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Developing Awareness about the Role of Cycling Infrastructure in Sustainability: Experiences from Architectural Design Studio

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Abstract: The sustainability performance of university campuses plays an important role in improving their users' quality of life and raising generations with sustainability awareness. The Green University Index (UI Greenmetric) is known as an instrument for measuring the sustainability performance of universities. By using environmentally friendly means of transport and creating education plans that prioritise sustainability, universities can meet the criteria set out in the Green University Index. In this context, it is important that architecture students are adequately equipped to incorporate environmentally friendly designs and low-carbon alternative modes of transport such as bicycles into their living environment.

Architecture education harbours considerable potential for the theoretical and practical communication of sustainability principles to students. In particular, the design studio environment enables students to develop their thinking and production skills in the context of environmental, social and economic sustainability. Within the scope of this study, the architectural design studio processes carried out with first year students of the Architecture Department of Niğde Ömer Halisdemir University and the gains gained by the students from these processes were discussed based on the necessity of the architectural design studio to create sustainability awareness among the students. As a result of the study, suggestions were made for architectural design studio processes through a survey. It was emphasised that informal learning processes should be supported, that users' experiences should be taken into consideration in the creation of the architectural requirements programme and that three-dimensional representation tools such as terrain models, vegetation figures and human figures should be used effectively.

Keywords: Architectural design studio, Cycling infrastructure, Sustainability, Informal learning, UI Greenmetric

Introduction

Universities play an important role in the changes in social, economic and political life. This important position also increases the influence of universities in the sustainability debate, which is one of the most discussed topics today. In the context of sustainable development, universities have an environmental and social responsibility (Özdal Oktay ve Özyılmaz Küçükyağcı, 2015). With this understanding, eco-friendly, sustainable university campus designs and applications are

rapidly increasing around the world (Benliay and Gezer, 2019). The Green Metric ranking system, which measures the sustainability performance of universities, is an international criteria system consisting of sub-items such as energy use, waste management, transportation, water consumption, infrastructure and education (Greenmetric, 2025). The Green Metric criteria were used in the study both as a source and design criterion for architectural design studios within the scope of the study. It is an important study topic to rethink the design problems and studio processes dealt with in the architectural design studio in accordance with the sustainability criteria established by Green Metric and to organise them in such a way as to increase students' awareness of sustainability. In particular, issues such as energy efficiency, green space ratio, reduction of carbon emissions and sustainable transportation can be directly considered in the architectural design. The Green Metric criteria provide an important frame of reference that shapes both the educational content of the design studio and the environmental impact of the projects produced. In this context, the use of bicycles, a sustainable mode of transportation, on the university campus is important both to reduce carbon emissions and meet environmental goals, as well as to create a healthy environment that enhances the quality of life of students and staff.

When university campuses are considered in the context of sustainability, bicycle-friendly campuses are characterised by prioritising cycling, which has environmental, social and individual benefits in transportation systems, and providing infrastructure such as safe cycle lanes, cycle parking, cycle repair stations and support services such as bike sharing schemes (Alkılınç et al., 2021). Architectural design should be included in the creation of a bicycle-friendly campus. Integrating this requirement into architectural education and conducting design workshops to popularise the use of sustainable transportation solutions such as bicycles will contribute to students' professional development and enable them to develop an awareness of sustainable transportation systems. In addition, a campus life that encourages physical activity will also promote students' physical and mental well-being.

Within the scope of this study, the architectural design studio processes carried out with first-year students of the Architecture Department of Niğde Ömer Halisdemir University and the gains obtained from these processes were discussed based on the need for the architectural design studio to create sustainability awareness among students and the importance of creating a bicycle-friendly campus. Architectural education has significant potential when it comes to teaching sustainability principles to students on a theoretical and practical level. In particular, the design studio environment allows students to develop their thinking and production skills in the context of environmental, social and economic sustainability. In this study, students were asked to design a "bicycle house" to be located on the university campus as part of an architectural design studio. This design problem was set to support sustainable transportation alternatives on campus and to develop proposed architectural solutions in accordance with Green Metric criteria. During the study process, students were asked to design energy-efficient, flexible and user-friendly structures that are integrated with the transportation infrastructure while developing strategies to reduce carbon emissions. In this context, the study aims to demonstrate the role of the architectural design studio in instilling sustainability awareness in students.

Method

In this study, the aim was to realise the bicycle house project on the campus of Niğde Ömer Halisdemir University with first-year architecture students and thus create awareness for the development of sustainable designs. In this context, an area was determined for the bicycle route and the bicycle house related to the reservoir to be integrated with the existing bicycle paths on the campus. During the 14-week semester, the students developed project proposals by working on sections of bicycle and pedestrian routes, bicycle-friendly urban furniture and an architectural programme for the bike house.

