vertical Gardens	,379	-,454	-,206	-,234	-,015	-,018	,038	,362
C8 Biodiversity-Supporting Landscape Designs	,476	-,442	-,073	-,034	,162	,186	,237	-,263
C9 Natural Rain Gardens	,588	-,381	,165	-,099	,189	-,090	-,089	,120
C10 Green Corridors	,254	-,262	,288	,413	,399	-,108	,078	-,026
C11 Pollinator Gardens	,460	,009	,455	,348	-,103	-,237	-,142	,117
C12 Scent Gardens	,282	,175	-,055	,486	,047	,097	,251	-,298
C13 Seed Gardens	,432	,254	-,430	,081	-,365	,085	,020	,128
C14 Carbon Sink Areas	,559	,165	-,123	,022	-,248	,230	,286	-,238
C15 Greywater Recycling Systems	,505	,287	,197	-,032	-,388	-,343	-,117	,187
C16 Permeable Surfaces	,232	,444	,084	,001	,109	,302	-,370	-,293
C17 Biological Ponds	,228	,450	,135	-,448	,007	,115	-,190	-,090
C18 Green Bicycle Paths	,154	,181	,308	-,417	,225	,312	,454	-,016
C19 Walking Trails	,020	,042	,442	,137	-,196	,489	-,064	,418
C20 Renewable Energy Utilization	-,289	-,367	,070	,185	-,247	,404	-,070	-,012

In the next stage, the correlation analysis between the criteria (Lv) was performed to see how the relationships between the criteria were. In the correlation table given in Figure 4, on the right side, there is a color scale from low correlation to high correlation (from dark to light). The scale divides the correlation degrees into 6 levels. The intervals indicate 1-no correlation, 2-very low correlation, 3-low correlation, 4-medium correlation, 5-high correlation, 6-very high correlation. Accordingly, among the parameters, it was determined that there was a "high correlation" between the C9 Natural Rain Gardens and C10 Green Corridors (0.268) criteria, C7 Vertical Gardens and C8 Biodiversity (0.267) criteria, and a "very high correlation" between the "C8 Biodiversity and C9 Natural Rain Gardens" and "C13 Seed Gardens, C14 Carbon Sink Areas (0.310) (0.319)" criteria. Because there is a positive correlation between these criteria, these practices are among the criteria that positively affect and strengthen students (Figure 4).

