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Semiotics Approach to Landscape Architecture

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Abstract

The human being, who makes sense of the environment human lives in and expresses it in a factual and conceptual dimension, uses many methods while performing this meaning production. Semiology, which tries to read the semantic basis of the environment, which includes living and non-living beings as a whole and creates a dense network of relations, is one of these methods. The changing and developing structure of people's creations and uses on nature affects both the environment and the universe of meaning of designers and users. Semiology, which makes it possible to read natural and cultural structures as a text through signs, constitutes an important perspective for landscape architecture, which is one of the basic disciplines working on these structures. In this context, the study aims to produce perspectives on the use of semiotics in landscape planning and design. Thus, it will contribute to the development of a sustainable, creative and ecological attitude in both existing and new space. In the study, first of all, the theoretical foundations of semiotics were emphasized, different interpretations of semiotics were discussed, and then an opinion was developed on how these perspectives could be used in landscape planning and design.

1. INTRODUCTION

The world is an objective and conceptual whole, with every part that endows it and every element that surrounds it. This whole has a particular dynamics within itself, with everything animate and inanimate. This dynamic, driven by most perceptual mechanisms, keeps the whole system in both intense communication and strong relationship. This web of communication and relationship is an effective means of coping with great diversity. Every sensory and perceptual phenomenon has a meaning and a correspondence to the meaning it expresses. The system protects itself and ensures its continuity.

The place of the process of meaning production itself and its results in human life is as important today as it was in the past. Semiotics attempts to analyze the mechanisms of meaning production and to determine how the systems formed by habitats function in different contexts. Semiotics offers perspectives for many disciplines.

In order to grasp and convey the structures of meaning found in all areas of life, certain representations are needed. Signs are representations that stand for something else, although they are not themselves. Signs exist as a defining dynamic in any domain where meaning is involved, especially in communication.

According to Nöth (1995) [1]; For Saussure, turning to the linguistic dimension of the sign, the sign consists of a concept and its expression form. The abstract concept in our minds corresponds to the signified and the concrete form of expression to the signifier. According to him, these two dimensions form an inseparable and interrelated structure like two sides of a paper. Peirce, who by classifying signs paved the way for their adaptation to domains other than language, defines the sign as something that represents something else in some respects for a person due to a certain quality it has. According to him,

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this thing that takes its place is its object. However, the sign refers to the concept rather than representing in every aspect what it stands for [2].

When we look at the definitions made in line with the place of the concept of indicator in daily life, most of these definitions explain the indicator on the basis of its feature of "replacing something". The definitions that emerge as a result of considering the sign with a theoretical content define the concept of sign through the unity formed by the planes of "signifier" and "signified".

Stating that signs produce a value around themselves, Barthes claims that this production is something more than the combination of the signifier and the signified. This process, expressed as meaning, is possible when the signifier and the signified produce the sign. Indicator production, on the other hand, emerges with the value created by the environment surrounding it [3].

The founders of semiotics define semiotics as a branch of science that studies how signs are formed and work. It is seen that semiotic studies, which were initially carried out within the scope of communication, text and logic studies, have been transformed into a format that can be used in all disciplines that produce meaning through new representatives involved in the process. The rapid spread of the semiotic method to many disciplines can be considered as a result of the dominance of signs in living spaces. At this point, the field of study of semiotics has an extremely large scope.

Every day, new fields are added in which the semiotic method is applied. Landscape planning and design are among these new fields. Nowadays, studies that incorporate the semiotic perspective in landscape planning and design are quite new. Although they are not very old, there are various studies on this topic all over the world. Considering the increasing pressure on natural resources, the need for of a more rational planning and design process is inevitable. In this direction, it is necessary to analyze the process well and maintain the continuity of the ecosystem's ability to satisfy the needs of the ecosystem while meeting human needs. At this point, semiotics is the most fundamental approach of the modern era, because its analytical capabilities allow a much more accurate reading of the natural and cultural structures.

Fields such as ecosemiotics, biosemiotics and zoosemiotics, which have recently come to the fore, contribute to landscape planning process. In addition, semiotic perspectives on socio-cultural and urban structures also contribute significantly to the design-production process in landscape design. Semiotic theories are important to evaluate the process from different perspectives and deepen the meaning of landscape. This is because they are a concise expression of creating a new perspective on the landscape and understanding the unique nature of the designer’s design language.

This study aims to develop views on how to use the semiotic perspective in landscape planning and design. Study; aims to contribute to the creation of innovative, sustainable and ecological spaces by supporting the production of different and new perspectives in the field of planning and design. The specific purpose of the study is to bring the semiotic perspective, which provides creative and analytical contributions, to the profession of landscape architecture. In addition, some suggestions have been developed on how to create this perspective. In the study, first of all, the theoretical foundations of semiotics are highlighted. In addition, various semiotic interpretations were discussed and an opinion was developed on how these perspectives could be used in landscape planning and design.

2. METHOD

The study was carried out to determine and reveal the scope and perspective of the phenomenon of semiotics in the field of landscape architecture. The lack of much research in the field of landscape architecture in a national perspective has made it necessary to study the subject.

In the first stage, the relationship of the phenomenon of semiotics with landscape design and planning was evaluated. For this purpose, the equivalents of the signifier and the signified in the landscape were evaluated and a relationship was established between them. While doing this, philosophical approaches

contributed. This section is designed to create a framework for indicators and displayed phenomena in landscape spaces with theoretical approaches, to draw attention and raise awareness.

In the second stage; Facts that can be evaluated on the basis of semiotics in the field of landscape architecture are included. It consists of 38 cases under 3 main headings: "elements of the landscape", "functions of the landscape" and "values of the landscape". These facts; It is designed to be evaluated in terms of natural and cultural reasons for the landscape and the relationship between the signifier and the signified.

In the last stage, suggestions were made for the use of semiotics in landscape design and planning.

3. THEORETICAL FRAMEWORK

3.1. Sign and Semiotics

Many of the definitions that are in line with the place of the sign concept in daily life explain the sign on the basis of its property of “substituting replacing something". According to Rifat (2018) [4], sign is “any kind of form, object, phenomenon, etc., that represents something outside itself and can replace what it represents.” [2] explains the sign as “which replaces that thing even though it is not that thing” and “the connection established between a concept and a form”. According to Kalelioğlu (2020) [5], “the main function of any sign is to indicate precisely the object for which it is used communication. It is also to enable communication between man and man or between man and nature”. While Peirce deals with the sign in its logical dimension, Saussure emphasizes its function in the social field. Peirce explains the sign with the trio of interpreter, object and sign, and Saussure explains it with the duo of signifier and signified [6].

Human beings convey their feelings and thoughts through their language. In addition to the socio-cultural structure of the society in which one lives, the awareness of this structure by the person also affects the activity of the process. The values of this structure, which the society has agreed on with a contract, serve some common purposes. In order to maintain the structure determined by the traditions and customs that will guide the lives of individuals, it is seen as a necessity for the individual to have awareness of this system. This awareness is possible with the correct use of the indicators that provide transfer as well as the dynamics that ensure the survival of this structure [5].

Signs and the systems that create them are accepted as entities that have meaning and create structures that enable the formation of a whole. Each sign symbolizes something, such as the happiness of a smile, the wedding ring that makes one think of an engagement or marriage, the red light at the traffic light that indicates that one must stop [7]. Notes that signs find their meaning in conventions and sees conventions as the social extensions of signs. These extensions have different meanings in each society. Therefore, to properly understand the meaning of a sign, one must understand the cultural structure in which it is found. This can be explained by the fact that the meaning of colors or visual signs used in public spaces changes according to geography and culture [8].

The indicator ensures that the cultural structure that societies collectively produce is passed on to both existing and future members of the society. The basic unit that shapes the semantic and functional system of this transmission is signs. In this respect, there are signs in every structure that is transmitted from human to human, nature and other living beings.

Hippocrates, who introduced the concept of "sign" in the field of medicine in ancient Greece, and Aristotle, who worked on semiotics, are the thinkers who took the first steps in semiotics. 17th-18th. In the century, as in the ancient period, studies were carried out by both medical scientists and philosophers to form the basis of semiotics. Henry Stubbes, John Locke and Jean Henri Lambert are among these names. In the late 19th and early 20th centuries, Saussure, the founder of modern linguistics, and Peirce, with the theory of signs he developed simultaneously, enabled semiotics to become a branch of science. Jan Mukarovsky, who based on Saussure's ideas, Charles William Morris, who developed Peirce's views,

and Louis Hjelmslev, who discussed non-linguistic sign systems, also contributed to the development of semiotics in this period. The field of study of semiotics, which started to become an autonomous science after the second half of the 20th century, gradually expanded. Claude Levi-Strauss, who tried to apply semiotics on social and cultural practices, Roland Barthes, who studied the functioning system of sign systems, and Michel Foucault, who researched the historical importance of semiotics, are the names that developed the applicability of semiotics to different fields. Umberto Eco, one of the recent thinkers, diversified the influence of semiotics through the relationship between thought and language and sign, and Jacques Derrida diversified the field of influence of semiotics through the deconstructionist criticism he developed [9].

The definitions that arise from theoretical treatment of the sign are not far from their everyday meanings. However, the concept of the sign has also acquired some new structures as a result. The concept of sign is theoretically defined by the unity of "signifier" and "signified".

Gottdinner works on the postmodern interpretation of signs and interpreting postmodern lifestyles and elements of material culture through Pierce's semiotic understanding. According to Gottdiener, semiotics is a system of relations whose basic unit is the sign, and this system appears as a way of understanding the world [10]. Semiotics attempts to determine how the structure expressed as representation, functions and is interpreted.

According to Saussure, who attempts to explain semiotics within the framework of linguistic studies, semiotics is a way to study all cultural forms because they are structured like a language [6]. In this case, semiotics proves to be a fundamental view that can be used in many fields.

Eco offers a contemporary interpretation of semiotics. According to him, the main concern of semiotics is not to analyze systems that are obviously signs, but to consider all cultural codes as sign systems. According to him, every cultural phenomenon is in fact a sign system. At this point semiotics comes into confrontation with reality. This is because the main concern of semiotics is to grasp reality [11]. For this reason, it will no longer be sufficient to consider semiotics within its own boundaries. The main objective should be to consider each domain where meaning production takes place as a cultural phenomenon and in this direction to develop different semiotic models for different domains [12].

Semiology differs from other disciplines in that it has its own method and technical framework. Moreover, the method that can be applied to an event, situation, phenomenon or concept from all walks of life is semiotics itself. Although semiotics is a science that deals with signs, it is also a method that all branches of science can apply.

Semiotics aims to uncover the working dynamics of many other fields such as astronomy, architecture or design, as well as artistic activities such as behavior patterns, lifestyles, body language, fashion, cinema, advertising, theatre and music. In this direction, it tries to read every aspect of communication as a text and to correctly establish the connections between structures synthesizing the resulting structure with different perspectives. Semiotics tries to analyze how the formed meaning is constructed and what is the meaning of this form that forms a holistic structure with the content [13].

3.2. Landscape and Signs Relationship

The landscape contains many values due to its structure. These values are basically divided into natural and cultural dynamics. Each dynamic has a meaning in itself and in this direction, it establishes a relationship with other dynamics in its environment. This network of relationships, which can be natural or artificial, shapes the meaning of the landscape as a whole. The European Landscape Convention [14] defines the landscape as “perceived by humans; It emphasized exactly this by defining it as "the area whose features are formed as a result of the interaction and activity of human and/or natural factors."

Le Corbusier [15] holds that the fields of urbanism and architecture are disciplines that serve the individuals and that the main purpose of these disciplines is to satisfy the material and spiritual needs of

people. The basic architectural element that satisfies the material and semantic needs of people is place. Place, which is created by combining natural or cultural dynamics, has different meanings and definitions depending on its purpose. According to Newton, who defines place by abstracting it from the objects in it, place is a piece of space; according to Leibniz [16], it is the set of relations formed by objects. The concept of place is defined on the basis of two different approaches: 'the structure that refers to volumetric dimensions' and 'the structure that refers to environmental perception that makes experiences meaningful' [17]. When these approaches, shaped on the basis of semantic and experimental place, are considered together, they yield a multi-layered view of the structure of articulation between form and social value that which transforms into place and patterns of use.

The concept of space reveals a complex process that links intellectual and cultural as well as social and historical structures. This process functions as the discovery of an unknown place, its production through its society-specific organization, and the creation of landscapes, monuments or structures. Although each space has a unique process of creation, it is subject to a certain logic. This logic is the general form of simultaneity because every spatial production or arrangement is based on the accumulation of intelligence and the material compression of the dynamics that generate simultaneity. Given these views of Lefebvre, who focuses on the fundamental dynamics of spatial production, it can be questioned whether there is a direct and immediately comprehensible relationship between the modes of production of societies and the spaces they use. Lefebvre argues that this relationship is not transparent and that the fundamental structure that disrupts this process is ideologies [18].

Kevin Lynch and Norberg-Schultz are two important names that attempt to explain the concept of space through the perception of space. Lynch attempts to examine the visual perceptual qualities of American cities through the imagined images of the people who live in the cities. According to Lynch, an urban planner and designer, cities, where the natural and artificial elements of the landscape meet, form a certain structure through recognizable symbols. To make this structure readable as a text, one must determine how cities form a whole with dynamics such as regions, boundaries and streets. However, although the understandable and readible features of the city are important features given circumstances such as the habitability, complexity, and size of the city, to understand a city, one must look at that city through the eyes of its inhabitants [19]. How the people who live in the city read the structures that make up the city, the way they are used, and the patterns of behavior that are developed through allegorical elements form a very rich field of study for semiotics. For landscape design, it is important to be able to read the land use of citizens, their preferences for buildings, roads, bridges or many other elements that contain cultural values. At this point, landscape design is an indispensable part of the texture that makes up the city.

Norberg-Schulz defines the constitutive elements of spatial perception as “center or place (approach), directions and paths (continuity) and areas/interests (boundary)”. By emphasizing the importance of the fundamental elements that make up space to spatial experience, he attempts to explain the balance created by the static and dynamic forces in urban spaces through these elements [20]. Schulz grounded his theories of architectural place by being influenced by Heiddegger's views and Gestalt psychology. By creating the concept of "genius loci (spirit of place)", Schulz shows the factors that create the "sense of place" in transforming space into place. According to Schulz [21], the relationships that enable space to transform into place are nourished by the contrast they create with their contexts. The tension created by this contrast is an important factor in the process that transforms space into place. In this direction, Schulz introduces the concept of space as a set of relationships shaped by the existential perception created by the structural and psychological effect of place on human beings [17].

If we define landscape as the natural and cultural unity of sensory and semantic elements in a field of vision, the concept of space forms the roof of this structure. When we act at the human level, the semantic process of space should be considered not only with the data from experience, but also with the symbolic structures that emerge in this process. At this point, the structure of space that turns into a sign, reveals a multidimensional system that includes the meaning of the landscape.

Social semiotics assumes that the sign is formed through the articulation of the objective experience of the world and the universe of meaning. Accordingly, everyday life and the context of the social are the fundamental mechanisms of meaning production. These meaning systems are multi-layered structures of authentic cultural codes that contain both social values and designations. The production and understanding of objective meaning derive from social structures and coded ideologies that are aspects of these structures [10].

The landscape, with its components, offers an unlimited number of signs. The transformation of natural or artificial structures, spaces and processes into signs is a result of human culture. When we look at the needs and forms of spatial design from the past to the present, we find that there are many variables that influence this process. As needs change, purposes and forms of use change, and signs transform.

The landscape has a structure in which the perception of space functions in many ways. Looking at the ways in which spaces are formed or produced also reveals the formation and production forms of meaning in the landscape. In this context, it means discovering the meaning that nature contains and being able to accurately determine the effect of all kinds of structures that humans have created as producers of meaning on this process and to correctly read the relationship between space and sign.

Roland Barthes emphasizes the effect of ideologies and cultural values on sign systems in the production of space. According to Roland Barthes, the connotative codes created by these structures feed the articulation forms and contents of the systems. Thus, rich structures of meaning emerge and the word or image, which is a much finer form of an entire ideology or cultural structure, emerges as sub-institutions [10].