The design studio process is divided into six phases: Researching the topic and scenario, creating the architectural programme, creating diagrams and sketches, workshop on placing masses on sloping terrain, working with models and figures and using informal learning tools, is designed to help students develop an architectural project that prioritises sustainability and meets the parameters of the green metric. The main aim of the designs is to increase the use of cycling as a sustainable mode of transportation on the university campus and to spread the culture of cycling among students, staff and academics using the campus.

In this context, the aim was to strengthen the recreational opportunities in the study area with bicycle paths and various functions. As a result of the study, a survey study was carried out to determine the extent to which the processes in the architectural design studio were successful in terms of the students' professional development and sustainability awareness. The survey study was conducted on 6 students who participated in the architectural design studio for 14 weeks. The survey, which was used to determine students' opinions and performance in relation to the project processes, consists of open-ended questions, multiple-choice questions and questions on a 5-point Likert scale. The students' opinions on sustainability, workshop processes and bicycle use were also analysed. As a result of the study, suggestions were made for the workshop processes.

Measuring the Sustainability Performance of Universities: Green University Index (UI Greenmetric)

The Higher Education Council (YÖK), which aims to increase the visibility of universities in Turkey by making them more sustainable in the world, supports the studies of university administrations on green universities (YÖK, 2025). According to the general report on the monitoring and evaluation of universities published by the Higher Education Council (YÖK), a total of 94 Turkish universities were included in the top 1000 of the Green University Index 2024 (UI Greenmetric). Niğde Ömer Halisdemir University ranks 293rd in this list (YÖK, 2025).

The Green University Index evaluates universities taking into account the three basic dimensions of sustainability, namely social, economic and environmental criteria. The Green University Index platform evaluates various parameters such as the proportion of green space, carbon footprint, electricity consumption, transportation, water use, waste management, settlement and infrastructure, energy and climate change as well as education and research. Using these indicators, it collects information on how universities respond to sustainability issues or manage them through strategies, measures and communication. The criteria used are listed in Table 1 (Greenmetric, 2025).

Table 1: *Green University Index Criteria (Greenmetric, 2025).*

Criteria	Description
Settıngs And Infrastructure (S_1) (15%)	Basic information of the university policy towards green environment. Include space for greenery and in safeguarding environment, as well as developing sustainable energy.
Energy And Clımate Change (Ec) (21%)	The university's attention to the use of energy and climate change issues. Universities are expected to increase the effort in energy efficiency on their buildings, nature and resources.
Waste (Ws) (18%)	Waste treatment and recycling programs are major factors in creating a sustainable environment. Universities must take note on its waste production as well as recycling efforts.
Water (Wr) (10%)	Universities are expected to decrease water usage, increase conservation program, and protect the habitat. This may include water conservation program and piped water usage.

Transportatıon (Tr) (18%)	Universities policies in limiting the number of motor vehicles in campus, the use of campus bus and bicycle to encourage a healthier environment and reduce universities carbon footprint.
Educatıon And Research (Ed) (18%)	University effort in creating and supporting the new generation concern with sustainability issues.

Sustainability Goals and Cycling Infrastructure of Universities

The concept of the Green University, which defines universities that care about sustainability, is quite new. The Green University is associated with the implementation of sustainability and environmentally friendly strategies on university campuses and the updating of the curriculum by including courses on the environment and sustainability (Atıcı, et al. 2021). With the Talloires Declaration (Talloires, 1990), one of the first international declarations calling on higher education institutions to protect the environment, the work of universities in the area of sustainability has accelerated. In the following years, the terms "green campus" and "green university" were used in academic circles (Wright, 2002). In 2010, the UI GreenMetric World University Rankings, initiated by the University of Indonesia, began to rank universities according to sustainability criteria. Thus, the concept of "green university" became known in the international academic community (Greenmetric, 2025).

A transportation policy that facilitates and promotes the use of bicycles ensures that the criterion of "environmentally friendly transportation" is met in the Green University Index (UI Greenmetric). Another criterion, "Education and research", also relates to the operation of the architectural design studio. For this criterion, it is important to educate a generation interested in sustainability, and in this context the existence of sustainability-related courses and activities at the university is assessed. The positive change achieved by the increased use of bicycles is also indirectly related to other criteria such as structure and infrastructure, energy and climate change, waste and water parameters and the corresponding sub-parameters (Greenmetric, 2025).

The analysis and planning study for bicycle paths on the central campus of Niğde Ömer Halisdemir University was carried out by the university administration and bicycle parking areas were established in the buildings on the campus. However, the marking of the planned separated bicycle paths with signs and the painting of the roads were only carried out in a very small area of the campus. As part of the architectural design studio, the bicycle paths around Akkaya Dam were planned to be integrated with the existing bicycle paths to be completed by the university administration.

