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Research Article

EVALUATION OF LANDSCAPE DESIGNS AT MICROECONOMIC LEVEL WITH ARTIFICIAL INTELLIGENCE

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ABSTRACT. Landscape design is increasingly central in urban areas due to the growing need for functional, aesthetically pleasing, and sustainable spaces. This study examines the sustainability of designs that consider ecological values such as biodiversity and energy efficiency. Additionally, it explores how landscape areas can achieve a microeconomic level, defined as a design approach that maximizes environmental efficiency while minimizing costs. Microeconomic designs are minimalist approaches that integrate environmental efficiency, social benefits, and functional landscape features into urban planning. These designs aim to create spaces that are not only ecologically sound but also economically viable in the long term. In this context, the study prioritizes factors such as energy consumption and water use to ensure the sustainability of landscape designs. The criteria for microeconomic landscape designs were determined based on extensive literature research, providing the basis for selecting the most appropriate measures. These criteria have been transformed into landscape designs within an artificial intelligence environment. Artificial intelligence has been integrated with a systematic evaluation method to assess the success of the emerging designs. The evaluation criteria include various factors that contribute to the effectiveness of the design. Ultimately, the study emphasizes that low-cost, environmentally friendly landscape designs have the potential to improve both ecological balance and public health. Furthermore, the proposed methodological approaches offer practical guidance for landscape professionals and designers working on sustainable urban projects with the use of artificial intelligence.

Keywords: *microeconomic designs; landscape design; artificial intelligence; sustainability*

INTRODUCTION

Landscape designs aim to create aesthetic, functional and sustainable usage areas with human and environment-oriented approaches. Today, ecological values are gradually replacing aesthetic concerns in urban areas. The integration of ecological values into landscape designs enables the use of the elements created in the designs at the micro level. In this context, designs at microeconomic level come into play. In addition to the cost of the product, it also plays an important role in creating designs for product efficiency. This approach shows that the sustainability of design elements can be increased.

When the concept of microeconomics is explained in the design dimension; it covers design processes that increase the efficiency of products. It optimises designs in a functional sense. Therefore, landscape designs should be kept at microeconomic level in functional terms.

Microeconomics and landscape design integrated studies play an important role in the creation of micro-scale green areas and sustainable cities. These studies aim to increase the efficiency of products in design processes and to provide functional optimisation. Microeconomic values can be applied to landscape designs with minimalist design methods other than cost. Minimalist design criteria enable ecological design approaches to create a link between these two concepts. Thus, more livable and productive urban landscape areas are created by ensuring both economic and environmental sustainability. Minimalist designs enable the creation of micro-scale green areas in aesthetic and functional terms. At this point, minimalist design criteria can be used as the intersection point of microeconomic values and landscape designs. Minimalist design approaches support both economic and environmental sustainability, enabling the creation of more efficient and aesthetically satisfying areas.

Minimalist design movement represents simple, few and simplicity in landscape architecture [1,2]. Minimalist design criteria aim to save energy in designs. In addition, economic contribution is provided by using less material. In the minimalist design approach, examining the functionality of design elements is the main factor. This approach makes it possible to apply landscape designs to areas where usage conditions are difficult in urban areas [3].

In addition to minimalist designs created to achieve microeconomic landscape design levels, sustainable landscape designs are also being developed. Although there are intersection points, sustainable landscape design criteria are more comprehensive than minimalist designs. Sustainable landscape design principles are also important links for microeconomic landscape designs. The application of sustainable landscape design principles indirectly leads to microeconomic landscape designs. In sustainable landscape designs; low water use, reconstruction of soil with impaired function (water storage/filtering), planting to reduce urban heat islands and energy consumption. Microeconomic landscape requirements are met at this point [4].

The content of the study shows the functional benefits of minimalist designs and sustainable landscape designs, as well as their contribution to ecological values. The creation and evaluation of these values with the help of artificial intelligence enriched the content of the study. It is possible to create new designs with artificial intelligence in order to obtain microeconomic landscape designs by using minimalist design and sustainable landscape design criteria. Artificial intelligence can be used in many areas of visual design. In addition to the evaluation and interpretation qualities, artificial intelligence provides sufficient data in the visual creation process [5].

In this research, it is aimed to create microeconomic landscape designs with the support of artificial intelligence by analyzing minimalist landscape designs and sustainable landscape design criteria. It is aimed to create a new design concept in accordance with the criteria of the two concepts. The contribution of minimalist and sustainable designs created for the purpose of obtaining microeconomic values to ecological, aesthetic and economic values has been shown. In addition, it has been stated that it is appropriate research to evaluate the success of artificial intelligence in accordance with the presented landscape design criteria.