Social perception of the physical environment is an undeniable fact. The collective memory and symbols carried by the culture feed on the material provided by this perception. If we look at the legends that occupy an important place in the cultural structure, we see that a physical environment is associated with them. This physical environment, such as a breathtaking landscape, forms the basic framework of this structure. The imaginary structure of the environment is the product of a two-dimensional process. While the environment represents a space with its own dynamics, the observer who perceives it also benefits from this space according to their needs, adaptive abilities or goals. The perceiver`s image of the material and spiritual is influenced by all these dynamics. And the images of the environment differ among different observers [19]. However, these differences between observers do not prevent a consistent image from emerging. This is because the users of the same environment share some common patterns in terms of needs, goals and ways of meeting them. While the inhabitants of a country, region or city create a collective ground at this point, this ground is fed by the cultural and ideological codes of the society. It is one of the duties of the profession of landscape architects, as well as building architects, urban planners and designers, to properly analyze the collective texture formed.

The natural and artificial values that make up the landscape and create fictions of space at various scales have the property of being a system both in themselves and with the structures they collectively create (Figure-1). While each system is in itself divided into subsystems, it also deepens the relationships and levels of meaning of the structure it creates.

All the types of relationships that allow each system formed in the landscape to make sense constitute context. Context is, in a sense, the integrity that each sign in the system creates with the system. On the other hand, it refers to the social and cultural codes that determine the conditions for the production and interpretation of the system. In Figure-1, the stream, the vegetation surrounding it and the bridge illustrate an interacting system. Each unit within this structure has the potential to form subsystems within itself. These units influence and are influenced by each other. Thus, they meet in a higher sense and become a new system. These systems together form the sense. The structure that determines in which direction, depth, framework and effect the meaning emerges is the context.

While the unity formed by the river, the plants and the bridge represents many things, such as being natural, being historical, being enthusiastic, being mischievous, being healthy, it has the potential to

transform into different signs in different contexts. In this context, the artificial and natural elements are both a value that creates meaning in the landscape and a sign that represents what it replaces.

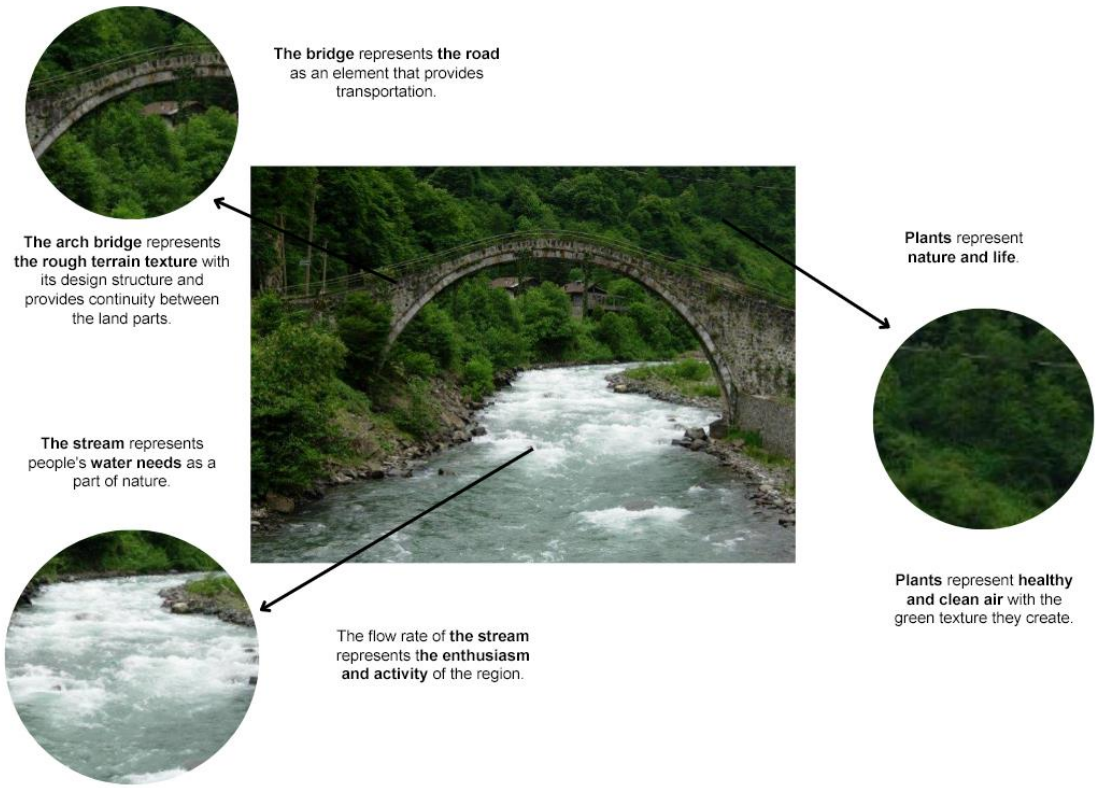

Figure 1. *System formation in landscape [22]*

The natural dynamics that make up the landscape are characters with their color, odour, texture, shape and size. Artificial dynamics, on the other hand, are different signs with their material, design, cost, size and color. The coexistence of plants with different characteristics for different purposes creates natural or cultural systems. The coexistence of devices with different properties for different purposes creates cultural systems. These systems, in turn, contribute to the perception of the place in which they are located in the context of scale, function, need, culture, aesthetics, etc. The content of the context created is shaped both by the objective perception of the design elements and by the cultural and social codes that weigh on these elements.

When the dynamics in the landscape are considered as signs, they reveal the denotation with their non-subjective and unchanging meanings. They also reveal connotation with their forms of articulation and derived meanings. Each element inserts into the space with many different meanings. This universe of meaning is the signifier of the sign. The object's universe of meaning also reveals its landscape value. This value is fed by the cultural and ideological codes of society as well as by the objective experience of the world.

The landscape creates a spatial structure in which many components interact to form a meaningful whole. However, it can also be seen as a structure in which visual materials and visual perception come to the fore. With this aspect, the landscape has a guiding function in planning and design. Proper reading of visual materials allows analyzing both the stimulus-response process in ecosystems and the needs of users. In this direction, the study of the visual components of the landscape as a unit and the determination of their interaction makes an important contribution to design and planning studies. For this reason, landscape semiotics studies are also important.

According to Kull et al. [23], landscape representations and preferences have generated a wealth of internal and semiotic research on topics such as the manifestations of power relations, the embodiment of

social structures and memory in landscapes. However, since semiotic terms are rarely used in landscape research makes it is very difficult to identify the beginning of landscape semiotics.

Visual aesthetics in landscape is very important for people's mental and physical health in high quality living spaces. At this point, visual quality is a component in the use of land for urban and rural landscapes. However, the visual components of the landscape do not only provide aesthetic value. They also show the relationship between cultural, economic and biological phenomena [24]. How the visual components are perceived manifests itself in the individual and society, but the perspective of the individual and society plays an important role in shaping this perception. At this point, the determination of the use of space and the creation of space make it necessary to recognize the sequences formed by the landscape signs and to determine in which context they are meaningful.

Systems allow the signs to work together and form a pattern of meaning. By revealing the holistic perception of the landscape, they allow this whole to be read through the relationship of the meaningful parts. Understanding the impact of cultural structures and ideologies on the process of creating systems and their guiding function requires a multidimensional assessment.

To examine, recognize, plan or design the landscape, one must first analyze the meaning in the landscape well. To reveal the meaning, it is necessary to analyze how the context is shaped and functions. At this point, semiotics is one of the methods that can be used to determine how the dynamics that create meaning in the landscape work and to closely observe how meaning changes.

3.3. Semiotics in Landscape Planning and Design

Landscape planning is a process of determining how land should be used, taking into account ecological factors. It is also extremely important of ensuring the sustainable coexistence of natural and cultural structures and in making predictions about this process. Landscape design, on the other hand, refers to the process of designing according to the pattern of meaning that the designer wants to create in the area. Landscape design is important because it is the phase in which both the planning process is put into practice and the spatial productions are carried out.

Ecosystems, which are the main structures of landscape design and planning, are a system in which different characters come together. From the point of view of ecology, these systems consist of matrices, patches, and corridors. Each strand has its own subsystem. And the signs in this system provide information about how patches, corridors and matrices function and change. Matrices, patches and corridors create a context that goes hand in hand with both the unity of the dynamics within them, the landscape mosaic they form together, and the social and cultural perspectives on them all. One of the most productive and best ways to understand this context is to analyze the signs that make up the process. At this point, the perspectives of fields concerned with the relationship between environment and people, communication between living things and the signs of biological processes will make an important contribution.

Fields such as ecosemiotics, biosemiotics (living semiotics), zoosemiotics (animal semiotics), which have emerged with the semiotic approach, make it possible to read and plan landscapes correctly. Thus, it contributes to landscape planning by creating important perspectives. Ecosemiotics emphasizes the semiotic nature of ecosystems by examining the semiotic relationships between organisms and the environment, the communicative relationships between species, and the role of indicators in ecosystems. In demonstrating the semiotic nature of ecosystems, one can first recognize that there is a broad semiotic field that can be related to the daily activities and cultural processes of human culture. Furthermore, a semiotic approach to ecology also allows us to understand that issues that are often defined as ecological problems often have semiotic causes [25].

Considering the setting of producing ecological planning approaches from a semiotic perspective, the first step of the semiotic view is to recognize what kind of meaning this approach produces within the framework of material and cultural values. The answers to questions such as how nature is perceived and

on what basis the use of space is shaped provide data both about the objective realities of the planning process and about how cultural and ideological codes operate in the geographies in question.

Design is a multidimensional composition of components with different functions and qualities. This composition is guided by the meaning that the designer wishes to give to the landscape. For this reason, the designer must read the landscape properly, analyze well the subdynamics that make up the landscape and its functional systems. The analysis to be made includes both the ecosystems and the socio-cultural and economic values of the users. Landscape design, as a discipline in which natural and cultural values interact, can only achieve successful spatial designs in this way.

The semiotic perspective is based on viewing landscape design from a semantic perspective and brings a hermeneutic approach to understanding the landscape. This approach supports the view that the meaning of landscape is not only found in the landscape itself or in the viewer, but is created between the viewer and the landscape. The concept of "dualistic landscape" can be used to support this view. In addition to landscape as "a setting for everyday life," landscape also comes to the fore as a "visual ideology" or "a way of seeing the world" also in this structure of meaning [26]. Landscape feeds on a set of meanings that emerge from the unity of experience and the universe of meaning based on that experience.

While signs in landscape design transform into ideas or fictions, they express a style, culture, belief or mystical meaning that defines landscape design as a concept. In addition, signs are more prominent in the design of objects and elements (sculptures, monuments, etc.) on a smaller scale. However, the symbolic content of these elements also reveals a story or idea [27]. Allegorical elements, with the meaning they carry, form a ring in the landscape system, and the articulation of these rings provides for the emergence of meaning in the landscape.

The aim in landscape design is to create spaces that meet the needs of users. By looking at the landscape as a text and noting how the parts that make up the text construct meaning in the singular and universal dimensions, one can see how needs change and what kind of change they impose on the landscape. These spatial creations must be compatible with the principles of ecological and sustainable development on the one hand, and with the culture and ideologies of the users on the other. The semiotic approach makes it possible to understand the signs in this dual structure, the systems formed by the signs, and the context that determines the functions of the systems.

Cities, one of the important components of the landscape, and the texture they create create a context through urban identity. Every individual who uses the city has an image of the city. The image of the city is the memories and meanings formed as a result of the interaction of the individual with the city components [28]. This cognitive, perceptual and experiential counterpart of the landscape creates the image with the concrete values of the city. The common construction of images in the mind of the society reveals the urban identity [29].

City identity is shaped through the system of indicators surrounding it. Productions such as streets, squares, parks or buildings create an experience intertwined with the cultural integrity created by design and planning. For this reason, city-related indicators focus on connotation as systems formed by cultural structures. These indicators, besides philosophical discourse or scientific theories; It can also be nourished by values and ideologies. The formal structure of urban space is a tool that reflects cultural identity, and these tools consist of many components [30]. These components both form a system in themselves and nourish the context of the city by establishing new systems together.

Semiotic theories are a concise expression of creating a new perspective on the landscape and understanding the designer nature of design language. For this reason, semiotic theories evaluate the process from different perspectives and are effective in deepening meaning in the landscape. It is an important contribution of semiotic theory to landscape architecture that the designer understands, on the one hand, the need to start from this meaning and, on the other hand, recognizes that designer is also an architect of this meaning.

4. CONCLUSION

The application of the semiotic method in landscape planning and design does not aim at arriving at factual data, as is the case in the natural or formal sciences. The dynamic and living nature of the landscape and the fact that man, who influences and gives meaning to the landscape, is a dynamic entity, makes these approaches obsolete. However, it is not possible to create an objective language in design, as this leads to the destruction of creativity in the essence of design and it is difficult to make general judgments. The fundamental question that arises in connection with all these features is: "What is the contribution of the semiotic approach for landscape architects?".

Landscape architecture is a profession that shapes nature according to the human needs and plans the use of space in this direction, creating space while protecting both nature and culture. The main objective is to recognize the changes that landscape architecture works with due to both natural causes and human factors, and to ensure that these changes meet the current needs in the design of the space. For this reason, landscape architects must be able to read and understand their material well.

When considering the landscape as a universe in which spatial fictions exist at different scales, it becomes clear that spatial perception and the dynamics of this universe form landscape systems by articulating each other. In order to uncover the interrelationships of these systems, it is important to determine the individual, social, cultural, or ideological codes of signs that make up landscape systems. However, the semiotic approach that makes it possible to analyze the systems creates rich data for the discipline of landscape architecture.

The use of semiotics as a method in landscape planning and design studies is a fundamental necessity given the needs and demands of our time. The most fundamental approach needed on a global scale is to satisfy the needs with a sustainable understanding and to minimize the pressures on ecosystems. This direction, the priority of planning studies should be to understand ecosystems correctly and to precisely analyze changes occurred. Similarly in rural and urban area planning, the way to create successful designs is to analyze the signs produced by the changes in both nature and human life. Thus the analytical skills of semiotic analysis will contribute distinctly to research in the field.

The evaluation of the patterns of use and the design of the rural and urban areas that make up the landscape, as well as other functional areas that are open to demand-based use, is directly related to the correct analysis and understanding of the dynamics in the structure, function and change of the landscape. In this regard, semiotic analysis of the basic components that reveal the holistic structure of the landscape provides an understanding of both the whole and its parts and the relationships between them. In this regard, semiotic analysis of the criteria that can be used in landscape planning and design will provide very important data to understand the nature and future of the landscape.

Landscape components for landscape semiotics analysis;
1.Elements of the landscape: Line, texture, measurement, colour, light, shape, point, typography.
2.Functions of landscape: Emphasis, movement, repetition, ratio, spacing, simplicity, balance, contrast, rapport, suitability, ıntegrity, wholeness, difference, domination, structure, volume, composition, unity, hierarchy, area, space.
3.Values of the landscape: Topography, flora, fauna, geology, soil, water, atmosphere and climate, architectural elements, time.

The grouping, function and value of the elements of the landscape reveal the landscape as a whole. This grouping allows both the indicator elements in the landscape and the potential of the dynamics that form the landscape to be transformed into signs. In this direction, it is possible to improve the readability of natural and cultural landscape signs through the analysis of sign components (signifier and signified, meaning and connotation or content and expression). These data, which provide information about the quality of life, improvement or sustainability of landscape areas, form the basis for development studies.
The semiotic approach will contribute to the functioning, needs and changes of ecosystems in landscape planning, and to the rational regulation of land use. In the field of design, it will contribute to the

architect's creation of a unique planning and design language by expanding the universe of meaning of the landscape architect. This will enable the landscape architect to understand nature, society and cultural structure, and to understand the meaning and value of the products he creates as an output of this. Planning and design approaches that read and understand nature, society and cultural codes correctly will bring both character and sustainability to spaces.

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Generation Z of Industrial Design Education

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Abstract

According to generational theories, members of the same generation have similar experiences, attitudes, behaviors, and ways of thinking because they have experienced similar social, cultural, and historical events. Thus, each generation has a different perspective on life and exhibits different approaches to work, education, and family. Generation Z, which constitutes the majority of university students today, also shows a unique approach. This unique approach can create differences in design education. To keep up with this difference, to meet the demands of Generation Z, and to transform them into talented designers, design education should be prepared for this new generation. Generation Z, which comes to design education from its perspective, opens the floodgates to review and renew the industrial design curriculum with generational effects that may require changes in educational strategies. In this context, the study aims to discuss the suitability of the current industrial/product design education curriculum for Generation Z and how the attitudes of Generation Z would be beneficial to change the design education curriculum. For this purpose, generation theories and the characteristics of Generation Z are first discussed in the article. Then, the requirements of the design education curriculum to meet the characteristics, attitudes, and expectations of Generation Z students are discussed. To see the place of these requirements in curriculums. According to the ranking determined for the Art and Design title in the QS World University Rankings 2023, the curriculum of the top 20 universities with industrial design and product design departments were analysed. As a result of the study, the aspects that support and need to support Generation Z in design education are presented.