Study Area and Field Data

The Akkaya dam was built in 1974 on the Niğde stream (Karasu-Tabakane stream) for irrigation purposes. The area of the dam is about 1 km2 (Bulut and Ceylan, 2011). Part of the dam is located on the grounds of Niğde Ömer Halisdemir University. To the east and south of the dam are agricultural areas and reed beds, to the west is the Bor district and to the north is the Niğde-Bor motorway (Başköse et al., 2012)

Figure 1: *Location of Akkaya dam and project site (Cüneyt, 2024).*

(Figure 1). Akkaya, which is close to the city centre, has great tourism potential, e.g. for bird watching, and should be established as a recreational area.

As part of the study, it was planned to treat the project area in line with the objectives of the green campus, including infrastructure such as a bicycle house and corresponding bicycle paths and walking paths. In this context, design studies for the area were carried out as part of the architectural studio course with first-year students from the Faculty of Architecture. The point with the best view of the reservoir within the campus was selected as the study area (Figure 2). It was requested that a bicycle and pedestrian path be built along the dam. The route of the path was determined, but the plan was that students to design its cross-section. There is also a tree in the project site that the

Figure 2: *Project site and tree to be protected (Taştan, 2024).*

Figure 3: *Location of Akkaya Dam and project site (Google,2024).*

students were asked to protect and include in their designs (Figures 2 and 3).

The structure of the Architectural Design Studio and the Stages of the Design Process

The main aim of the architectural design studio is to introduce architecture students to cycling culture to ensure that they understand the design principles that prioritise sustainability and the standards for bicycle-friendly design. In this context, the aim was for students to develop proposals as part of green campus studies and to develop an awareness of sustainability through their work in the design studio processes. The 14-week studio process, in which a total of 6 students took part, was carried out with various presentations and workshops with the students. The studio processes and students' achievements are as follows (Table 2).

Table 2: *Design Studio processes and student achievements*

Design studio processes	Student achievements
Researching the topic and scenario	Research on the use of bicycles as a sustainable means of transportation on university campuses and bicycle culture. Creating a link between the university's existing bicycle paths and the study area and developing future scenarios.

Creating the architectural programme	Creation of bicycle house architectural program. Determination of spatial and technical requirements of units such as bicycle club, bicycle station, guesthouse, cafe. Understanding of user needs.
Creating diagrams and sketches	Creation of schemes for the design of masses by preserving the trees in the study area. Understanding the importance of vegetation.
Workshop on placing masses on sloping terrain	Settlement on sloping terrain while preserving the natural gradient, solving traffic problems for cyclists and pedestrians. Development of accessibility solutions. Understanding the principle of minimising intervention in the topography
Working with models and figures	Expression of the realised design with models in different scales. Development of three-dimensional thinking and spatial design skills.
Using informal learning tools	Inspection of the project site, analysis and sketches Exchange of project examples/ideas with the help of the google classroom application. Exchange of student work in the google classroom application, obtaining opinions. Support peer learning through activities such as group work and presentations in the workshop. Obtaining user opinions, obtaining opinions from bicycle and campus users.

Design Decisions of Student Projects

During the process of scenarizing the project and identifying user needs, it was decided that the bike house to be built on a university campus could consist of three main units: Café, Bicycle Club Room and Guest House, and in this context various design experiments were carried out (Figure 4).

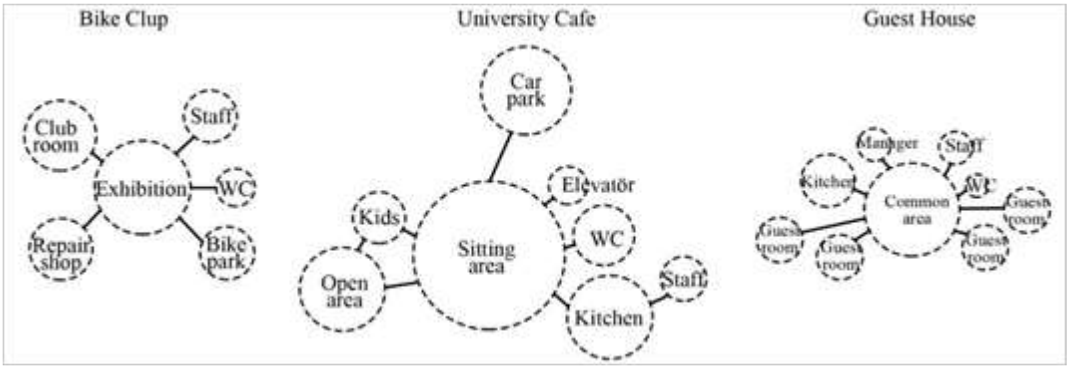

Figure 4: *Bubble diagram (Adopted from İsmail Tekeli's drawing)*

When planning their projects, the students defined different usage scenarios and the locations of the various devices in the work area. Accessibility was ensured by ramps, stairs and lift solutions on the site with a six-meter slope.