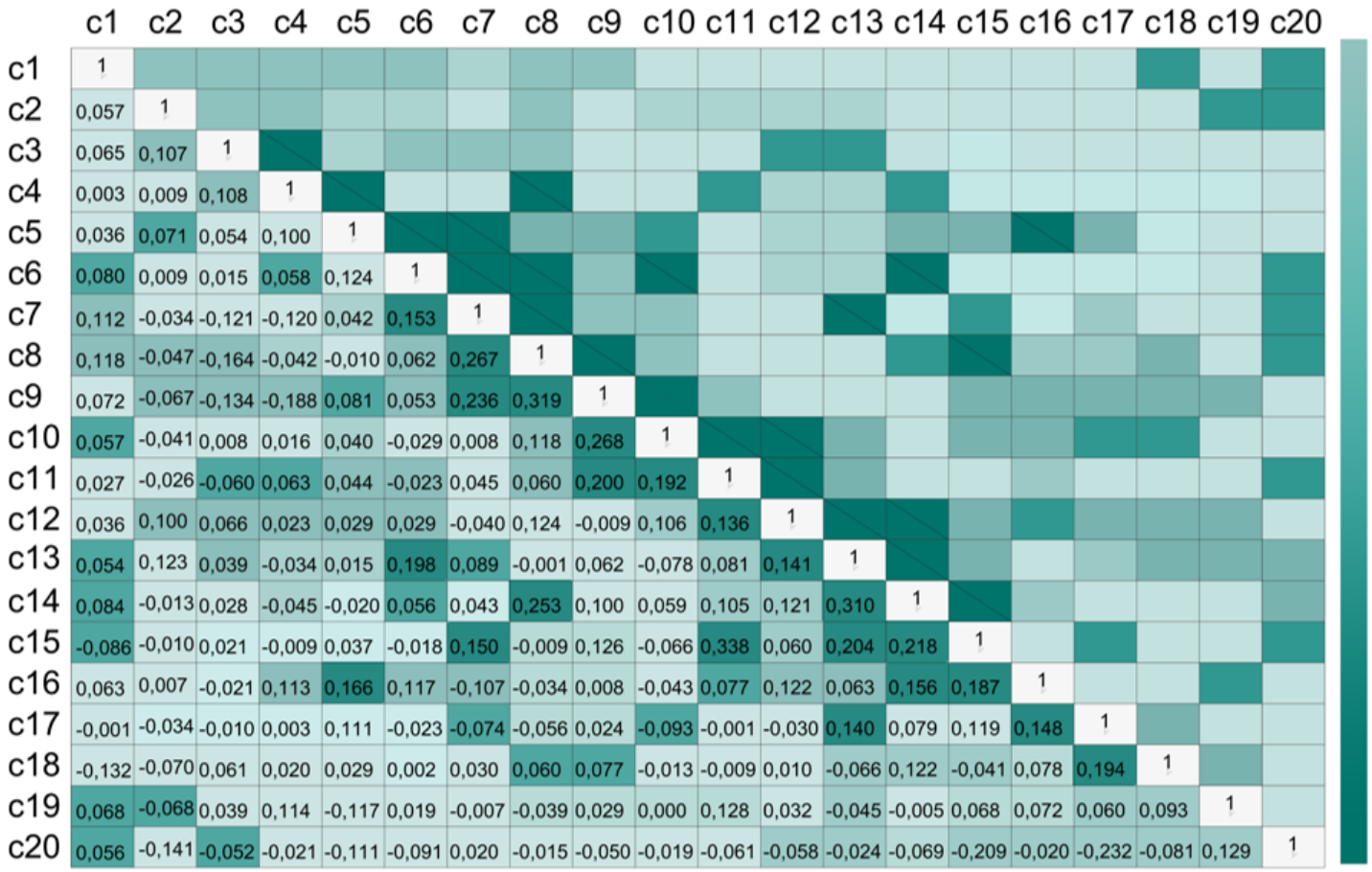


Figure 4. Results AHP comparison matrices

CONCLUSION

Today, university campuses serve as important laboratories for achieving sustainability goals. However, there are uncertainties about which criteria to prioritize in the planning and implementation of eco-campus applications. This study aims to provide a scientifically based guide for decision-makers by quantitatively demonstrating the importance levels and interrelationships of eco-campus evaluation criteria. Such a prioritization study is needed especially for the efficient use of limited resources and maximum environmental benefit. The increasing environmental challenges faced by urban areas and academic institutions highlight the urgent need for sustainable campus solutions. Eco-campus projects play a critical role in mitigating climate change, preserving biodiversity, and promoting resource efficiency. However, the effective implementation of such projects requires a systematic evaluation of priorities and synergies between different sustainability measures. This study fills a critical gap by quantitatively assessing the importance levels and interrelationships of eco-campus applications, providing a data-driven framework for decision-makers.As a result of the AHP analysis conducted in the first stage, the Green Infrastructure and Ecological Solutions category (51%) was determined to have the highest weight and the applications of this category, especially the critical elements such as Carbon Sink Areas (0.163), Seed Gardens (0.149) and Green Corridors (0.154), were found to be of the highest importance. This finding reveals the importance of prioritizing green infrastructure applications in the planning of eco-campus projects. In addition, the fact that

applications such as Carbon Sink Areas and Seed Gardens are among the most important sub-criteria of this category shows that increasing ecosystem services can provide long-term environmental benefits. The Smart and Sustainable Urban Infrastructure category (28%) attracted attention with applications such as Air Quality Monitoring (0.242) and Vehicle Charging Stations (0.214). The category with the lowest weight was Water Management and Sustainable Transport with 21%, but this category also includes important elements such as Green Bicycle Paths (0.207) and Renewable Energy Utilization (0.167).

Although the Smart and Sustainable Urban Infrastructure category (28%) has a lower weight, it is understood that the applications in this category also have an important place. Technological infrastructures such as Air Quality Monitoring and Vehicle Charging Stations in particular represent the modern solutions required to ensure the sustainability of cities. It can be said that these applications play an active role in critical areas such as energy efficiency and air quality improvement. However, the fact that this category is not as weighted as Green Infrastructure means that technological infrastructure is a lower priority compared to environmental infrastructure. The lower weight of the Water Management and Sustainable Transport category (21%) shows that water management and sustainable transportation solutions are still important, but less emphasized than other categories. However, the prominence of applications such as Green Bicycle Paths and Renewable Energy Utilization in this category shows that sustainability of transportation and renewable energy use should be fundamental elements in eco-campus projects.

In the second analysis, 8 factors determined by factor analysis explained the variance of the criteria and revealed the most important applications. The highest variance of the factors was concentrated in criteria such as Smart Lighting (0.370), Green Roofs (0.414) and Walking Trails (0.418). These findings show that eco-campus applications include important elements from both environmental and technological perspectives. In addition, the correlation analysis between the criteria revealed that elements such as Natural Rain Gardens and Green Corridors showed high correlations with each other, and there was also a strong relationship between Biodiversity-Supporting Landscape Designs and Vertical Gardens. These high correlations show that certain applications create supportive effects when used together and that such applications can be used more effectively in eco-campus projects.

The results of factor analysis provide a more detailed understanding of the relationships between the criteria. In particular, the high correlation between applications such as Natural Rain Gardens and Green Corridors demonstrates the benefits of using these elements together as complementary solutions. Similarly, the relationship observed between Biodiversity-Supporting Landscape Designs and Vertical Gardens shows that these elements can work in harmony to increase ecosystem diversity and improve environmental quality.

These findings provide important information on how different categories can be used together and in harmony in eco-campus projects. In future projects, more emphasis on green infrastructure applications can produce more effective results in terms of environmental sustainability and biodiversity protection. In addition, the integration of technological infrastructure and transportation solutions with environmental applications will ensure that the entire system works more efficiently. In order for such projects to be successfully implemented, it is of great importance to consider the relationships between the criteria and the weights of these criteria.

As a result, it is emphasized that the applications used in eco-campus projects should be integrated in a harmonious way and that especially the elements in the Green Infrastructure field should come to the fore. The findings of this research provide important data on which applications should be given priority in order for eco-campus projects to become more effective in terms of environmental sustainability. In this context, the relationships and weights between the criteria should be taken into account for a more efficient application process.

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Author Contributions

The researchers contributed equally to all parts of this study. The authors declare that there is no conflict of interest.