MATERIALS

Within the scope of the study, conceptual literature researches were carried out before microeconomic landscape designs were created using artificial intelligence. As a result of these researches, the criteria of minimalist and sustainable landscape designs were determined as the material part of the study.

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The research applications were carried out in micro areas in Çanakkale Onsekiz Mart University Terzioğlu Campus. The areas are shown in the location below (Figure 1).

Fig. 1. *Application Area Location (Created by Modifying Google Earth)*

The application area of the study includes areas at a scale where microeconomic landscapes can be reflected and implemented. Two of these areas have a visual view of the sea and have features that enable the minimisation of water use according to the microeconomic area request. After the site location was determined, it was selected according to these criteria.

First Area: It is located in front of an old restaurant on the campus. This area, which has a sea view away from the campus buildings, has a size of 1093 m².

Second Area: It is located behind the campus restaurant. This area, which has the potential to provide resting opportunities for students, especially during transition moments, has a size of 743 m².

Third Area: It is the area behind the Vocational School of Health. This area has a size of 876 m².

Conceptual literature research has been carried out for the determined areas and these concepts have been discussed within the scope of minimalist designs and sustainable landscape designs. The concepts were presented to artificial intelligence as descriptive criteria while creating the design in the method phase. Sustainable landscape designs

were used in the ecological dimension of microeconomic landscape designs, while minimalist designs were used in the visual and aesthetic dimensions.

Sustainable Landscape Design Criteria

Sustainable landscapes consider designs as a whole and emphasise not only their aesthetic features but also their ecological and economic qualities [6]. Therefore, it intersects with the requirements of microeconomic landscape designs. Sustainable landscape designs respond to microeconomic needs with features such as ecological and economic level, less material use and controlled water management. Sustainable landscape criteria that support microeconomic landscape designs are listed below:

Water Management: The economical use of water in landscape design is very important for environmental sustainability. Ensuring the minimum use of water, water controls after precipitation, the use of new waste water systems enable us to use water effectively in landscape designs.

Protection of Soil Health: Maintaining soil health improves the water storage and filtering properties of the soil. The water storage feature of the soil used in landscape designs uses the amount of water to be utilised after precipitation in natural ways.

Planting to Minimise Energy Consumption: Planting should be done at designated points to reduce the energy needs and costs of design spaces. Especially green roofs and plants should be used to reduce the effect of urban heat islands. In order to reduce the need for water in planting designs, plants with low water requirements should be included in the design.

Use of appropriate materials: Creating the structural textures in the area with recyclable, sustainable and local materials; integrating measures to ensure that the waste level is reduced to zero into the designs are important elements of sustainable designs in economic and environmental terms [4].

Minimalist Landscape Design Criteria

Minimalism is derived from the French word "minimum". The term "minimum" is defined as "as much as something is necessary or the least/smallest, the lowest" (TDK). The main purpose of creating microeconomic landscape designs is to utilise as much as necessary. The term minimalism meets microeconomic landscape designs at this point. Minimalist design features that help in the creation of microeconomic landscape designs are indicated.

- Precise forms,
- Fixed, monochrome surfaces,
- They are unitary designs.

Minimalist designs represent microeconomically simple designs with the use of monochromatic plant palettes [3].

METHODS

In the study, a conversation with artificial intelligence was initiated after determining the criteria supporting microeconomic landscape designs. At the beginning of this conversation, questions were asked about minimalist landscape designs, sustainable landscape designs and microeconomic landscape designs in order for the artificial intelligence to understand the subject more clearly. Gemini and PromeAI artificial intelligence applications were used in the study.

Definitions Offered to Artificial Intelligence

Before requesting designs from artificial intelligence in application areas, definitions suitable for the artificial intelligence programme have been created within the scope of the subject. In the first stage, the desired efficiency could not be achieved with a single definition. Therefore, more than one definition was used. Detailed inputs were insufficient. The definitions were changed according to the answers given by artificial intelligence. As a result, designs were created in accordance with the general definitions.

In order to obtain the most appropriate designs from the definitions presented to artificial intelligence, 3 separate definitions are given, each covering 3 areas. definitions are given in order. After the feedback of artificial intelligence, correction data were entered to maximise the conformity. Definitions, feedbacks and correction data are given respectively:

1. Create urban landscape designs in line with sustainable landscape requirements (economical use of water in landscape designs, planting to minimise energy consumption, use of recyclable, sustainable and local materials, protection of soil health) and minimalist design criteria (precise forms, fixed, monochrome surfaces, unit designs). Evaluate the resulting design at microeconomic level.