The projects implemented designs that prioritise social, economic and environmental sustainability, such as preserving the existing trees on the site and incorporating them into the structure, minimising interference with the topography, creating observation terraces to observe the Akkaya Dam and the bird species that visit the dam, designing bridges, designing the shoreline to create a connection with the water, designing piers overthe water, creating semi-open areas that can be used by cyclists and pedestrians around the dam at all times of the day, and creating indoor gardens and shaded areas that provide shelter from the climatic conditions (Figure 5).

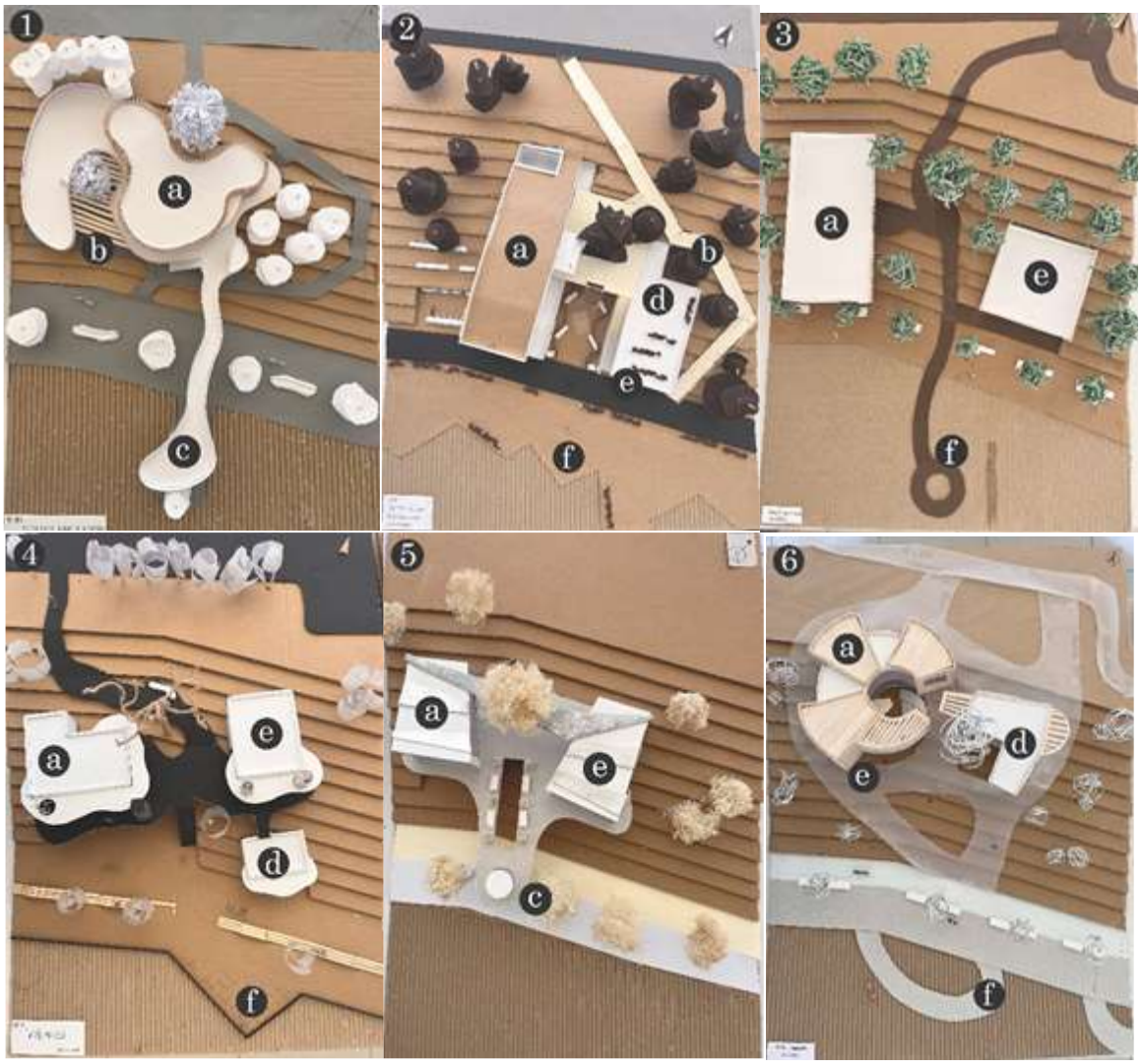

Figure 5: *Design decisions and locations of units on the project site*
(1: Altynbek Mamyrov, 2: Özlem Merve Büyükakkaş, 3: Shams Dheyaa Mahmood Almarawee, 4: İsmail Tekeli, 5: Münire Battal, 6: Seyedeh Asmae Alboshokeh)
a: cafe b: inner garden c: observation terrace d: guest room e: bike club f: wharf

Street sections and bicycle-friendly urban furniture designs

The pedestrian and bicycle route around the reservoir was designed using the Bicycle Route Regulation (Bicycle, 2025) published by the Ministry of Environment and Urbanisation on 12 December 2019. The pedestrian and bicycle path were separated by urban furniture and the safety of the pedestrian path was ensured by creating a natural barrier with the help of trees. Piers and viewing points were created around the dam (Figure 6). Semi-open areas were created that can be used on days when the public and bicycle houses are closed.