1. INTRODUCTION

Just as technological, cultural, and social changes cause changes in the design field, everyday social and historical events experienced by a generation also change the individual who realizes the design. Design education is also affected by this difference. Most of today's university students are Generation Z. Considering the characteristics of different generations and how they perceive the world is essential for educators to increase efficiency and effectiveness in education [1]. Therefore, it is necessary to consider Generation Z students' attitudes, thoughts, behaviors, and beliefs and the points where they will affect education. According to Seemiller and Grace, we can mobilize, empower, prepare, and educate this generation to solve our world's problems or miss a great opportunity [2].

On the other hand, design is a process that introduces new values and ways of thinking, transforming itself as living standards and technology change. Design practices are constantly transforming to keep pace with change and bring about change. This transformation, of course, also affects designers. For this reason, one of the points to be emphasized in design education is that students should be handled carefully as future designers to direct and meet the change in design practice. Developing design practices will change who and how design is done and significantly impact design education [3].

As Trowler states, learning involves social participation and communication [4]. Therefore, for design education, communication, and social skills can be used as guidelines for curriculum design, and student profiles and characteristics are significant factors to consider in structuring design education. For this

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reason, as students from different generations with different characteristics are involved in design education, education programs, and curricula should be reviewed for student adaptation, such that maximizing the knowledge and skills of Generation Z as new-generation designers are essential for both the professional future of students and the future of the design discipline.

To better meet the expectations of Generation Z, it is essential to review the industrial design education curriculum and consider how to renew and improve it. Considering generational differences in industrial design education can provide valuable information to understand better students' learning processes and learning resources and to strengthen communication with students [5]. Generational studies can also make significant contributions to developing effective practices, policies, and programs for institutions [2]. For this reason, the study aims to examine the industrial design education curriculum within the framework created in the context of generational theories depending on Generation Z.

2. GENERATION THEORIES

With the generational theory, researchers state that individuals born within a typical period have similar ways of thinking and behaving, value judgments, and attitudes through shared experiences. Gasset says that each generation forms its behaviors and perspectives through the power of significant cultural and historical events shared by people with a typical birth date range [6]. Mannheim, likewise, states that individuals born in the same historical period and socio-cultural context have similar mindsets, experiences, and behaviors due to the influence of the typical events they have experienced during the formation years of a generation [7]. Events that attract attention and profoundly affect and capture the emotions of many people during a generation's formation phase help to determine that generation's characteristics [8]. Therefore, what makes a generation unique is that from birth onwards, all its members encounter similar trends at similar ages [9]. For this reason, many researchers argue that generational similarities are influenced by history rather than the chronological birth year of an individual and are related to similar social events experienced by members of a generation during their growing up years ([10]; [11]; [12]; [13]).

Every generation has a generational identity. This is a set of generally common behaviors and attitudes that a generation expresses throughout its life cycle. [8]. Generational identity defines an era and finds the boundary that separates it from other generations. Because each generation develops different behaviors and attitudes from others with the subjective experiences it has lived in the historical context in which it exists. However, it is not correct to say that every member of a generation will carry all of these behaviors and attitudes. A generation, like an individual, has many different characteristics, and none of these characteristics alone is decisive [8]. Although not all generation members carry all the characteristics of generational identity, most of them develop some common characteristics depending on historical and social experiences. Therefore, all members of a generation are influenced by their generational personalities, although not every individual fits the personality profile of the generation exactly [9].

According to Edmunds and Turner, global generations are emerging with increased communication and interaction thanks to technological advances [14]. Today, changing technology, social and societal changes and the ability of individuals to communicate and follow each other through many different channels create a global generational identity. Accordingly, young people belonging to a generation are becoming more and more similar globally [15].

2.1. Generation Z

When academic studies on generations are examined, studies on Generation Z are relatively new and limited. The related literature is still developing [16]. There is more disagreement on the birth dates of Generation Z. For example, [17] (2005-2025); [18] (1998-...), [19] (1991-2000); [20] (1993-2005); [21]; [22]; [23],- (1990-2000); [24]; [25] (1995>...) and according to Seemiller and Grace [26] it consists of individuals born between (1995-2000). Generation Z is the world's first 21st-century generation [27]. Although their digitally evolving social characteristics make Generation Z unique, they are not the only

thing that defines them. They have been shaped by technological progress, violence, a volatile economy, and social justice movements [2].

Table 1. *Characteristics of Generation Z*

Characteristic Properties	In Seemiller and Grace's study, Generation Z members were loyal, thoughtful, compassionate, open-minded, and responsible [26]. Older generations see them as good-natured, diligent, innocent, risk-averse, and emotionally fragile [17]. Their distinctive characteristics are independence, dependence on technology, speed, practicality, efficiency, impatience, dissatisfaction, and being result-oriented [24]. To these characteristics, they are expected to prefer multitasking, effective technology use, individual work, creativity, global perspective, and non-standard and personalized products [24]. They are highly educated, technologically savvy, and creative [28]. They may need help developing their creativity and awareness of new technologies [26], and an educational approach that can equip industrial design graduates with more robust creativity may need to be adopted.
Educational Life	Generation Z is, first and foremost, an education generation [23]. They have received education earlier than previous generations and have grown up in an advanced and planned education system. Without going to school, the age that was home-schooled first is the most ready for school [29]. They are expected to be the most diverse university students ever [30]. According to Renfro, Generation Z students learn through graphics, prefer customized educational activities, and dislike exams [31]. They expect clear assignment definitions. They expect continuous and immediate feedback and may be frustrated if they do not receive quick feedback. They are interested in the present depending on the knowledge required at a particular moment. Therefore, pre-planned learning activities are thought to be less effective for these individuals [23].
Learning Preferences	They care about learning through real-life experiences [32]; [26]. They want to know the necessary skills for their future careers, and their learning experiences are markedly different from those of previous generations. According to Northeastern University's Innovation Survey, they prefer learning opportunities to apply to real life [2]. Although they value hands-on opportunities that lead to career success, this expectation is not only related to professional practices. For this reason, educators can be supportive not only of career opportunities and interests but also of the more significant meanings in their lives and of capturing their values and passions [2]. They also attach importance to internship opportunities to gain connections, skills, and experiences that will contribute to them in the future. Therefore, it may be beneficial for organizations to offer various internship opportunities that will contribute to the development of students [2].
Relation to Technology	Generation Z refers to people born after the popularisation of the "World Wide Web" [22]; [23]. They were raised in a demanding and impatient culture that harbours high-tech products connected to social networks [33]. According to Tulgan, the ubiquity of the internet and technology integration into life means historical change for this generation [34]. This generation sees technology as a part of natural life [35]. It is thought that social media will leave significant traces on Generation Z and create addiction [24]. This generation is thought to be predisposed to learning and development activities supporting their freedom in technology-enabled, personally optional conditions [23]. The individualistic nature of technology has helped Generation Z to get used to independent learning [2]. They are independent, intrinsic, and self-paced learners who can access and study information wherever and whenever they want, and they prefer to learn from the Internet rather than printed materials [26]. They come to class with mobile phones, laptops, or tablets that enable them to connect to the internet and access information [33]. Generation Z students who prefer hands-on learning are observant and like to watch others complete tasks before doing them themselves. This approach is reflected in the tendency to acquire knowledge through video [2]. Generation Z, who use YouTube like Google and most have their video platform, likes to communicate and inform each other through video [23]. Therefore, in addition to traditional educational materials, materials with visual content may be more helpful for this generation. Thanks to internet technology, they can simultaneously deal with more than one subject [24]. Generation Z, who are technologically literate, is shaped for multitasking using technology and media. They move quickly from one task to another [21]. Therefore, it takes a long time for them to adapt due to difficulty focussing. Attention deficit is quite prominent compared to previous generations [36].
Entrepreneurship	Generation Z students want to know what competencies are expected in the professions they want to have with an education that prepares them for a meaningful career. These characteristics contribute to their willingness to learn [30]. They are interested in innovation and entrepreneurship [2]. According to the Northeastern University Innovation Survey, they believe that universities should teach the knowledge and skills needed to run a business [2]. Renfro stated that most Generation Z students will work in jobs that do not currently exist [31]. Wiedmer added that they will be self-employed entrepreneurial professionals with specific expertise and broad flexibility and bring solutions to problems [29].
Teamwork	They prefer to work independently in teamwork, even in cooperation [37]. They want to develop solution-oriented relationships with their counsellors and peers and need guidance in dealing with difficulties [30]. They see their peers and instructors as valuable resources and often like to work with others independently after thinking through a project on their own [2]. They respect authority, embrace hierarchy, and want their ideas to be considered and valued [26]. To conduct successful teamwork, it is necessary to understand why they prefer individual learning. They like to work individually because they can focus, determine their work pace, and evaluate their knowledge before sharing it with others [2].
Social and Environmental Sensitivity	For Generation Z, who are sensitive to social issues, "we" rather than "me" is significant [26]. Most of them stated that they do not want to disappoint others, will defend their ideas, and want to make a difference in people's lives [26]. Therefore, rather than the "self-centred" definition attributed to Generation Y, Generation Z is considered "off-centred" [30]. Discussions on social justice, immigration, and women's rights have affected Generation Z's sensitivity, who believe they can change the world. Therefore, they care about community engagement opportunities that provide lasting solutions for social problems [2].
Problem-solving, Coping with Failure, and Risk-taking Ability	Generation Z is growing up trying to understand the rapidly changing world [24]. They have had social, economic, and technological experiences such as terrorism, violence, and global pandemics. These experiences can help to understand why Generation Z is risk-averse, cautious, and sceptical [26]. Generation X adopts a protective style in raising this generation [17]. Generation Z children live more planned lives with less freedom; they are more isolated and programmed than ever. Helicopter parenting tendencies increased in intensity during this period ([22]; [34]). Therefore, they prefer structured and organized learning styles [38]. They want a technology that is easy to use, supports solving problems, helps in various activities, and provides communication and information with relevant people [23].

Social Skills and Communication Preferences	Its command of technology provides this generation with unlimited interests and makes it a global generation. They prefer the internet for comfortable and effective communication and thus socialize. Therefore, social skills need to be taught in face-to-face meetings [23]. They live together in a virtual peer ecosystem through verbal and visual communication established through technology [34]. Cross-Bystrum stated that Generation Z shows honest communication through Facebook, Facetime, Skype, and similar communication mechanisms, even though they do not share the same physical space [39]. It is stated that they learn primarily from their peers and teachers [40]. However, establishing personal relationships strengthened by communication through interactive media is very important for them because they still expect and desire personal interactions [26].
Knowledge Behaviour	The gap between the unknown skills of the future and those taught today is increasing. Therefore, to acquire these skills, Generation Z students should be taught how to discover and produce knowledge. Due to their instant access to information in the digital environment, it is thought that students of this generation need to pay more attention to details and trust the first information they reach without checking its accuracy [26]. In addition, they are overwhelmed by the crowd of data and need help with evaluation [30]. Therefore, the focus should be on helping this generation of students assess resources [29]. Due to their easy access to information, they prefer learning through observation, visual experience, and practice rather than passive activities such as listening to classroom presentations. The world is an open book for Generation Z as they grow up one click away from any information [27].

3. METHOD

This study aims to determine the suitability of the design education curriculum for Generation Z, to contribute to its development accordingly, and to address the current situation from a broad framework. In this context, the study sample was determined to be among the top twenty universities with industrial design and product design undergraduate departments according to the ranking decided for the Art and Design title in QS World University Rankings 2023 [41]. In addition, only universities for which information on curricula was available were included in the study. Within the scope of this study, since there is no known and reliable success ranking for industrial and product design, universities were determined using the QS World University Rankings 2023 success ranking. These universities were selected because they are pioneers in education and have entered this ranking with a certain standard of success. The universities included in the study are shown in Table 2.

Table 2. *The Universities within the scope of the study*

	University Name
1	University of the Arts London
2	Rhode Island School of Design
3	The New School
4	Pratt Institute
5	Politecnico di Milano
6	Glasgow school of art
7	Art Center College of Design
8	Savannah College of Art and Design
9	Carnegie Mellon University
10	Tsinghua University
11	RMIT University
12	The Hong Kong Polytechnic University
13	Emily Carr University of Art
14	Konstfact University of Arts, Craft and Design
15	Universität der Künste Berlin
16	Loughborough University
17	Maryland Institute College of Art
18	National University of Singapore (NUS)
19	University of Technology Sydney
20	Zurich University of the Arts

In this study, firstly, information about the curriculum was collected from the official web pages of the selected universities' industrial design/product design departments. This information generally includes data such as curriculum structure, course package, course contents, course syllabus, and learning outcomes. In this context, the study's data were obtained from about 1500 courses and information about the curriculum structure and learning outcomes of 20 departments. The data were analysed by content analysis method. Content analysis is a method used to draw repeated and valid conclusions by analysing the content of a text [42]. In this method, data are coded by predefined categories and interpreted through a systematic classification [43]. The content analysis method consists of coding the data, creating themes of the coded data, organizing the codes and articles, and defining and interpreting the findings [44]. In this context, the data related to the curriculum of the universities examined in the study were coded under the headings associated with Generation Z, as shown in Figure 1. These headings were created in parallel

with the characteristics of Generation Z presented under specific themes based on the literature in Table 1.

Figure 1. *Topics to be considered in education for Generation Z.*

During the analysis, the authors first coded the data separately, and then the study was completed by comparing the structured data. In the analysed courses, coding was done by looking for a relationship with the headings shown in Figure 1. Although the universities are analysed separately in the study, it is aimed to reveal the general situation. For this reason, the courses associated with Generation Z were evaluated within the broad context of industrial design education depending on their intensity in the curriculum.

4. RESULTS

To include digital tools, applications, and learning environments

Rapidly developing technology and the digital world significantly affect the dynamics of product design. In terms of design education, the new generation needs to include the technologies that are widespread today both directly in the curriculum as a subject and to use technology in practice. When the relevant schools' curriculum, course contents, and procedures were examined, it was seen that the effort to include technology in education with digital tools and applications was more common than other topics. A total of 112 courses from fifteen universities meet the expectations of Generation Z with their content and design practices. It has been observed that schools that include digital tools, applications, and learning environments such as 3D modelling programs, rapid prototyping and other prototyping tools, digital fabrication, programming, coding, virtual reality and augmented reality technologies, robotics, game technologies, animation, internet of things, intelligent products, wearable technologies, data analysis, media production, digital communication, social media use and information technologies in their curricula, which are the subject of contemporary applications related to technology, mostly use the opportunities to benefit from the possibilities of technology to benefit new generation designers. In addition, it is noteworthy that there are courses related to photography and video, albeit only a few, and videos to support traditional lessons. For Generation Z, who are prone to learning through video, sharing their knowledge, and being visible, it may be easier to associate these lessons with real life. For this generation, also called gamers [40], it is thought that classes with games included in the curriculum will also attract their interest.

Developing Creativity

According to the examined university curricula, 22 courses from 10 schools were found to be specialized in increasing students' creative thinking skills. Although there is a possibility of adopting an approach that extends to all of the courses since design education is already related to developing creativity, it was found that more than half of the relevant universities have classes that directly help to mobilize the creative potential of students, encourage different perspectives, and examine the creative process. Inspected courses were primarily structured on creative expression, strategies, and creative thinking methods. In

addition, the designer's attitudes, behaviours, ways of thinking, and methods of producing creative responses to design problems are also mentioned.

Encouraging Entrepreneurship

When the related curricula were analysed, it was seen that 18 courses from 10 universities were available to support Generation Z in entrepreneurship. The topics are developing entrepreneurial skills, business opportunities, collaborations, technology-oriented entrepreneurship, leadership, project management, career planning, and starting an individual company. It also showed how design thinking skills can be used for business opportunities, how new technologies can offer new entrepreneurial opportunities, how bringing different disciplines together can benefit entrepreneurship, and how designers can shape the agenda. In addition, topics related to business ideas, economics, business administration, marketing, and customer relations were also included, albeit to a lesser extent.