Feedback: Did not present the design visual for recognition. He provided information on how sustainable landscape designs and minimalist designs can be used together to create microeconomic designs.

Correction Data: It was asked to create a design visual adhering to the definition. He repeated his feedback in the same way.

According to the long explanations in the definition and the criteria given, the artificial intelligence did not present the desired design. Therefore, the criteria given in brackets in the definition were removed and the definition was directed to artificial intelligence again.

2. Create urban landscape designs in line with sustainable landscape requirements and minimalist design criteria. Evaluate the resulting design at microeconomic level.

Feedback: Artificial intelligence presented perspective images that do not conform to the boundaries of the plan view area.

Correction Data: Plan images of the designs were requested. The artificial intelligence went beyond the definition by creating similar perspective images after the correction data and transmitted the evaluation letters.

In the second iteration, the desired design visuals were not achieved.

3. Create landscape designs that have a plan appearance that combines sustainable landscape designs and minimalist designs. Evaluate the resulting design at the microeconomic level.

Feedback: Artificial intelligence offered designs suitable for the areas.

Ultimately, the visual creation phase was finalized using the third iteration. After the appropriate definition was determined and design visuals were created with artificial intelligence, the created visuals were asked to be evaluated based on the given definition.

RESULTS AND DISCUSSION

Artificial intelligence has created a design within the area boundaries (figure 2) we have presented. This design was subsequently adapted to the site boundaries and applied within the boundary perimeter.

Fig. 2. *Area Boundaries (Created by Modifying Google Earth)*

Created Landscape Designs and Evaluations

Artificial intelligence created landscape designs in accordance with the determined area boundaries and given definitions. These designs were evaluated by artificial intelligence. The generated designs and their evaluations are shown (Figure 3,4,5).

Fig. 3*. First Created Landscape Design (Gemini AI, 2024)*

Positive Evaluations

When the design created with artificial intelligence is evaluated at the microeconomic level, it is seen that the hard floors are created with a single material and the surrounding plantations affect the area. Taking advantage of this situation, the plantings in the area were kept to a minimum. There is no limitation of any structural element on the elements consisting of the same material and texture.

The area provides multi-directional use. The fact that the usage zones within the area are not restricted has revealed functional usage features for opportunities such as resting, walking and activities.

Artificial intelligence has indicated that the circular areas in the image can be considered as puddles or rainwater collection basins, which can be developed in the next stages and this is a positive sign in terms of efficient use of water.

Negative Evaluations

Since the materials used in the design are not specified, it is not possible to make a definite judgement in line with the criteria given