The aim of the project was to ensure that the seating areas and the lift, which are an extension of the café, are accessible at all times of the day (Figure 6). In another project, this barrier was

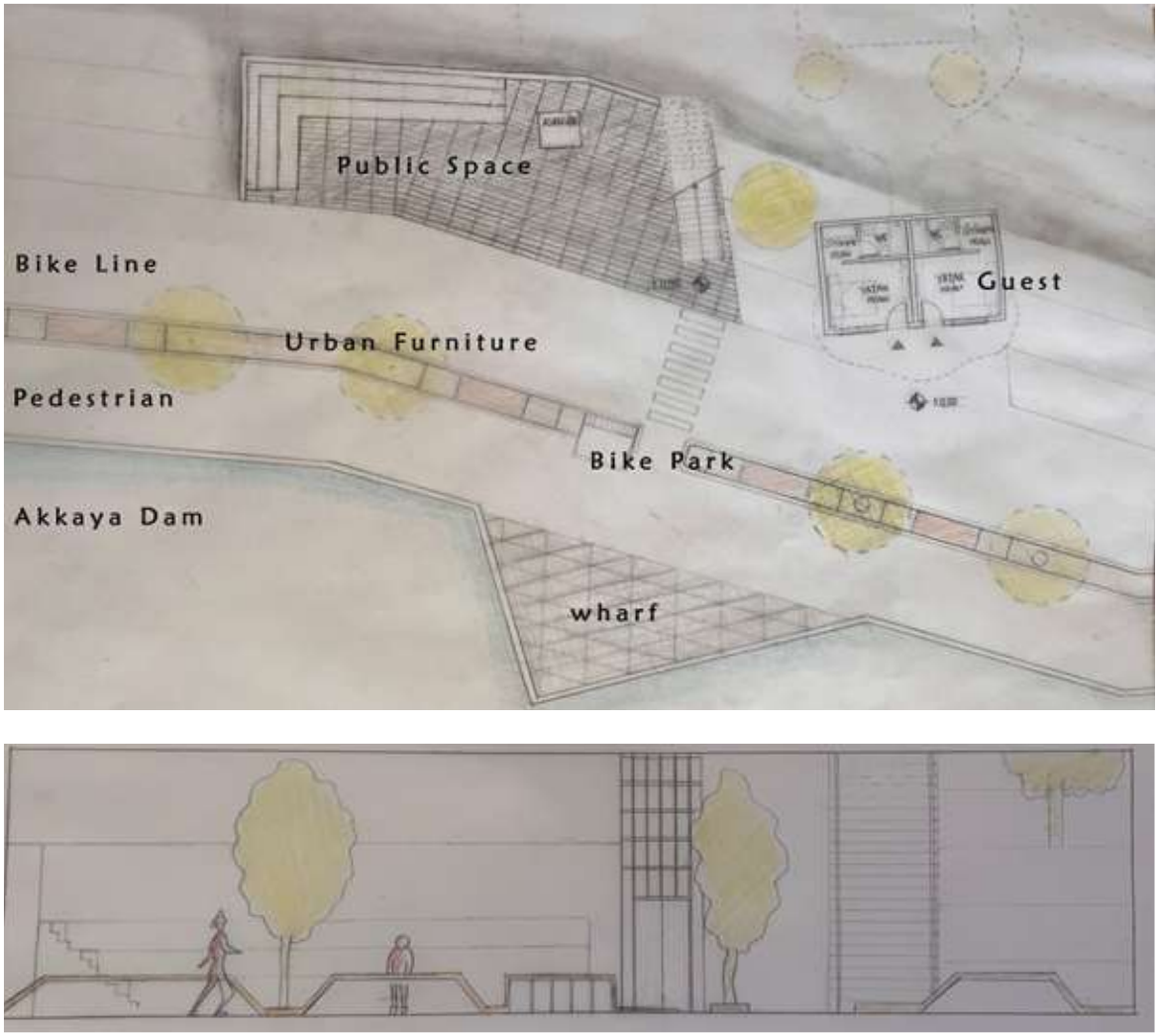

Figure 6: *Street section and its relationship with water (İsmail Tekeli)*

reinforced by bicycle parking spaces and shading elements (Figure 7).