Fostering Interdisciplinary Collaboration and Teamwork

According to the curricula analysed, 35 courses from 15 universities were found to be customized to support Generation Z students for teamwork and interdisciplinary collaboration. The courses mainly include projects in partnership with different disciplines, project work with student groups, various industries and public institutions, real-life projects, and using digital environments that support collaboration. Collaboration, working practices, team criticism, and communication methods were also emphasized. For the Carnegie Mellon University "Collaboration by Design" course, stating that students will collaborate with their instructors to develop the curriculum can be considered a particularly developmental approach for Generation Z, who want their ideas to be considered and valued.

To Include Environmentally and Socially Sensitive Practices

When the curricula, course contents, and practices of the related schools were analysed, it was seen that 96 courses related to environmental and social sensitivity were available in 20 universities. The topics are mostly centred around sustainability, circular design, eco-design, sustainable change, social sustainability, social innovation, projects and collaborations focusing on social problems, designer's responsibilities, and ethics. Practices are diversified, with opportunities for collaboration with various organizations and local communities. The effort to include environmental and social sensitivity issues and practices in education was observed to be more common than other topics. In more detail, themes such as universal design, design for health, plan for disadvantaged groups, ideal for a changing world, design for the future, cultural studies, design for social justice, public service design, diversity and equality, collective intelligence, social participation, and empathy emerge. To provide an understanding of the impact of design on the individual, society, and the environment. Therefore, the aim of understanding design's social and environmental impact on the individual comes to the fore.

Developing Problem-Solving Skills

According to the curricula analysed, 11 courses from 9 universities were found to be directly tailored to support students' individual decision-making and problem-solving skills in the design process. The courses mainly include self-management skills, problem analysis and framing, multidimensional, creative, and critical thinking about the problem, and designer behaviour. In addition, teamwork and the ability to take responsibility were supported.

Developing the Ability to Cope with Failure and Take-Risk

When an evaluation was made regarding the ability to cope with failure and risk-taking skills, it was seen that six courses in 4 of the universities approached these issues. Even if the courses are not directly related to these issues, they were included in the scope of the research because they addressed these issues. The content of these courses commonly focused on learning through failure, failure, and trial and error as an element of the creative process, the ability to reach successful results based on past experiences, questioning, observing, and reframing problems. It was also observed that risk-taking skill was associated with entrepreneurship.

Opportunity to Learn with Real Life Practices

The analysed curricula showed that 16 courses from 11 universities are directly structured to support students' learning through real-life problems in the design education process. In this context, it has been observed that projects and internships carried out through institutional partnerships play a significant role in helping students establish concrete connections with companies from various sectors to develop experiences for the professional working environment. Design by the companies' production techniques and material properties and professional design process issues have also attracted attention.

Practices that Improve Communication Skills

According to the analysed curricula, 14 courses are available in 7 universities to support the communication skills of the new generation of students. The topics are mostly centred around developing communication and presentation skills, communicating with stakeholders, preparing for professional life, storytelling, and the role of technology in touch. In addition, topics related to collaborations, digital applications for communication, representation methods in design, visual and verbal communication, and team communication were also included, albeit to a lesser extent.

To Bring the Ability to Research and Access Accurate Information

When the curricula, course contents, and practices related to research and gaining the ability to access the correct information were analysed because Generation Z is exposed to intensive knowledge through the internet and needs help with the reliability of the information they access, it was seen that 23 courses in 10 universities approached these issues. The topics are research methods, selection of appropriate research methods, user research, data analysis and visualization, and information literacy. In addition, the place of research in the design process and digital literacy were also mentioned. Analysing information is one of the most essential skills to be gained by Generation Z students, and critical thinking, distinguishing reliable sources, and correct information have been considered less than other subjects.

The topics that the titles in which the data described above are coded correspond to in the curricula, and the topics on which the universities analysed are concentrated are shown in Figure 2. Although it is not aimed to compare universities in the study, the universities that add the subjects that may interest Generation Z to their curricula the most in terms of course density are Art Center College of Design, The New School, and Carnegie Mellon University. In contrast, the universities focusing on these subjects the least are Konstfack University of Arts, Crafts and Design, Politecnico di Milano, and Emily Carr University of Art.

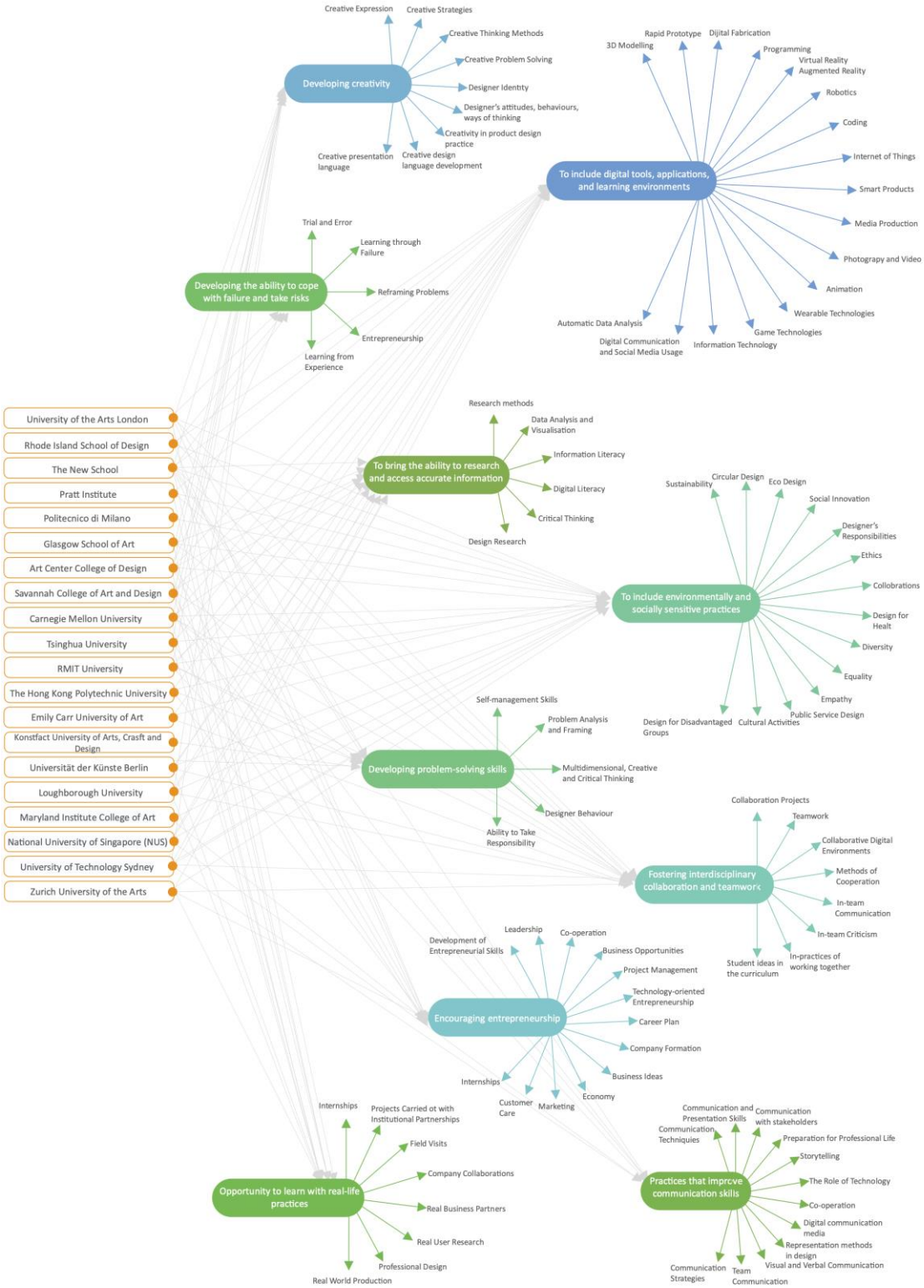

Figure 2*. Subject Headings and Distribution to University Curricula*

5. CONCLUSION AND DISCUSSION

Considering the characteristics of generations to determine a collective understanding with the acceptance that the factors determined with generational theories will not emerge in a precise way in every individual can provide a different perspective for redesigning education. With members of Generation Z starting university, considering the characteristics, learning styles, and educational preferences of this generation

can help to develop inclusive, flexible, and interactive educational methods. In addition, with technological and social changes and the demands of the industry, design education needs to be restructured as it moves towards different fields of knowledge and distinct levels of interaction. In line with this requirement, universities are restructuring their curricula differently.

In this study, the design education curriculum is analysed within the framework created by generational theories depending on the changing students' generations. It has been observed that industrial design/product design departments have curricula at different levels and focus on other subjects within the scope of the preferences, expectations, and aspects that need to be developed by Generation Z and the current requirements of design practice. Topics and methods involving digital tools, applications, learning environments, and environmental and social awareness were found to have a higher potential for inclusion in education than other topics. On the other hand, it was observed that the intensity of courses to promote coping with failure and problem-solving skills was less (See Figure 2). In general, all other topics were highly affected by the close relationship with technology.

Generation Z's close relationship with technology also affects their expectations for education in this direction. Curricula are sufficient to meet this expectation in general. The widespread inclusion of contemporary technological tools, methods, digital content, and learning environments in curricula and course practices is highly valuable to encourage Generation Z and ensure their active participation. The presence of familiar technological tools can improve students' abilities and competencies by increasing their motivation and engagement and supporting their learning approaches. In addition, including videos related to any subject can increase their participation by utilizing Generation Z's interest in learning through observation [2]. Therefore, by integrating technology into learning environments and applications, it is necessary to regard students as active learners and provide experiential knowledge. Students have stated that using the internet and information technology positively impacts design education and that they support using the internet to support design education [45]. In addition, Generation Z has access to a large amount of information via the Internet, and curricula need to focus more on developing skills to analyse, make sense of, evaluate, and distinguish reliable sources, visualize, and present data. In addition, about the development of curricula with digital tools, applications, and learning environments, it was observed that subjects such as the Internet of Things, digital fabrication, artificial intelligence, coding, and robotics, which came with Industry 4.0, were intensively included in the programs.

It has been observed that Generation Z students' awareness of their responsibilities by considering the environmental and social dimensions of their designs is widely supported by the curricula. Even if the intensity of issues such as sustainability, eco-design, and social innovation is because they have been taken into consideration in design practice and design education for a long time, addressing them together with technology for communication and collaboration seems to be a new way to meet the sensitivity of Generation Z on this issue.

It has been observed that the intensity of the courses added to the curriculum to provide skills to support the creativity of Generation Z needs to be higher in number. However, although not directly structured on this subject, it is thought that other project-based courses, by the nature of the design curriculum, support students' creativity. In addition, it may be appropriate to include an essential system that supports Generation Z students who are afraid of taking risks, coping with uncertainty and failure to express their ideas freely, and presenting the concept of creativity in theoretical and practical terms in close relation with other courses. In parallel, it is very significant to support the ability of critical thinking and problem-solving in the design curriculum. Students should be supported because these subjects are integral to the design process. Generation Z has an entrepreneurial aspect. This provides an opportunity for the innovation and business-related aspects of design. Therefore, considering the intensity of entrepreneurship-related courses in the data, it should be supported more in the curriculum. The curriculum can also be supported in terms of issues such as innovation, planning, business modelling, teamwork, project and team management, internship and interdisciplinary collaboration with professionals, real-life experience, and online communication because the roles of designers are changing towards a more inclusive and collaborative approach based on the subjectivity common in human

relationships [46]. Design students are expected to develop the ability to use new technologies and tools to address design problems comprehensively, communication and collaboration skills for becoming interdisciplinary team members, and lifelong learning skills. In this direction, there is an increasing interest in new academic programs that include projects involving students from different departments, such as industrial design, engineering, and marketing, in the education process. [47]. Therefore, design education should prepare students for changing roles, increasing responsibilities, and problems related to different fields to support Generation Z students.

A comprehensive design education curriculum is significant for creating a favourable institutional environment for students to develop practical skills and mindsets. In this context, it can be said that each university has started to restructure its courses according to the expectations and needs of Generation Z to encourage, support, and guide them more skilfully and consciously by enriching its curriculum under several interrelated topics, even if it does not include all of the issues identified for Generation Z characteristics. Universities that successfully update their curricula can set an example for the future planning of design education and can be pioneers in collective progress.

Although the study has a scope that can be extended to other design fields, the first limitation is that it is limited to industrial design and product design departments. In addition, another end of the study is that it is impossible to reach a success ranking for industrial design/product design departments and departments such as industrial design engineering, whose curricula can be parallel to these departments, and some essential universities cannot be included in the study. On the other hand, although the official websites of universities are a crucial channel for sharing information, it isn't easy to know whether the information about the curriculum is up-to-date and complete. Therefore, the existence of information that cannot be accessed directly through official websites is another limitation of the study. However, the study is intended to provide a window into the changes that can be made for Generation Z. Future studies can be restructured by addressing the relevant limitations. Self-evaluation of universities with industrial design/product design departments by using their data and tacit knowledge within the department may offer a different perspective for the future of design education. In addition, conducting a field study directly with Generation Z students in industrial design/product design departments may be interesting to learn first-hand the direction in which design education should evolve. It would also be helpful to get the opinions of lecturers who have the opportunity to observe and communicate with Generation Z students. In addition, it may also be beneficial to examine in detail the practical implementation of each topic identified for Generation Z.

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Reading The Relationship of Children's Playgrounds with Disciplinary Architecture Through John Dewey's Educational Strategies

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Abstract

Playgrounds, included in a child's education and daily life, appear as places that, with their spatial configuration, affect the child's play experience, current teachings, and future references, thus his internal education and external freedom of movement. 21st-century playgrounds, defined enough to influence thinking or exploration, are a "disciplinary" socio-spatial problem that reinforces boundaries for children. The hypothesis of this study is that space design has disciplinary effects on the child's experience. In the study, which approaches Dewey's educational strategies and active learning methods in search of improvement, firstly, the implicit disciplinary aspects of playgrounds were identified. During the second stage, Dewey's educational strategies were examined. Finally, the focus was on "adventure playgrounds" that overlapped with Dewey's educational strategies. Riis Park Plaza and Adventure Playground, which were among the sixteen adventure playgrounds implemented in America until 1977, were determined as the sample for the study. These two areas were examined using a case study, one of the qualitative research methods. As a result of the investigations, it has been understood that playgrounds that avoid limited design criteria have the potential to activate the child's sense of curiosity, positively affect the quality of the experience, and increase the level of external freedom.

1. INTRODUCTION

"Every experience is a driving force. Its value changes only in the context of where it is pushing." [1]. The individuals' experiences and the learning or habits resulting from these experiences are related to the childhood period and the acquaintances of this period. Each experience gained is nourished by the previous experience and contains conditions that will affect the next experience; therefore, it is considered a matter of development. In this development scenario, the places where the child meets are the areas that form the basis for today's learning and influence the references of tomorrow with their active role in thought and experience.

Children's playgrounds, which serve the child's outdoor activities and "play" activities, are one of the places that have a say in the child's development [2]. While play is stated as a communication and expression model that combines thought and action, it is also considered as a means of learning to live [3,4]. Play is a child's way of learning [5]. Similarly, Bengtsson, who defines play as a natural way of intellectual and physical development, says, "play is a constant happening, a constant act of creation in the mind or in practice." [4] emphasizes the importance of play in a child's life adventure. In fact, play and learning are mutually supportive requirements for a healthy childhood and competent adulthood [6]. According to Bengtsson [7], playgrounds created for play action are at least as important as schools; at the same time, there are many things that children cannot learn from books and must experience. While playing in playgrounds, children explore the environment and their abilities, learn to avoid injuries and take risks, and further develop their ability to evaluate [8]. At this point, while play as an experience is directly involved in the child's educational scenario, playgrounds are essentially educational spaces that should encompass the game in all its aspects. Therefore, while the setup of playgrounds and the implicit

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meanings of this setup determine the educational aspect, some experiences in the space can create negative results, contrary to expectations. Emphasizing the importance of children learning by encountering various individuals, ideas, and environments, Dewey [1] stated that an experience may lead to indifference and a decrease in reactivity and sensitivity, thus limiting the chance of gaining richer experiences in the future. In this context, an experience in a place can have a negative impact on the child's thoughts, and in line with these thoughts, it can cause the child to be disciplined by limiting his behavior according to external teachings. At this point, when we look at traditional schools, the movement of students who sit in desks fixed in military seating order and move in accordance with certain signs is externally restricted while also limiting their mental and moral freedom [1]. The limitation emphasized here is that while it expresses control and guidance over behavior and thought, the limit corresponds to its psychological and social meaning in the depths of its physical meaning.