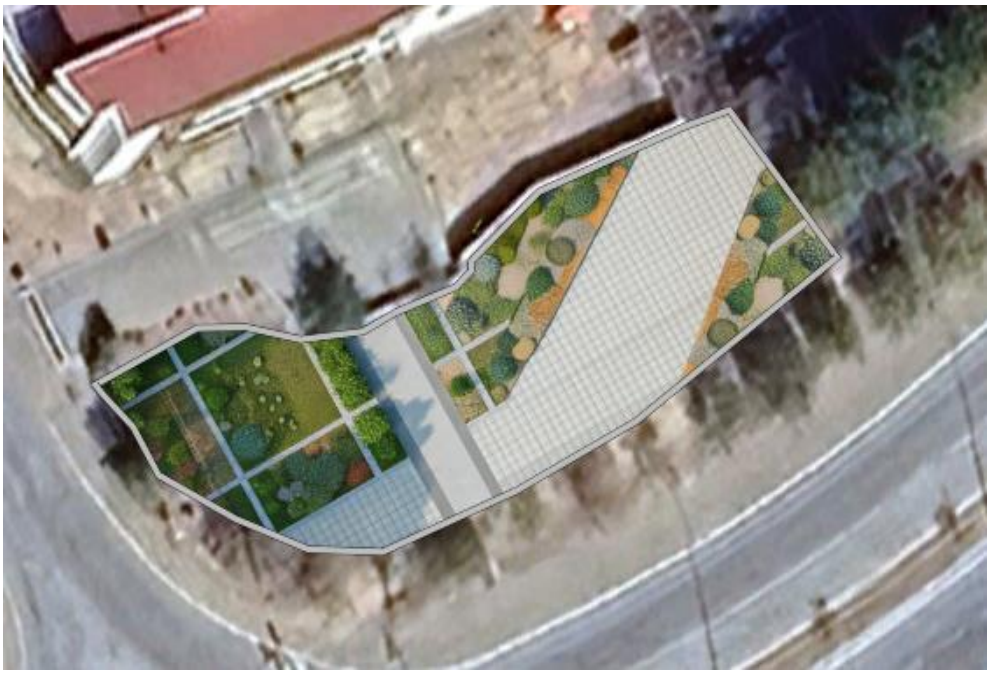

Fig. 4. *Second Created Landscape Design (Gemini AI, 2024)*

Positive Evaluations

Since the area is on the roadside, it benefits from environmental lighting. Thus, there is no additional energy consumption in the area.

The simple and plain appearance of the design is in harmony with the minimalist approach. The balance between green areas and hard floors creates a minimalist aesthetic. The balanced use of materials reflects the functionality of the design area.

The presented design has the potential to comply with the principles of sustainable and minimalist landscape architecture.

Negative Evaluations

A more comprehensive analysis is required to elaborate the design and to eliminate deficiencies.

In order for the given landscape designs to be sustainable, they should be made of recyclable and natural materials. For example: wood, natural stone can be used. It is stated that recyclable materials should be used in structural areas in the design

Fig. 5*. Third Created Area (Gemini AI, 2024)*

Positive Evaluations

Artificial intelligence, design minimalism, sustainability and microeconomic landscape principles are successfully combined. The design has been evaluated.

Simple Forms and Lines: The shapes and clean lines used in the design reflect the approach.

Single Colour Palette: The use of a limited colour palette maintains the integrity of the design and reinforces the minimalist aesthetic.

The Importance of Spaces: The effective use of spaces in the design supports the principle of "less is more".

Creating spaces that will serve different purposes in the design increases the efficiency of the space.

Negative Evaluations

The environmental impacts of the design (noise pollution, air quality, impact on water resources, etc.) should be assessed.

Access can create difficulties for people with disabilities or the elderly. Inadequate ramps, uneven ground and narrow paths can exacerbate this problem.

Landscape design cannot be evaluated definitively without a more detailed examination. However, in general, there are points to be considered such as compliance with site boundaries, ease of maintenance, accessibility and environmental impacts.

CONCLUSION

When the integration of human definitions and artificial intelligence is evaluated, studies in which human and technology are used together create mental integrity [7]. In the visual creation stages, providing quick access to the data results presented by the person to artificial intelligence reduces the loss of time. In the content of the study, the

criteria determined for the creation of designs at the microeconomic level within the scope of urban landscape designs were presented to artificial intelligence. Urban landscape designs created with artificial intelligence were evaluated negatively and positively. The negative interpretations that emerged out of the examinations made within the scope of the subject determined the deficiencies of artificial intelligence in understanding the definitions, creating visuals and adapting them to the field boundaries. Artificial intelligence has not been able to fully substitute human creativity and intuition. It is shown that human expertise and experience are still critical in the design processes of the intelligent behaviour of AI.

It has been stated that the descriptions used in visual generation processes should consist of general inputs and that the descriptive level of these inputs should be high. Despite this, artificial intelligence has provided positive as well as negative results to the definitions. The fact that it presents developable designs within the definition limits shows that visual diversity can be enriched with the cooperation of artificial intelligence and human. It was observed that artificial intelligence was able to interpret the designs created, to include realistic issues while making these comments and to act in accordance with the specified criteria.

In line with minimalist and sustainable design criteria, artificial intelligence was able to design aesthetically improvable, simple and functional landscapes. Thus, the concept of microeconomics can be analysed in the design dimension. A guiding study in which the concept of microeconomics is analysed in the design dimension has been presented. It has been shown that the design dimension of new concepts can be evaluated from the combination of different design criteria, connected or unconnected aspects of other design issues. In short, it has been demonstrated that design analyses can be made on a single concept by considering the dominant values of two concepts. It is shown that different design concepts can be produced with various design criteria. The combination of landscape design criteria has been analysed.

In line with the minimalist and sustainable landscape criteria determined in order to ensure the use of the microeconomic concept in design areas, it has been shown once again with the study that designs with ecological and aesthetic values can be created.

It is stated that the microeconomic concept is an approach in which the functionality aspect is dominant, which reduces the use of many elements by using fewer elements and thus indirectly reduces the formation cost of the design area. It is emphasised that it is possible to create more efficient urban areas with designs that use few elements but have high functionality.

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