Bicycle-friendly urban furniture is one of the most important ways of increasing bicycle use and developing a cycling culture in a place. A design that is linked to bicycle paths and provides bicycle parking facilities enables cyclists to socialise and use facilities such as cafés and bicycle clubs more easily. During the

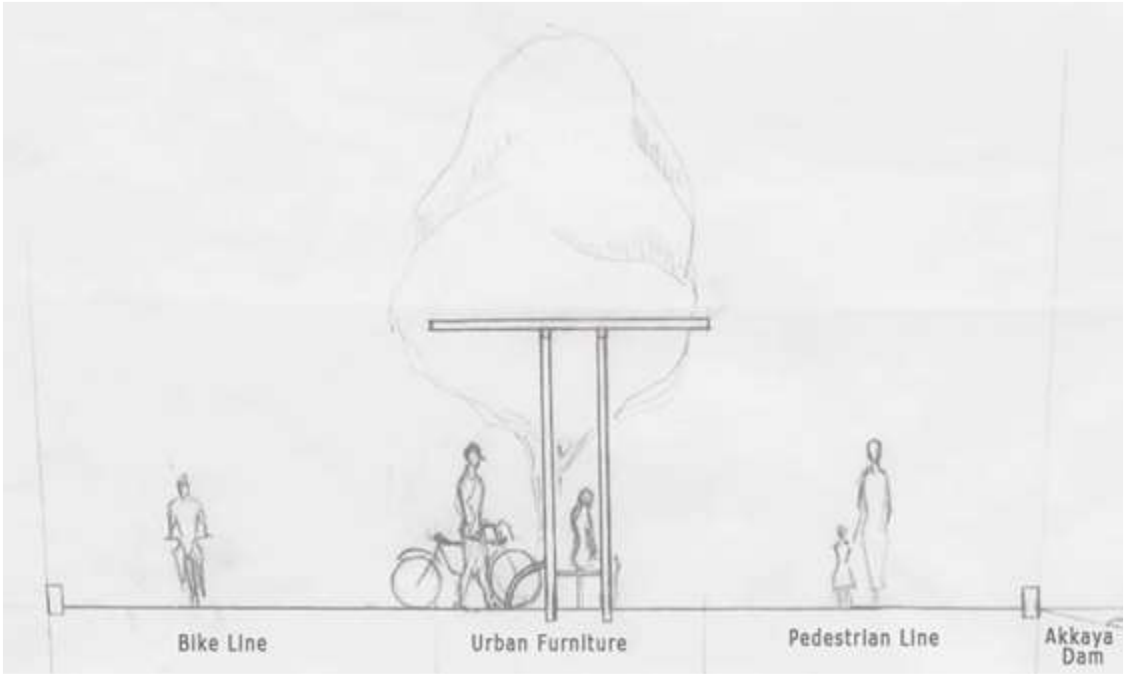

Figure 7: *Design of bicycle and pedestrian paths around the dam (Altynbek Mamyrov)*