Within the scope of spatial organization, the border is both a physical and psychological factor that defines a place, divides it, unites it, sometimes creates the space, sometimes destroys it, but basically restricts the movements of the individual and, moreover, determines the movement with its physical scenario. This situation is seen as a problem in 21st century children's playgrounds, where the planning is repetitive, the fiction is almost fixed, and the movement begins to be defined as a command and as a socio-spatial problem related to the understanding of "disciplinary architecture", which has begun to push the child's thinking, discovery, and creation acquisitions in the developmental process into the background.

This practice, known with conceptualizations such as "exclusionary architecture", "hostile architecture", "defensive urban architecture", "Crime Prevention Through Environmental Design (CPTED)" and "disciplinary architecture", basically aims to control the urban and therefore public space through architecture and design; it aims not only to restrict access to this area but also to shape the ways the area is used and to direct attitudes in the area.'" [9]. Therefore, this practice indicates that the space predicts certain behaviors for the users, and the space design is used as a control tool to direct these predicted behaviors. The effect of this control system, which is considered a socio-spatial problem, on playgrounds, which are an important place of experience in the daily scenario of a child who learns through experience and grows with what he has learned, needs to be examined. In this context, it is necessary to investigate the reflection of space on external mobility, behavior, and freedom of thought. In this respect, while the study discusses the importance of the child's self-experience and level of external freedom in children's playgrounds through Dewey's educational strategies, it focuses on America, where Dewey's strategies were first implemented within the scope of disciplinary architecture and freedom in experience.

Dewey's educational strategies were tested at the Laboratory School he founded at the University of Chicago in 1896. The essence of the education given in this established school is to understand the relationship between social goals, values, and meanings and to support self-education [10]. At this point, Dewey argues that in the traditional education approach, adults try to impose their own standards, behavioral styles, and methods on children who progress to adulthood [1] Moreover, Dewey, who criticized the narrow and fixed structure of traditional school and the education provided in the school, stated that traditional education was far from the ordinary conditions and impulses of life [10]. At this point, in traditional practice, the difference in skills and experience between children and adults is ignored, thus making it difficult for the child to participate in the learning process. While the child is mostly taught the memorization method, the child is restricted from establishing different and flexible relationships with things, and as a result, there are some one-way verbal relationships that acquire mechanical habits and encourage uniform actions [11]. Dewey, who considers this situation as waste in education, draws attention to the lack of organization of the traditional school. Therefore, it has been argued that in traditional practice, various departments are isolated, unity in educational objectives is lacking, and consistency in studies and methods is weak. At this point, according to Dewey, "the great problem in education on the administrative side is to secure the unity of the whole, in place of a sequence of more or less unrelated and overlapping parts, and thus to reduce the waste created from friction, reduplication, and transitions that are not properly bridged." [10]. Therefore, when Figure 1 is examined as a proposal to combine the parts of the system, the block in the middle represents the school system, while the connections indicate that the school system is not limited to itself. At this point, the connection

between the school and parts 1 (home), 2 (garden, park, county), 3 (business), and 4 (university): It expresses the relationship of effects, ideas, and materials. According to Figure 1, the school is located in a natural environment while having direct contact with the home. Children are encouraged to have contact with the environment, spend time in gardens and parks, and play outdoors. The necessity of free play within the scope of business life and school is stated. At this point, Dewey states that in traditional education, children cannot use the experiences they have gained outside of school fully and freely within the school, and states that in this education system, children cannot apply what they learn at school in their daily lives [10]. This situation corresponds to the isolation of the school from life in practice, which in theory should be a part of social life, in other words the whole.

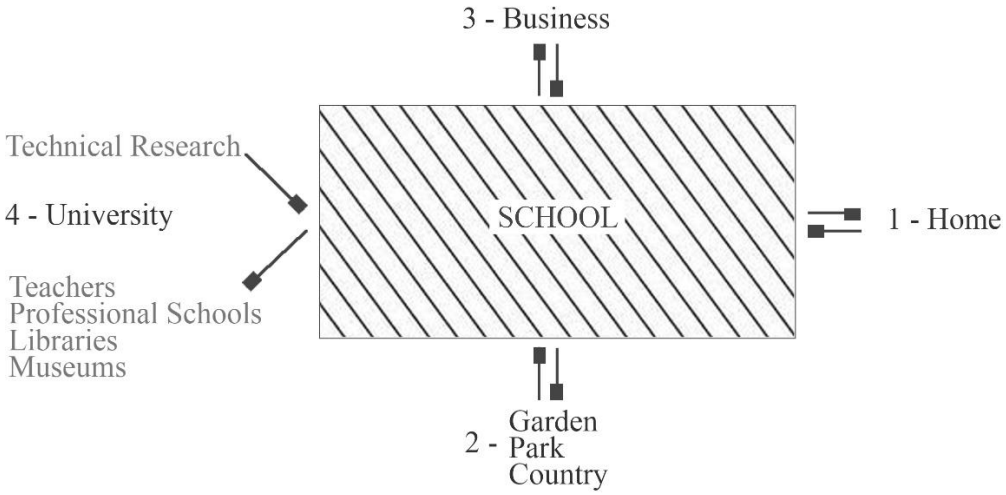

Figure 1: *School as a part of social life [10] (Redrawn by the author)*

Dewey criticized the functioning and understanding of the traditional education system based on coercion from above and outside. As part of his educational strategies, he advocates: Addressing the whole rather than focusing on the parts; learning through experience as opposed to the idea of learning from teachers and texts; the expression and development of individuality, against coercive behavior or teachings; freedom of action against disciplinary practices from above or outside; and becoming acquainted with the changing world, against static goals and tools [1]. Therefore, Dewev's educational strategies describe a system that is integrated into daily life and the environment, establishes a direct relationship not only with the school but also with the neighborhood, immediate surroundings, and frequently used places, is gained through experience, feeds from the whole, and serves the whole.

Aiming to bridge the gap between a child's school experience and home and neighborhood life through this school project, Dewey [12] focused on the games and pursuits that the child engages in his daily life and aimed to transfer the interest the child finds in games to education. Therefore, play and playgrounds were given physical, cognitive, social, and emotional meanings for child development within the scope of Dewey's educational strategies; the developments regarding playgrounds during this period were evaluated as the "early playground movement" [13]. However, this mobility has slowed down as many questions have arisen. Immigration issues, widespread disease, housing insecurity, and rising crime rates in the United States during the late 19th and early 20th centuries created a crisis environment. With the growing questions, a law was passed by the New York City authorities, making it a crime to play on the street, and a process occurred in which hundreds of children were arrested [6]. The Great Depression and World War II followed this process. The development of the early playground movement was slowed by World War II [13]. However, play continued for children during and after the war, with children continuing to play in bombed areas, among rubble, or in war-related environments [14]. Using the materials they easily found in the field to play, they improvised and used their imagination by building various structures, especially areas such as shelters and lighting fires, and reflected their instincts through play [15]. Therefore, playing has been considered a way to cope with negative conditions and perhaps escape from reality, albeit for a short time [14]. After the war, the role of playgrounds was reviewed for children who had witnessed and lived through the violence of the war [16]. At this point, in the post-war

period, there was a need for children to have environments that would adapt to their diverse and versatile behaviors, in other words, playgrounds where they could freely and unrestrictedly express their instinctive tendencies to explore, experiment, and invent [15]. "Adventure playgrounds" emerged in Europe by designers observed that children playing with rubble or scraps in debris fields were creating their own play and thus forming their own playgrounds [17]. In the United States, in the mid-1900s, there was a need for playgrounds where children could express themselves freely, and adventure playgrounds, where various tools and materials were provided and climbing elements were used, began to be implemented [18]. With these playgrounds, it was expected that the physical and psychological damage caused by war could be healed through play [19]. The American Adventure Playground Association (AAPA), founded in 1976, stated that there were sixteen adventure playgrounds in America in 1977 [13, 14].

Adventure playgrounds, which prioritize internal development over external guidance for play action, are associated with freedom and autonomy, and at the same time encourage children to create their own play by removing external restrictions [16]. Contrary to the monotony and homogeneity offered by traditional playground installations like swings, slides, and monkey bars, adventure playgrounds have suggested a creative playground that provides diverse experiences for the child with its space design and focuses on decision-making, strategy development, and achieving results [19]. In this context, it is understood that adventure playgrounds emphasizing the quality of the experience align more with the self-learning method than with controlling the experience through discipline. While adventure playgrounds, with their meanings and purposes, overlap with Dewey's educational strategies, they form the research universe of this study, which aims to investigate the limiting implicit meanings of 21st century playgrounds within the scope of these strategies.

The hypothesis of the research focusing on children's playgrounds is that the design of the space has a disciplinary effect on the child's experience. Disciplined, defined, or limited playgrounds can restrict a child's experiences, thereby affecting the child's environmental adaptation. At this point, when the existing literature is examined, it is noticed that playgrounds, physical activity, and child development are frequently discussed, but the disciplinary implicit meanings of these areas within the scope of space organization are not emphasized enough. Therefore, the study highlights the perceptual limits of playgrounds, which have very clear definitions and determined usage, on the child as a user and also discusses the implicit meanings of the experiences gained from such playgrounds through Dewey's reflexive thinking methods. The study, which focuses on the perceptual boundaries of children's playgrounds and examines how these boundaries affect the child's experiences with disciplinary architecture, is significant as research within its scope. The aim of the study is to expand the concept of disciplinary architecture, which is applied within the scope of controlling or restricting people, and to extend the research area of this concept to include children's playgrounds, thus drawing attention to the fact that space design and fiction are factors that can limit thought or experience.

2. METHOD

The structure of this research was planned in three stages. In the first stage, the implicit disciplinary aspects of 21st-century playgrounds that that draw the child to their own limits were discussed, and in the second stage, Dewey's self-experimentation, learning by doing and active learning strategies were examined through playgrounds. In this regard, the active or passive aspects of the playground on the child were questioned. The study, which guided the research universe within the scope of Dewey's educational strategies, approached America as the place where these strategies were first implemented, and focused on adventure playgrounds that overlap with these strategies. Within the scope of the research, two out of the sixteen adventure playgrounds established in America until 1977 were reached and the sample for the research was determined in this way. Therefore, the two playgrounds reached in the final stage, Riis Park Plaza and Adventure Playground, were examined using the case study method, which is one of the qualitative research methods. In the study where the inductive approach was applied, this method was preferred because the research population to be brought closer from the part to the whole. Thus, the study, which has focused on children's playgrounds, has been narrowed down within the context of disciplinary architecture and Dewey's educational strategies, and deepened by reading the disciplinary elements of today's playgrounds through the determined examples.

3. EXPERIENCE AND PLAYGROUNDS WITHIN THE SCOPE OF DEWEY'S EDUCATIONAL STRATEGIES

Discipline is a form of power, and this power is to keep the means necessary to achieve goals under control [11]. Discipline within the scope of behavior; It is expressed as teaching certain behaviors to regulate and direct behavior [20]. When examined through Kant's philosophy of education, "The constraint whereby the constant propensity to deviate from certain rules is limited and finally eradicated is called discipline" [21]. Discipline, which has comprehensive reflections on both education and behavior, is considered a tool used to adapt the individual to the system proposed in practice. At this point, space and space design respond as a tool for the user, the "discipline" expressed within the scope of this study is related to the clear definitions of space and the role of the usage scenario it offers to the individual in line with these definitions on free thought and behavior. At this point, space is a critical element that has the potential to direct and attract the individual to his own discipline, to influence the quality, diversity or aspects of the experience that affect curiosity by either encouraging behavior or inhibiting thought. Therefore, space has implicit but strong aspects that regulate and restrict the user, and in essence discipline by directing perception.

The main lines of thinking of adult individuals are already guided or determined by the conditions they experience. A child whose place in society or interests are not predetermined is encouraged to display certain behaviors as a result of his own enthusiasm, the will of those around him, or the circumstances he is in [11]. While one of these directors is the physical space that the child experiences, the spaces that the child frequently uses and the setting in these spaces become critical issue. At this point, the guiding and descriptive level needs to be handled together with questioning and discovery in the construction of children's playgrounds that aim to liberate movement, behavior, and thought.

According to Dewey [11], observing children's activities is associated with endless testing and discovery. The child pulls, handles, punches, pushes, holds, and throws objects; in short, he plays with the object until he has exhausted all the actions he can perform. However, in playgrounds where actions and movements are clearly defined, the child's ability to discover or assign a new function to the play element is quite limited. If there is a slide on the playground, there is a sliding action, if there is a swing, there is a swinging action, and these actions are so obvious that they do not need to be questioned or thought about. At this point, thinking is described as a combination of confusion, astonishment, or curiosity [11], curiosity emerges as an important acquisition in a child's educational journey and developmental stage. Curiosity, considered the overall expression of extroverted tendencies, is considered a fundamental element for expanding experience and is also one of the primary components of reflexive thinking [11]. Reflexive thinking, on the other hand, can be considered as a flow of thoughts that arise from and support each other, and as a thought system in which a person explains himself by asking questions such as how and why. However, getting quick answers to questions in any situation or action both erodes and neutralizes curiosity. It is important to transform curiosity, which has an organic connection with the child's method of exploring the physical environment, into a tool that will serve mental or intellectual purposes during the child's education process [11]. Therefore, children's playgrounds with highly defined elements like swings and slides can diminish children's sense of curiosity and thus weaken the child's thinking or imagination. The play environment, planned on this axis and presented to the child's experience, indicates an area that externally directs the child and limits both the mind and movement adventure with the expected behaviors.

While toys or equipment in playgrounds with a clearly defined purpose describe individual play, this content is integrated into a form devoid of social meanings. This situation has consequences that impact the circumstances of coming together, learning together, and social interaction. Stating that social life improves and enlightens experience in relation to teaching and learning, Dewey [22] touched upon the aspects of sociality that enrich and activate the imagination and, at the same time, create a sense of responsibility for the accuracy of thought. At this point, he stated that self-education can be supported by observing the child's learning and knowledge during interactions or sharing with other children. In this scenario, the play has served as the foundation for creating the social environment. On the other hand, Dewey [22], who evaluated education as a social process, emphasized the importance of free

communication in experience and stated that internal or external obstacles that could affect communication should not be imposed. At this point, physical or perceptual boundaries created by design can be considered obstacles that limit a child's social communication with other children who share the same space. Therefore, playground equipment such as swings and slides that do not require community, that prioritize playing together, or that actually envisage a singular activity that prioritizes individuality are considered as elements that weaken social orientation. The predominance of these elements in a public, collaborative, and shared environment such as a playground indicates a socio-spatial problem. In such playgrounds, one child's play causes the other child to wait, this situation is considered a potential exclusion of the waiting child from the game in an environment where he is there to play. In other words, although the child is unable to join in a common play with the other children around him, he also waits for his turn without being able to establish a relationship with the play elements as he wishes, thus being pushed into a passive position in an environment where not only his thoughts but also his movements are limited by the commands of the space.

Physical inactivity is another factor that deepens passivity in children and seriously reinforces the tendency to create and receive. Physical inactivity is associated with a level of external freedom. External freedom of action is having the power and freedom to reason, make comparisons, and realize goals knowingly chosen by the child [1]. On the other hand, the external and physical aspects of movement cannot be considered independently of freedom of desire, thought, and purpose [1]. At this point, one of the most important places to encourage physical activity in children is playgrounds. Therefore, the mental and physical constructs that the child creates on his own in these areas emphasize his active role. However, playgrounds with elements that have been defined by other people and whose usage, function, form, and scenario have been determined, and almost even the play that the child will play have been decided, are where the child is controlled with his "passive" identity, while the place exhibits a controlling attitude with its "active" identity, influencing the child's intellectual direction. It describes a disciplinary environment that promotes planning.

According to Dewey [11], the cognitive aspect of education aims to preserve reflexive thinking habits, if they exist, or to acquire and develop them at every possible opportunity. Therefore, the need for reflexive thinking, the presence of diverse experiences, various stimuli, and elements that require attention in childhood and their integration into the child's daily life are conditions that encourage thinking. If we need to focus on playgrounds that are included in the child's daily life, these spaces are related to the residence and educational institution where the child lives, within the scope of walkability and accessibility. At this point, the playgrounds in the neighborhood and the diversity in these areas have a say in the quality of the experience. While diversity is emphasized as the basis of effective thinking within the scope of Dewey's educational strategies, it is incompatible with external uniformity and continuity of thought [11]. Therefore, the presence of various play elements in playgrounds, as well as the differentiation of these elements from other playgrounds in the area, contribute to different experiences and perspectives. However, as a result of standardization, repetitive or similar playgrounds in the same neighborhood display an attitude approaching uniformity. The monotony of the outside world and the ordinariness of the inner world weaken the sense of curiosity. At this point, curiosity is piqued by innovations, differences, or unexpected situations [11]. While diversity is associated with innovation, once the novelty wears off, children tend not to go anywhere that is not “their territory” as much [23]. In fact, repetitive situations for the child also damage the relationship of belonging established with the playground. Given all these factors, a situation has occurred where the child could choose to withdraw from play or could not prefer the playground, and even if the playground is used, it has become very difficult to talk about a qualified activity for the child in this space. Therefore, while monotonous playgrounds could encourage children to take uniform actions, they do not exhibit an attitude that arouses curiosity and discovery, promotes innovation, or keeps them engaged. On the contrary, conditioning the learned movements in a familiar place for the child, who has experienced the same or similar ones in the previous playground, can further reinforce the constraints that suppress the child's inner world and external freedom.

21st-century children's playgrounds contain implicit disciplinary meanings with clear definitions and regulations. The "regulation" mentioned here should not be described as a completely negative element.

“It is not true that regulation is a principle entirely foreign to experience. Otherwise, the experience will be so disorganized that it will be chaotic [1]. Within the scope of this study, there is a search for improvement in the level of limiting factors, in other words, external guidance. In this direction, in the next stage of the study, two areas that were theoretically compatible with Dewey's pragmatist-based active learning strategies and reached among the sixteen adventure playgrounds implemented in America until 1977 were examined. The extent of external freedom that the examined adventure playgrounds offer for the child within the scope of disciplinary architecture is discussed.

4. FINDINGS

Riss Park Plaza, designed by Paul Friedberg, and Adventure Playground, created by Richard Dattner, are the first examples of adventure playgrounds in America [19, 24]. Of these two examples, Riis Park Plaza was implemented in 1966, and Adventure Playground was completed in 1967 in the Manhattan district of New York. These projects were evaluated as a radical approach in the divided post-war cities of the United States and were the products of a sophisticated approach in urbanism in which activism could shape architecture [25]. At this point, the radical approach aimed to end the game based on a series of boring interactions and classical installations of separately planned elements in playground practice [19]. In fact, while these projects support social action, they are aimed at prioritizing play, imagination, and creativity in playgrounds as basic needs for children.

Riis Park Plaza, planned by Friedberg, who sees increasing play opportunities in playgrounds as part of the design, includes an amphitheater used as a playground, water pool, or seating area, has referred to an area that allows socializing or self-play with a game of checkers or similar silent games, and a place that provides a basis for different experiences [26]. This space appears as an innovative, non-standard adventure playground with a sand floor, where climbing equipment, old railway fittings, repurposed concrete sewer pipe parts, a labyrinth, and ziggurat-like spaces are used [25]. Using many innovative materials and various elements together, Riis Park Plaza has had a public expression for children that extends over a large area, thus requiring active mobility to explore or experience this diversity.

At Riis Park Plaza, where different geometric forms are used, there are different equipment and different functions that these equipment provide, as seen in Figure 2. As play equipment spread across the land, this spread followed each other with play elements. Therefore, there are no independent elements in the play field, rather a plan that ensures the flow of movement and thought rather than pauses or waiting during the play action. The flow mentioned here does not represent a fixed route but is evaluated as an organization that allows the child to progress to different elements or directions according to its own decisions within diversity. On the other hand, different levels were used within the playground, and thus the child's relationship with various dimensions was included in the play action. While these levels, which accompany the act of jumping, bouncing, or climbing, find a functional response for the child, they propose a form that prevents direct observation for the parent but allows gradual monitoring and actually increases the perception of "own space" or "free space" for the child. Solutions for vertical circulation for children to reach different levels are not stereotyped as stairs as in standard playgrounds, but the "going up" or "rising" action is provided by the play element itself, serving this function, as shown in Figure 2-b. The connecting elements among the game components have been distinguished from conventional gaming spaces as patterns similar to traversable bridges, and these elements are considered as a flow element incorporated into the play for the child. On the other hand, the connection scenario of the play equipment has suggested a plan that encourages movement by enabling the child to jump or run from one element to another and pushes him to think while in motion. In fact, at Riis Park Plaza, there is a simple yet diverse and uninterrupted composition in which simple shapes that could adapt to movement are used extensively.

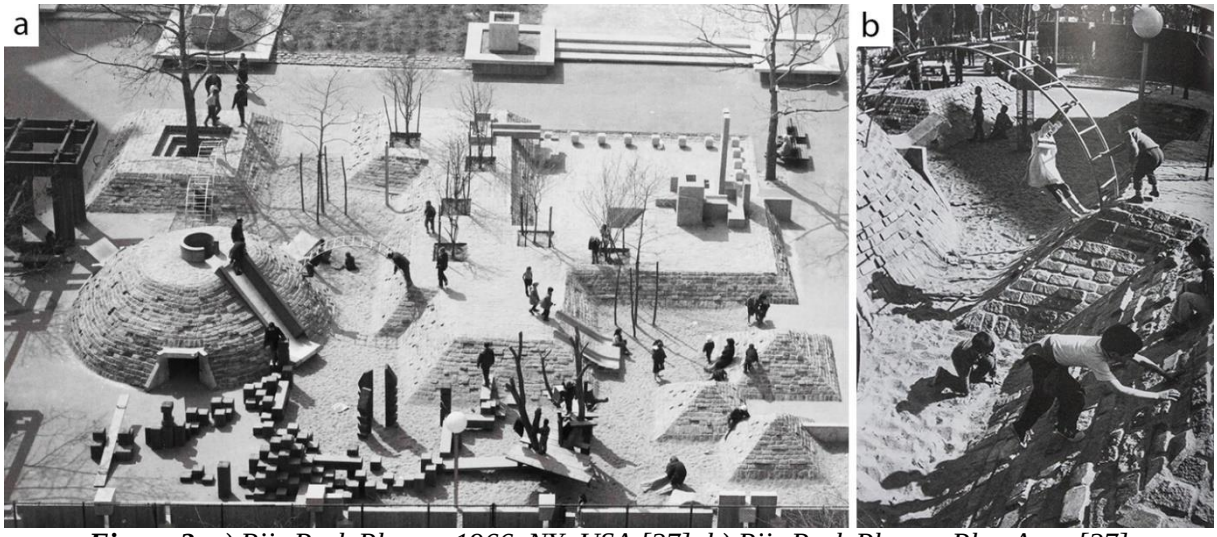

Figure 2. *a) Riis Park Plaza – 1966, NY, USA [27], b) Riis Park Plaza – Play Area [27]*

Criticizing figuration in playgrounds, Friedberg [24] stated that figurative play structures direct the child to certain uses, and at this point, he expresses concrete design as "real design", while real design is the element that "limits the child's imagination". At this point, figurative elements, such as animal figures, which are frequently encountered in 21st-century playgrounds, were not used in Riis Park Plaza, and abstract and more undefined play elements were used. Sand was used on the floor of the playground, and a part of the amphitheater located in the north and covering a large volume of the playground was planned as a pool to which water channels and canals are connected. As shown in Figure 3, the playground and play elements have created multiple scenarios that can be integrated into both individual and collective play. On the other hand, these elements have mostly removed boring qualities for the child, such as waiting for turns, repeating the same behavior, and restricting movement.

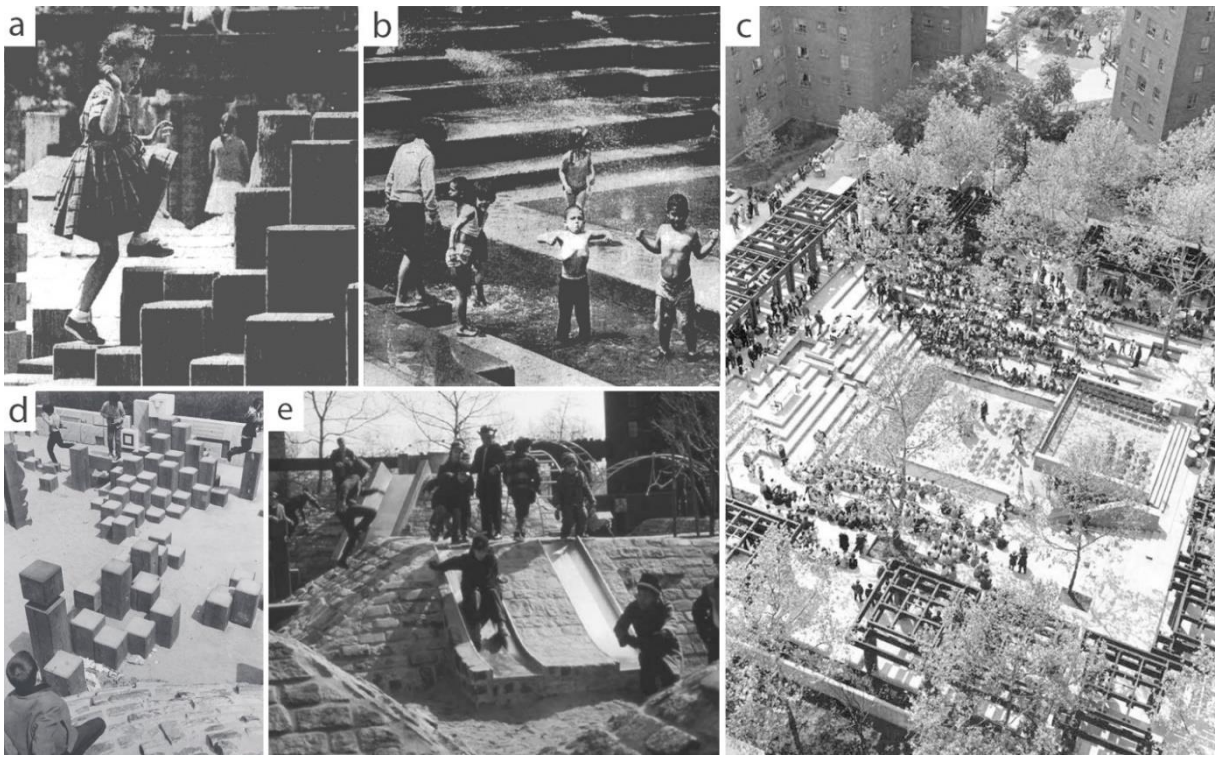

Figure 3. *a) Riis Park Plaza- Play area, A child playing by herself [28], b) Riis Park Plaza – The pool and Water Channels in the amphitheatre area [28], c) Riis Park Plaza – The amphitheatre [25], d) Riis Park Plaza – Play area [29], e) Riis Park Plaza – Play Area – Children playing together [29]*

Stating that children learn the conditions or rules of the adult world through play, Richard Dattner argues that playgrounds should be a "small-scale copy of the world" for children [5]. In this regard, Adventure Playground, planned by Dattner, is a practice of transforming an old playground into a more qualified area for children. This practical surface is defined as sand, and it refers to a multi-purpose adventure playground with round granite hills, a pyramid, a low tree house, slides, tunnels, water channels, and an amphitheater. In this playground, which extends on the south-north line and spreads over a wide area, the place where the amphitheater at the north end is located has also been determined as a place that will allow activities such as painting for children [24]. At this point, when the design of the playground is examined, the south side of the playground, planned in relation to the main entrance, serves physical mobility, in other words, actions such as jumping, passing through tunnels, running, skipping, hiding, rising, or climbing, as shown in Figure 4-a. On the north side, there is an application area that promotes both mental and physical actions such as playing with water, painting, playing with sand, digging, and building, as shown in Figure 4-b. This application indicates an environment created with interconnected forms within the playground, in other words, a space where different functions are solved in an interrelated manner in the same area for the child's play activity.

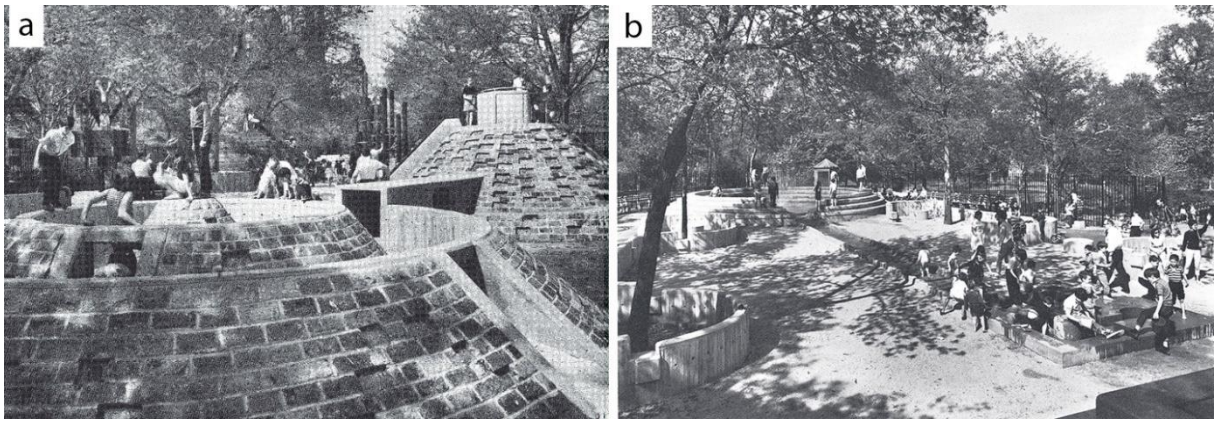

Figure 4. *a) Adventure Playground – Mounds and tunnels at the southern side [19], b) Adventure Playground – The amphitheatre and water channels at the northern side [19]*

At Adventure Playground, where different levels or heights are used and the play action continues not only at the ground level but also vertically, connections such as tunnels and channels to encourage play are used between the play elements, as in Riis Park Plaza. The fullness and emptiness relationship that spreads throughout the playground has brought diversity to actions such as "rising", "passing", and "stopping", and has moved them away from their stereotypical meanings and forms in standard playgrounds. Similarly, an empty space was left in the middle of the play elements placed around the playground. This empty space, which is the intersection of space, served as a square that allowed children to gather or meet. Play equipment, on the other hand, is planned to allow both individual and group play, as seen in Figure 5, and to adapt to different scenarios as a formation of simple or complex systems. All this planning has been organized on wooded land, in a natural environment, and in a green area.

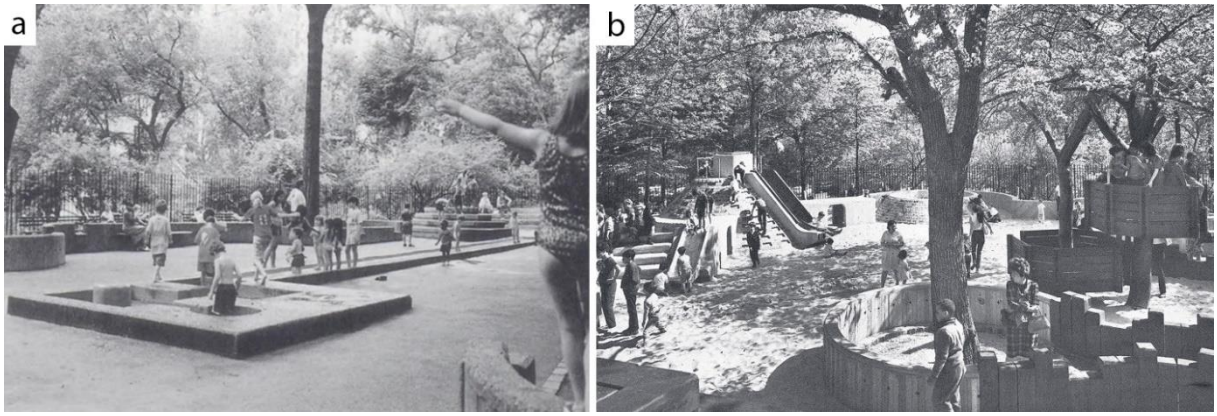

Figure 5. *a) Adventure Playground – The water channel in the north [24], b) Adventure Playground – Wooden house in the middle area [19]*

5. EVALUATION

While the child learns through play [26], the role of education is to facilitate the experience of the child, who is not yet as hardened and habits as an adult but whose attitude towards the world is flexible, curious, naive, and experimental [11]. In this context, the materials, equipment, and organization of the adventure playgrounds, which are the subject of this study, are influential factors on the child's education and experience, contributing to diversity and functionality. While the material choices in the playgrounds examined showed similar characteristics, both rigid and flexible materials were used in both areas. At this point, the sand and water elements used in the playground are considered as elements that vary in terms of the area they cover and their type; they are associated with the "loose parts theory" of Nicholson, who states that all children enjoy playing with variables such as materials and shapes. Within the framework of this theory, Nicholson [30] asserted that children like to play, experiment, invent, discover, and have fun using physical phenomena such as liquids, sounds, vibrations, movements, plants, ideas, fire, chemical interactions, and gravity. Thus, he emphasized that both creativity and the possibility of discovery are directly proportional to the type and number of variables. Therefore, this activity, which the child enjoys doing, has been considered as a basis for active learning, which coincides with Dewey's strategy of learning by doing or experiencing on his own. Thus, a relationship was established between a favorite activity and active learning, and this was evaluated as an important quality that would ensure the preference and continuity of the activity. On the other hand, the diversity and functionality of play equipment have been evaluated as an effective approach against the mechanization in Dewey's educational strategies, which limits the power of thinking. At this stage, the mind must play an active role so that the child's achievements or abilities are not mechanical but rather intelligent [11]. In both playgrounds examined, equipment has moved away from its forms and meanings in standard playgrounds; in other words, by getting rid of clear stereotyped meanings and descriptions such as "sliding from the elephant's trunk" and conditioned situations such as "being a captain on the ship", it has been freed for new and various meanings that the child will create in his own world of thought. In short, the organization and setup of the space at Riis Park Plaza and Adventure Playground fostered the continuity, development, and diversification of the play. In fact, for children, learning through experience or learning from experience is supported by the space.