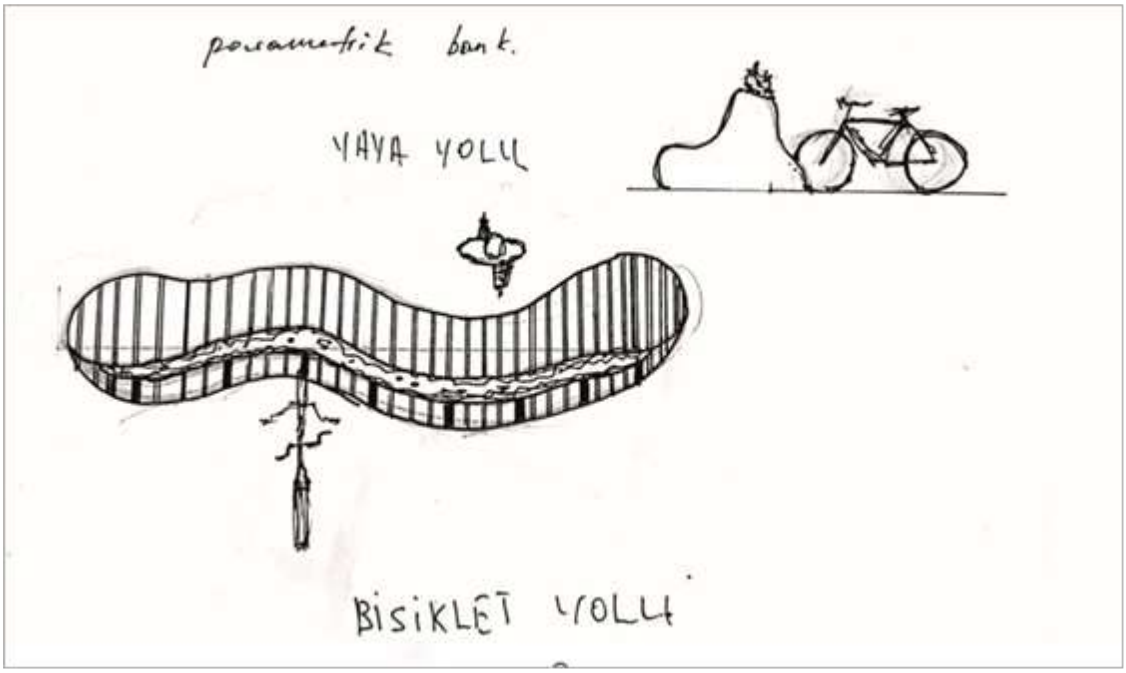

Figure 8: *Bicycle-friendly urban furniture designs (Altynbek Mamyrov)*

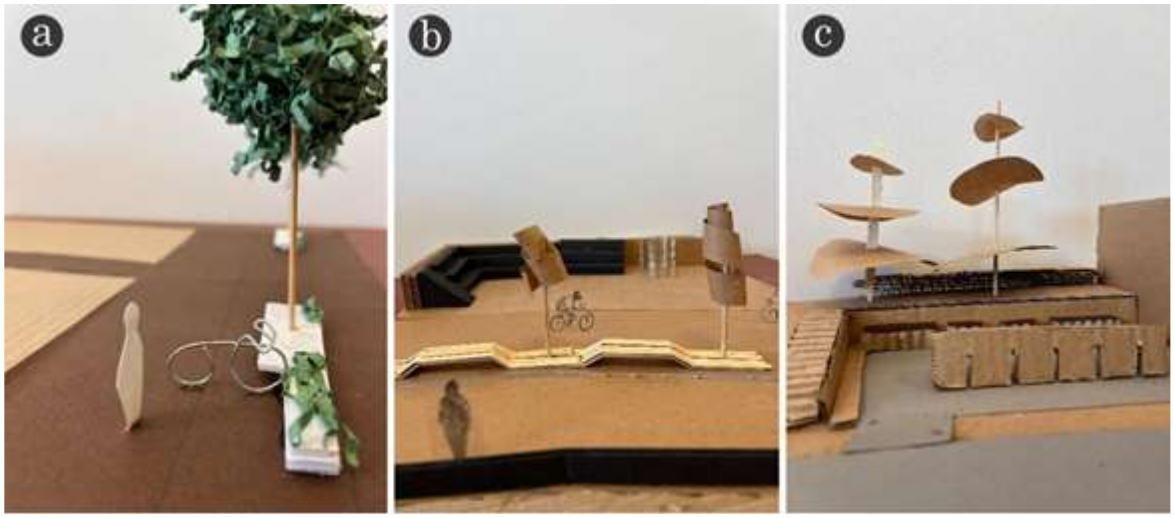

Figure 9: *Model examples (a: Shams Dheyaa Mahmood Almarawee, b: İsmail Tekeli, c: Özlem Merve Büyükakkaş)*

design studio, various furniture designs were realised, represented by both drawings and models (Figure 8, Figure 9)

In order to internalise the designs created during the design studio and better understand the technical details, three-dimensional vegetation and human figures were used and model studies were carried out at various scales (Figure 9). In addition, informal learning tools such as social media and Google classroom application were used during the study process and peer learning was supported.

Evaluation of Architectural Design Studio Stages

Design studio processes were evaluated with a survey conducted with architecture students. The main goals of the studio processes are for students to be aware of the Green metric parameters, namely, Settings and Infrastructure, Energy and Climate Change, Waste, Water, Transport and Education and Research, and to carry out future design projects by taking these criteria into consideration.

The results obtained from the survey conducted according to the five-point Likert scale are shown in Table 3. Accordingly, it is possible to make various inferences. The interviews conducted with bicycle users (Q7) were more effective than the literature research conducted on the subject (Q1) in the design studio students' recognition of bicycles as a sustainable means of transportation. The interviews conducted with users and the observations made in the study area were effective in the creation of the architectural needs program and in determining social needs such as the need for socialization areas in addition to physical needs. Diagramming and sketching studies enabled students to make basic decisions about their projects faster (Q10), while preserving the existing plant texture and placing masses according to the positions of the trees increased students' environmental sustainability awareness.

With the presentation and design studies carried out in the Mass Placement on Sloping Terrain Workshop, students gained awareness of designing according to the natural slope and designed their projects accordingly (Q3). Students who worked with models and figures understood human-space interaction more easily and made progress in subjects such as space perception, placement on the slope, and designing in harmony with nature (Q18).

The use of informal learning tools was supported during the design studio process, and sample projects were shared with students with the help of the Google classroom application. In addition, peer interaction was supported in the workshop environment. According to the survey results, it is seen that the participants

think that they benefited from informal learning tools sufficiently (Q19). However, having only one group during the process negatively affected the informal learning process, and the variety of architectural expression, design and model material use remained limited to the ideas provided by the studio lecturers. As a result, it can be said that the methods of interacting with the user and working with three-dimensional representation tools are relatively more effective than other methods in the processes of students understanding a design problem and finding a solution by considering the principles of sustainability.