The reduction of embodiment on objects or equipment in the examined playgrounds has also been linked to cognitive constraints and limitations. At this point, Dewey [11], who discusses abstract thought despite a stagnant monotony, asserts that abstract thought is an imagination that perceives familiar objects in a new light and thus creates new areas of experience. Therefore, the abstract form and undefined function of play equipment actually express the meanings that will be shaped or loaded by the child through play. This situation has the potential to nourish the child's imagination and world of thought. This practice, which distances the child from the conditions and boundaries of the space, actually allows the discovery of new forms of play. In these playgrounds, where innovation is preferred over standard equipment and restrictions, contrasts such as fullness and emptiness are applied, pits and mounds are used, and the play equipment is planned as an interconnected whole. In other words, rather than the separate use or

independent expression of using individual pieces in standard playgrounds, numerous complex possibilities or combinations have been created by integrating them with each other. These forms, with their form and function, have the potential to encourage children to think freely.

Adventure playgrounds, which are the subject of this study, indicate a free environment for children. These areas offer the child the opportunity to encounter many children like himself, rather than an authority or instructor such as a teacher or parent. At this point, Dewey [1] stated that children learn many situations, such as showing power, desire to rule, justice, and impartiality, while playing with other children, and stated that children are more sensitive than adults on these issues. Therefore, while playing together is considered a part of children's education, in the adventure playgrounds examined within the scope of this study, there is a non-hierarchical, socio-spatial environment that encourages playing together instead of disciplinary elements that require compliance with line or order. On the other hand, it has been argued that very few, if any, serious injuries related to these playgrounds, where adult supervision is minimal, are very few or even almost non-existent [14]. In fact, this situation can be linked to the child being more responsible towards himself when applying his own demands in a place where he can act on his own and being more careful about what he does. The mistake made under these conditions has been considered as a kind of achievement that the child achieves by trying, and therefore the child learns on his own. As a result of all these, the child learns to take responsibility, plan, think, help, and seek solutions, and actually experiences many conditions in life while playing both on his own and with other children. Therefore, the space design that supports this social interaction aims to compensate for the restrictive system in which children playing together are constantly monitored or controlled by their parents or teachers. Therefore, the space design that supports this social interaction aims to compensate for the restrictive system in which children playing together are constantly monitored or controlled by their parents or teachers. It offers a play environment that gives the child the chance to make mistakes, break down, and rebuild, and allows the child to play by thinking and taking responsibility rather than being dictated to or directed.

Although the examined adventure playgrounds presented many opportunities for the intellectual and physical development of children, they were requested to be demolished in the late 1900s due to safety concerns raised by parents. At this point, while it is claimed that adventure playgrounds are considered to be risky play for children, it has been reported that these playgrounds have the same or fewer emergency room-type injuries compared to standard playgrounds and even have a surprisingly low injury rate [14]. Ultimately, this situation was not taken into account, and while Riis Park Plaza was demolished in the late 1900s, Adventure Playground was restored. The Adventure Playground, which was saved from demolition, had holes that disturbed the parents. Some holes were closed, sand areas were replaced with safe surfaces; pyramids were lowered; and railings were added where there were none before [24]. Therefore, the child's experience of space was interrupted for reasons that the parents described as "security" and his self-learning was restricted. At this point, situations that still cause discomfort even today, such as children climbing to a place with a very low risk level, children passing through a tunnel where they cannot be observed from where parents sit, children jumping from a place with a low risk level, running in case they trip or fall, or playing in the sand, are considered safety problems. This situation, which continues today, is related to ignoring the fact that falling, rolling, or tripping is an experience caused by space equipment and materials that do not pose a risk. In fact, this situation, as stated by Frost, who argues that excessive security elements have become almost as deep as parental supervision, gradually weakens the child and, moreover, negatively affects the development of physical and cognitive skills that would protect him against possible injuries [6]. At this point, while acknowledging the necessity of a basic level of safety is mentioned, it is stated that a certain level of risk, in other words, an "acceptable risk" level, is needed in playgrounds in order not to prevent children from becoming competent individuals [14]. The fear that parents who experienced these risks at a young age have that their children will have the same experience can be associated with not choosing, not using, and finally eliminating them. In connection with all these factors, excessive security conditions in playgrounds planned in line with pure security elements have responded as one of the implicit disciplinary elements that limit the child's space experience, movement, and thought world.

According to Dewey [11], true freedom is intellectual, and the intellectual aspect of education is related to giving the child careful and comprehensive thinking habits. Playgrounds are places that have an impact on thinking habits, both through their frequent use and their functions. While thinking habits are nourished by children's current experience, they are considered a reference or driving force for their decisions in adulthood. In this regard, playgrounds that encourage children to learn on their own by being planned at an acceptable risk level rather than fixed, taught, and prepared experiences are gaining importance. More uncertain playgrounds that require questioning, discovery, and experimentation have the potential to affect the child's education, intellectual aspect, and essentially their freedom. In other words, there is an "unfinishedness" and this unfinished perception applies not only to the play but also to the play elements. The constantly reproducing, transforming, and reshaping structure of the design, rather than its fixed and finalized state, is an opportunity for the diversification of the play. A product with a flexible structure or a changing form can evolve to a point where different ideas increase and even transform the elements. At this point, while the playground is a tool for the child to generate ideas, ideas can change, and the play equipment must adapt to this situation in line with the changing ideas. Playgrounds, where unexpected, new, and rich possibilities are presented and where these possibilities are discovered by the child, have opportunities that can make the game multidimensional for the child.

Focusing on the relationship of social purposes, values, and meanings, Dewey characterized the child's life and the places he came into contact with as a whole and evaluated the teaching of a place as a general gain directly added to the child's social life. This acquired teaching creates a thought system that is added to each other or develops with a cause and effect relationship, thus activating reflexive thinking. What is mentioned here is an education model in which the child gets to know, repair, and develop himself and his own world of thought in a place reserved for him, with different experiences and various stimuli, without any external influence or force. This model describes an intertwined process for the child, which feeds the next thought or experience and actually becomes the source of another thought. In this context, playgrounds for reflexive thinking, nourished by the child's extrovert tendencies, sense of curiosity, and enriching experiences, allow and accompany actions such as discovery, understanding, reinterpretation, trial, error, risk taking, dreaming, and building, thus serving the whole. A design proposal is expected. Therefore, within the scope of this research, it was understood that the aspects of playgrounds that support reflexive thinking or the implicit aspects that restrict or limit the child are related to the design strategy of the playgrounds or equipment and are shown in Figure 6. In this respect, while the concretization of game equipment is associated with intellectual restriction; play equipment in more abstract form, which will be shaped by the meaning the child will give, has been evaluated as an application that supports reflexive thinking. On the other hand, fixed play equipment in playgrounds, play elements that only allow individual use (requiring compliance with order and order), and the concretization of these elements are considered as elements that weaken a child's curiosity and desire to explore; Loose pieces, game elements that allow playing together, and the abstraction of these elements have been found as elements that foster reflexive thinking. In addition, in this study, while the play equipment created in playgrounds solely for safety concerns was evaluated as an application that restricts movement and thought; It has been argued that play equipment designed by taking acceptable risks is an application that fosters reflexive thinking in order to ensure the child's own control. Finally, while standardized, uniform play equipment is defined and therefore considered as an element that restricts thought; Various and multi-layered possibilities have responded as an element that increases curiosity and thus supports reflexive and free thinking.

Aspects of Playgrounds that Support Reflexive Thinking	Implicit Aspects of Playgrounds That Discipline or Limit
Replacement and loose parts	Fixed elements
Abstraction of game elements	Concretization of game elements
Acceptable risk	Extreme security elements
Different forms	Repeating forms
Elements that allow playing together	Elements that allow individual use only
Various, new and multi-layered equipment	Standardized, uniform equipment
Undefined function	Defined and designated function

Figure 6: *Effects of Playground Design on Children*

5. CONCLUSION

Within the scope of this study, playgrounds are used as tools in the intellectual and educational role of the play, and their strengths are mentioned. This power has implicit disciplinary meanings for the playgrounds built in the 21st century, with defined and limited aspects that take control over the play from the child to a significant extent. These areas, which should accompany the child's play with both the meanings they carry and the functions they have in theory, display an active attitude that determines the play to be played by pushing the child into a passive position in practice, conditions the child's behaviors and movements with clear spatial definitions or patterns, and essentially puts the child under his own discipline. In other words, today's playgrounds are in the position of managing with the order and discipline they have, while the child, as the user, is in the position of being managed and following the commands of the space. Within the scope of this study, organization, material, and equipment are considered the governing elements of the space. At this point, physicality, which encourages playing in adventure playgrounds, is more undefined, away from patterns, allows playing together, and adapts to change and movement, has been evaluated as factors that support free play and nourish self-experience and active learning strategies. The acceptable risk for the child in playgrounds could be considered a need for the child to learn on his own. In relation to the investigations, while uniformity, concretization, definition, external control, individuality, and excessive security elements in the playgrounds implemented in the 21st century are considered disciplinary elements, a relationship has been established between the disciplinary implicit elements that close the child's experiences to innovations and new thoughts and the level of freedom. However, within the scope of the study, there is no mention of completely eliminating this level or creating a completely free environment for the child without any restrictions. While it is not possible to create an environment where security will be completely ignored or all borders will be destroyed, it is clear that even the location of playgrounds on certain land is a limiting factor. The essence of this study draws attention to the importance of an improvement in which the elements that discipline experience and experience-based learning will be reduced. As a result, in line with the findings obtained, it has been understood that the designs of playgrounds, as a place of education and experience, that accompany the play, activate the child, and encourage children to think freely are an important factor that can affect the child's present and future as an extension of today's learning. At this point, it has been realized that playgrounds that avoid commands or defined and limited design criteria have the potential to positively affect the quality of the child's experience, stimulate a sense of curiosity, and at the same time increase the level of external freedom.

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PART B: ART, HUMANITIES, DESIGN AND PLANNING

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Integrating UN Sustainable Development Goals into Campus Planning: Pathways for Higher Education Institutions

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Abstract

This research article explores the significant role of higher education institutions (HEIs) in contributing to the Sustainable Development Goals (SDGs) by analyzing their sustainability initiatives through the lens of the GreenMetric University Sustainability Rating. It scrutinizes the commitment of prominent universities across various continents to environmental stewardship, focusing on essential areas such as infrastructure, energy efficiency, waste management, water conservation, and sustainable transportation. The study examines the sustainability practices at notable institutions including the University of Indonesia (UI), Wageningen University & Research (WUR), the American University in Cairo (AUC), Lincoln University, the University of California, Davis (UC Davis), and the University of São Paulo (USP). It organizes these efforts into six main domains: Campus and Infrastructure, Energy and Climate Change, Waste Management, Water Conservation, Transportation, and Education and Research, providing a detailed analysis and recommendations for enhancing campus sustainability. Through a comparative analysis, presented in a structured format, the article highlights exemplary practices and aims to serve as a blueprint for other universities seeking to integrate sustainability into their operations. This research underscores the pivotal role of higher education institutions (HEIs) in driving sustainable solutions and aligning with global environmental objectives, advocating for a systematic and scientific integration of sustainability principles across university operations and curricula. It offers an in-depth analysis of current sustainability trends in higher education, stressing the critical need to motivate institutions towards greater sustainability commitments and to foster the development of leaders and innovative approaches for a sustainable future.

1. INTRODUCTION

Global warming, often called climate change, represents a formidable challenge to the health and stability of our planet and its inhabitants. This phenomenon is primarily driven by the accumulation of greenhouse gases, such as carbon dioxide and methane, in the Earth's atmosphere. These gasses function like a thermal blanket, trapping solar heat and incrementally elevating global temperatures. The ramifications of this process are multifaceted and profound, encompassing a spectrum of environmental and socio-economic impacts. These include the gradual rise of sea levels, the accelerated melting of glaciers, an increase in the frequency and severity of extreme weather events, significant ecological alterations, and a myriad of threats to human health and livelihoods. The primary sources of these greenhouse gas emissions are deforestation, the combustion of fossil fuels, and various industrial activities. A concerted effort at local, national, and international levels is imperative to combat global warming. This includes a transition towards renewable energy sources, enhancement of energy efficiency, adoption of sustainable land use practices, conservation of ecosystems, and a commitment to reducing overall greenhouse gas emissions.

Sustainability refers to the judicious use of resources to meet current needs without compromising the ability of future generations to meet their own needs. Although the word sustainability, which originates from the Latin word 'sustinere', has been used in many meanings in dictionaries, it is mainly used in the

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meanings of sustaining, providing, continuing, supporting, and existing [1]. It encompasses a holistic approach, integrating environmental stewardship, economic viability, and social equity to foster a balanced and enduring development. The importance of sustainability lies in its capacity to ensure long-term ecological balance, safeguarding natural systems and resources crucial for the survival and prosperity of humanity. Moreover, sustainability is pivotal in addressing global challenges such as climate change, resource depletion, and social inequality, thereby ensuring a viable and equitable world for future generations.

Additionally, the United Nations' Sustainable Development Goals (SDGs) [2] play a crucial role in this context. These goals, established in 2015, are a universal call to action aimed at addressing the world's most pressing social, economic, and environmental challenges through 17 interconnected objectives. The SDGs endeavor to eradicate poverty, ensure education and gender equality, provide clean water and sanitation, develop sustainable cities and communities, and, notably, combat climate change. Goal 13, for instance, places a spotlight on the need for immediate action against climate change. The SDGs call for a unified effort to reduce greenhouse gas emissions, enhance renewable energy usage, bolster resilience against climate-related hazards, and promote sustainable consumption and production patterns. Through the implementation of strategies that increase energy efficiency, expand renewable energy use, and foster low-carbon economies, countries can significantly reduce their greenhouse gas emissions. Additionally, sustainable practices in agriculture, forestry, and urban development can contribute to climate change mitigation while also supporting other SDGs, such as zero hunger, life on land, and sustainable cities and communities. In conclusion, integrating climate action into broader sustainable development initiatives is essential to ensure a prosperous future for all while safeguarding the integrity of our planet.

The concept of a university or college campus encompasses not only the physical space but also the facilities that are an integral part of academic and extra-curricular activities. The term 'campus' was used in America in 1746 for Princeton University [3]. This comprehensive space includes but is not limited to, academic buildings, classrooms, libraries, laboratories, residential halls, sports facilities, and additional areas dedicated to various student activities. Within these confines, a campus serves as a dynamic hub for learning, research, social engagement, and community involvement. It acts as a crucible for the academic and personal development of students, educators, and staff, fostering an environment conducive to collaboration and intellectual growth. Moreover, the presence of green spaces, walking paths, and recreational areas significantly enhances the quality of life for those residing on or frequenting the campus. Additional facilities such as administrative offices, dining services, student support centers, and cultural or artistic venues contribute to the holistic nature of a campus environment. The emblematic significance of a university campus extends beyond its physical boundaries. According to Alshuwaikhat and Abubakar [4], because of their size, population, and the many complex activities on campus, universities may today be considered "small cities" because of their significant direct and indirect environmental effects.