Table 3: *Survey results*

Studio Processes		Question Aiming to Measure	Value
1	Researching the topic and scenario (3,56)	(Q1) The research process allowed me to recognize bicycles as a sustainable means of transportation.	3,33
		(Q2) During the research process, I learned about the existing bicycle paths on our university campus.	3,83
		(Q3) During the research process, I learned about the bicycle culture and bicycle use on campus.	3,50
		(Q4) With the design I realized, I aimed to popularize bicycle use on our university campus.	3,50
		(Q5) My views on bicycle use changed positively after the project process.	3,66
2	Creating the architectural programme (3,88)	(Q6) Creating the architectural program at the beginning of the project facilitated my design process.	3,83
		(Q7) I interviewed bicycle users and analysed existing examples in order to create the requirements program.	4,00
		(Q8) Determining the needs and requirements of bicycles and bicycle users facilitated my design process.	3,83
3	Creating diagrams and sketches (4,00)	(Q9) Sketch work and diagrams allowed me to proceed systematically in the placement of masses.	3,83
		(Q10) I was able to express my ideas quickly with the stain work.	4,16
4	Workshop on placing masses on sloping terrain (3,76)	(Q11) Placing my masses on the sloping terrain was easy for me thanks to the presentation made by the lecturers.	3,83
		(Q12) Designing bicycle and pedestrian paths on a slope was easy for me thanks to the presentation made by the coordinators.	3,66
		(Q13) I think I settled into the natural slope with minimal intervention to the land.	4,00
		(Q14) I maximized accessibility on a slope with elevators, bicycle and pedestrian paths.	3,66
		(Q15) The goal of maximizing accessibility on a slope with elevators, bicycle and pedestrian paths increased my awareness on this issue.	3,66
5	Working with models and figures. (3,83)	(Q16) Making models made it easier for me to think three-dimensionally during my design process.	3,66
		(Q17) Advancing my design process on the model positively affected my settlement on a slope.	3,83
		(Q18) Discovering different model materials and using them in my model made it easier for me to understand and express my project.	4,00
6	Using informal learning tools (3,70)	(Q19) Sharing about the project area and subject with my friends contributed to my project.	3,83
		(Q20) Sample projects shared by the project coordinators on google classroom application contributed positively to my design process.	3,66
		(Q21) Seeing other students' projects and listening to lecturers' comments during the studio process contributed positively to my design process.	3,50
		(Q22) Interacting with other students during the studio process contributed positively to my design process.	3,83

Conclusion and Recommendations

Although the main purpose of universities is to provide education, they have the potential to be pioneers in many areas such as social, economic and ecological. In this study, the role of architectural design studios in creating sustainability awareness among architecture students was discussed. In this context, with the study carried out in the design studio, it was discussed how students could include green metric parameters in their designs, especially Transportation (Universities policies in limiting the number of motor vehicles in campus, the use of campus bus and bicycle to encourage a healthier environment and reduce universities carbon footprint). Settings and Infrastructure (Basic information of the university policy towards green environment. Include space for greenery and in safeguarding environment, as well as developing sustainable energy.) and Energy and Climate Change (The university's attention to the use of energy and climate change issues. Universities are expected to increase the effort in energy efficiency on their buildings, nature and resources.). The design studio's organization in this way means providing another green metric parameter, Education and Research (Universities effort in creating and supporting the new generation concern with sustainability issues.). The results developed through the study are shown in Table 4.

Table 4: *Design studio processes and developed suggestions.*

Design studio processes	Developed suggestions.
Researching the topic and scenario	While creating the user profile and scenario in the design studio, an environmentally and socially sustainable lifestyle should be targeted. Functions that are suitable for sustainability goals should be defined.
Creating the architectural programme	The architectural needs program should be designed to meet social needs as well as physical needs.
Creating diagrams and sketches	The existing plant tissue, animal population and wildlife in the project area should be included in the design process.
Workshop on placing masses on sloping terrain	The principle of minimising interventions in the topography should be adopted and cost-effective settlement strategies developed.
Working with models and figures	The designs that are realized should be expressed with models at different scales, and the perception of space and the human-space relationship should be kept in the foreground.
Using informal learning tools	The most important component of the design studio is informal learning. Interaction within the group should be encouraged and effective use of technological tools should be ensured. A production and discussion environment should be created through workshops.

Considering the role of architects and designers in achieving sustainability goals, the role of education in design studios in creating sustainability awareness is important. In this context, further work is needed on how studio processes can be better structured. The process itself and the tools used should be just as sustainable as the education provided.

Notes: N/A
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