In the context of sustainability, university campuses assume a pivotal role. Sustainable campuses serve as living laboratories where sustainable practices and theories are not only taught but actively implemented and observed. Ali and Anufriev [5] state that the concept of a green university is inspired by environmental sustainability, encompassing the efficient use of natural resources, effective environmental management, pollution prevention, and economic considerations of profit and cost within the broader context of the environment, economics, and society. According to Velazquez et al [6] a sustainable university is defined as “A higher educational institution, as a whole or as a part, that addresses, involves and promotes, on a regional or a global level, the minimization of negative environmental, economic, societal, and health effects generated in the use of their resources in order to fulfill its functions of teaching, research, outreach and partnership, and stewardship in ways to help society make the transition to sustainable life-styles.” Alshuwaikhat and Abubakar [4] also state that “A sustainable university campus should be a healthy campus environment, with a prosperous economy through energy and resource conservation, waste reduction and an efficient environmental management, and promotes equity and social justice in its affairs and export these values at community, national and global levels”.

Furthermore, sustainable university campuses act as exemplars of practical solutions and best practices that can be emulated by other institutions and communities. Through the adoption of energy-efficient buildings, renewable energy systems, comprehensive waste management programs, and initiatives promoting sustainable transportation, these campuses demonstrate the feasibility and benefits of sustainable practices. This not only stimulates innovation and research in sustainable technologies and practices but also encourages multidisciplinary collaboration among students, educators, and researchers to address complex environmental challenges. By adopting sustainable practices, these campuses significantly reduce their carbon footprint, resource consumption, and overall environmental impact. In doing so, they not only embody the principles of sustainable living but also inspire and encourage broader societal adoption of these practices. Sustainable university campuses are not only centers of education and inspiration but also serve as catalysts for promoting sustainability within and beyond their campus borders.

LEED (Leadership in Energy and Environmental Design) [7] and BREEAM (Building Research Establishment Environmental Assessment Method) [8], are renowned rating systems that play a pivotal role in the evaluation and certification of sustainability in buildings. The LEED system, established by the U.S. Green Building Council, is a comprehensive framework designed to assess the green credentials of buildings, encompassing the entirety of their lifecycle from design and construction to operation and maintenance. Its assessment criteria are multifaceted, focusing on energy efficiency, water usage, indoor air quality, and material selection. On the other hand, BREEAM, originating in the United Kingdom, offers a similar yet distinct approach. It provides a holistic evaluation of the environmental and social impacts of buildings, incorporating a broad range of categories such as energy, water usage, waste management, the surrounding environment, and transportation infrastructure. This system places a significant emphasis on the broader ecological footprint of construction projects.

GreenMetric World University Sustainability Rating (WUR) [9], introduced by the University of Indonesia [10], plays a pivotal role in the realm of higher education by providing a specialized tool for assessing and benchmarking the sustainability of university campuses globally. Established in 2010, this rating system evaluates a wide range of aspects including infrastructure, energy and climate change policies, waste management strategies, transportation systems, and the quality of sustainability education. It serves not only as a tool for measuring current practices but also as a catalyst for ongoing improvement in campus sustainability. The system advocates for the adoption of energy-efficient technologies, the use of sustainable materials, waste reduction initiatives, and the establishment of comprehensive environmental management systems. These recommendations aim to enhance the sustainability of building and campus operations, thereby reducing environmental footprints and contributing to a sustainable future. The GreenMetric platform fosters a competitive and collaborative environment among universities worldwide, emphasizing global participation and raising environmental awareness in the academic community. Lauder et al [11] state that in shaping the GreenMetric WUR, the ranking design team was influenced by the holistic sustainability focus of the Holcim Awards [12], the localized green building practices of GREENSHIP [13], the extensive campus sustainability metrics of STARS [14], and the broad evaluative approach of the College Sustainability Report Card [14], integrating these diverse perspectives to assess universities' comprehensive efforts in environmental, social, and economic sustainability. Also, Hamzah et al [16] state that the methodology of GreenMetric is closely intertwined with the United Nations' Sustainable Development Goals (SDGs), demonstrating a significant alignment between the two frameworks.

Annual rankings are determined by the aggregate scores that higher education institutions garner through GreenMetric evaluations, which span various categories, each with its own set of weightings: Setting and Infrastructure (SI) at 15%, Energy and Climate Change (EC) initiatives at 21%, Waste (WS) at 18%, Water (WR) at 10%, Transportation (TR) at 18%, and Education and Research (ED) at 18% [17]. As detailed in Table 1, the number of indicators, points, and the percentage contribution of each category to the total points are meticulously outlined, with the total score being 10000 [18]. Setting and Infrastructure (SI), which assesses open space, vegetation, and sustainability budget; Energy and Climate Change (EC), focusing on energy efficiency, renewable sources, and greenhouse gas reduction; Waste (WS), which looks at waste management practices; Water (WR), evaluating water conservation and pollution control;

Transportation (TR), assessing vehicle policies and zero-emission initiatives; and Education and Research (ED), which measures the integration of sustainability into courses, research, and community engagement. Each category comprises various indicators, such as the use of energy-efficient appliances, 3R waste programs, water recycling, shuttle services, sustainability courses, and research funding, aiming to provide a comprehensive overview of a university's sustainability efforts. This detailed and encompassing approach underscores the pivotal role that universities play in championing and exemplifying sustainable practices, thereby contributing significantly to the global effort to promote sustainability within the higher education sector.

Table 1. *Indicators and Categories Suggested for Use in the 2023 Rankings by Greenmetric [18]*

Category	Number of Indicators	Points	% of Total Points
Setting and Infrastructure (SI)	11	1500	15%
Energy and Climate Change (EC)	10	2100	21%
Waste (WS)	6	1800	18%
Water (WR)	5	1000	10%
Transportation (TR)	8	1800	18%
Education and Research (ED)	11	1800	18%

Although GreenMetric is considered a pioneer in the field of sustainability assessment within higher education institutions, it has been subject to critique by experts on several fronts, highlighting areas in need of methodological refinement and greater scientific rigor to enhance its reliability and applicability in guiding sustainability policies and practices in universities globally. The critical review of the GreenMetric methodology by Ragazzi and Ghidini [19], highlights several issues including the absence of entry thresholds, lack of scoring bands, the relativity and high sensitivity of scores, and the incompleteness of the ranking in fully addressing the social and economic dimensions of sustainability, suggesting the need for methodological improvements for a more objective, transparent, and comprehensive assessment. Despite its recognition as a pioneering tool for assessing sustainability in higher education institutions (HEIs), the GreenMetric faces challenges in indicator selection, methodological stability, and long-term strategic planning utility, necessitating further refinement for enhanced transparency, objectivity, and scientific rigor. Boiocchi et al [20] argue that the UI GreenMetric ranking system's indicators for assessing global university sustainability often fall short, either due to irrelevance or lack of proper normalization against local context, highlighting the need for more accurate, unbiased indicators and emphasizing the complexity of ranking universities on sustainability while accounting for context-specific factors and data reliability. According to Karasan et al [21] the UI GreenMetric has globally promoted the green campus concept, especially in developing countries, yet necessitates updates, clearer priority guidelines, and new category-specific awards, while encouraging broader sustainability goals beyond ranking achievements, like the SDGs.

According to Atici et al [22], Muñoz-Suárez et al [23], and Marrone et al [24] aside from GreenMetric, the three other significant university sustainability rankings are the Academic Ranking of World Universities (ARWU), QS World University Ranking (QS Ranking), and Times Higher Education World University Rankings (THE Ranking). Launched in 2003 by Shanghai Jiao Tong University and now managed by ShanghaiRanking Consultancy, the Academic Ranking of World Universities (ARWU) [25] is the pioneering global ranking, annually listing the top 1000 research universities based on transparent,

objective criteria across six key dimensions. Launched by Quacquarelli Symonds (QS) in 2004, the 20th edition of the QS World University Rankings [26] evaluates 1,500 institutions across 104 locations, uniquely focusing on employability and sustainability, and provides a comprehensive comparison of global universities by region and subject on its website. The Times Higher Education (THE) World University Rankings [27], launched in 2004 and publishing independently since 2010, assesses 1,906 universities across 108 countries with 18 performance indicators across teaching, research environment, research quality, industry engagement, and international outlook, making it a leading global academic ranking for comprehensive university evaluation.

Despite its shortcomings and criticisms from some quarters, the GreenMetric ranking system is still considered by many to be the best tool for measuring sustainability in Higher Education Institutions (HEIs) for several compelling reasons. Firstly, it offers a comprehensive framework that encompasses a wide range of sustainability dimensions, including infrastructure, energy and climate change, waste management, water usage, transportation, and education. This holistic approach ensures that various aspects of sustainability are evaluated, providing a well-rounded assessment of an institution's sustainability efforts. Secondly, GreenMetric's methodology is transparent and globally applicable, allowing universities from around the world to participate and be evaluated on a common platform. This global standardization facilitates the comparison of sustainability practices across institutions, encouraging a competitive yet collaborative environment for improvement. Moreover, GreenMetric places a significant emphasis on innovation and continuous improvement by updating its criteria and weightings to reflect the evolving understanding of sustainability. This adaptability ensures that the ranking system remains relevant and encourages institutions to continually enhance their sustainability practices. The ranking system also serves as a powerful tool for universities to benchmark their performance against peers globally, identify areas for improvement, and strategize their sustainability initiatives. By participating in the GreenMetric ranking, institutions not only gain visibility for their sustainability efforts but also join a global network of universities committed to advancing sustainability in higher education.

Furthermore, GreenMetric's focus on data-driven assessments provides a quantitative basis for evaluating sustainability, making it easier for institutions to measure their progress over time and set concrete targets for future development. According to Ragazzi and Ghidini [28], the GreenMetric Ranking establishes a strong foundation for embedding sustainability principles in Higher Education Institutions, underscoring the significance of measuring efforts towards sustainability. In summary, despite its limitations and the critiques it may face, the GreenMetric ranking system's comprehensive, transparent, and adaptive approach, combined with its global applicability and focus on continuous improvement, makes it an exemplary tool for measuring and promoting sustainability in higher education institutions worldwide. Given these strengths, this research focuses on analyzing universities that rank first on their continents in the GreenMetric ranking system, examining their sustainability practices and achievements in detail.

2. METHODOLOGY

The primary objective of this research is to enhance awareness and understanding of sustainable development within university campuses, a crucial setting where students, as major stakeholders, spend significant time. This research aims to investigate key environmental challenges including global climate change, conservation of energy and water, waste recycling, and sustainable transportation, to educate and prepare future generations for a sustainable future. Additionally, it seeks to demonstrate the practicality of implementing sustainability initiatives in academic environments, focusing on cost-effective and efficient solutions for sustainable development challenges. A key aspect of the research is to promote a culture of long-term commitment to sustainability among university administrators, thereby addressing not only campus-specific environmental issues but also contributing to the broader discourse on global challenges such as air pollution, habitat loss, species extinction, climate change, and water scarcity. The primary data source was the GreenMetric website, recognized for its specialized focus on categorizing higher education institutions based on sustainability parameters. This platform provided valuable insights into the sustainability practices and policies adopted by these universities. Additionally, an extensive array of internet resources was utilized to gather a broader understanding of each university's sustainability efforts.

This included official university websites, academic publications, news articles, reports on special events, climate action plans, and annual sustainability reports. These diverse sources were instrumental in providing a comprehensive view of the sustainability initiatives at each institution.

The research methodology emphasized qualitative analysis, focusing on non-numerical data to understand the depth and nuances of each university's sustainability strategies. Content analysis was the primary analytical technique employed, enabling a systematic organization and evaluation of the collected data. This process involved a detailed examination of the sustainability content presented on the GreenMetric website and the integration of findings from various online sources. The study aimed to identify key themes, trends, and best practices in sustainability, as demonstrated by these leading universities. A significant component of the methodology was the in-depth review of relevant literature and documents related to university sustainability. For each university, documents were analyzed annually, covering the period from 2010 to 2023. This longitudinal approach allowed for an understanding of the evolution of sustainability practices over time and provided context to the current standings in the GreenMetric ranking. The 2023 GreenMetric ranking offered a comprehensive comparative analysis of 1183 universities from 84 countries, categorized into six geographical regions: Asia, Europe, Africa, Oceania, North America, and South America. This global perspective was crucial in illustrating the varied and extensive sustainability efforts undertaken by universities worldwide. The top-ranking universities in each region, as per the GreenMetric scores, were the focus of this study, showcasing their commitment to advancing sustainability within their campuses and curricula. This approach not only highlighted the achievements of these specific universities but also served as a benchmark for other institutions striving for sustainability excellence. The comprehensive data and insights gathered formed the basis of a detailed comparative analysis, presented in Table 2, to underscore the diverse sustainability strategies employed across different global regions [29].

Table 2. *GreenMetric Ranking by Region 2023 [29]*

Region	University	Country	Setting and Infrastructue Total: 1500	Energy and Climate Change Total: 2100	Waste Total: 1800	Water Total: 1000	Transportation Total: 1800	Education Total: 1800	Total Score 10000
ASIA	University of Indonesia (UI)	Indonesia	1325	1850	1575	950	1425	1800	**8925**
EUROPE	Wageningen University & Research (WUR)	Netherlands	1350	1825	1800	1000	1750	1775	**9500**
AFRICA	American University in Cairo (AUC)	Egypt	1060	1285	1800	1000	1400	1425	**7970**
OCEANIA	Lincoln University	New Zealand	1350	1425	1575	800	1700	1575	**8425**
NORTH AMERICA	University of California, Davis (UC Davis)	USA	1400	1900	1800	1000	1575	1750	**9425**
LATIN AMERICA	University of Sao Paulo (USP)	Brazil	1450	1775	1800	950	1700	1750	**9425**

3. FINDINGS

This study undertook an expansive examination of sustainability initiatives at six leading universities across different continents, identified through the 2023 GreenMetric University Sustainability Ranking. The methodological approach was multifaceted, combining qualitative analysis with a comprehensive review of online resources and the GreenMetric platform's data. The universities selected for the detailed study were the University of Indonesia (UI), Wageningen University & Research (WUR), the American University in Cairo (AUC), Lincoln University, the University of California, Davis (UC Davis), and the

University of São Paulo (USP). These institutions, representing their respective geographical regions, were chosen based on their high GreenMetric rankings and their diverse approaches to sustainability. Data on the sustainability practices of these six universities were meticulously compiled from their sustainability websites, dedicated web pages, sustainability and climate change reports, and scholarly articles on the topic. These sources offered a detailed insight into each university's commitment and actions towards sustainability. Efforts in the same domain were aggregated to present a unified perspective on the sustainability endeavors across these institutions. For each of the six universities, detailed information is presented under distinct headings, including their GreenMetric scores and their standings in previous rankings. Furthermore, the document elaborates on the specific dimensions of sustainability each university prioritizes, alongside a comprehensive description of the initiatives and measures they have implemented to address these areas. The narrative extends to discuss the future strategies and plans these institutions have devised to further their commitment to sustainability, indicating a proactive approach towards continuous improvement in environmental stewardship.

3.1. The University of Indonesia (UI), Indonesia/ASIA

According to GreenMetric's rankings, the University of Indonesia (UI) in Depok, Indonesia, has been recognized as the most sustainable university in Asia for the years 2022 and 2023 [30]. In sustainability, UI has achieved the highest ranking in the Asia region, achieving 8925 out of 10000 points. The university's accomplishment is a testament to its consistent commitment to sustainability in multiple areas, such as setting and infrastructure, energy usage, waste management, water conservation, transportation, and education. In terms of setting and infrastructure, UI boasts a suburban campus where 92% of the area is open space, with a significant 22% covered by forest vegetation. UI maintains 75% of its campus area for reforestation, emphasizing the importance of green spaces in urban settings. This emphasis on natural preservation, coupled with environmentally friendly landscaping, underscores the university's commitment to creating a sustainable environment. Furthermore, the campus's energy conservation initiatives are evident in its reduced electricity consumption, which saw a 6.9% decrease in 2018 compared to the previous year. UI's approach to renewable energy is multifaceted, incorporating solar panels for office and street lighting, hydrogen fuel cells, and wind turbines. The campus also makes extensive use of LED lighting and solar energy for air conditioning purposes. The integration of energy-efficient products increased by 25% in 2018 compared to 2017, with smart buildings constituting 25% of all floor space. These buildings are equipped with advanced features like CCTV, voice call systems, automatic fire alarms, and the strategic use of natural light and indoor vegetation. The UI library on the Depok campus, known as the "crystal of knowledge," was designed with sustainable principles in mind. It utilizes solar energy and is noted for its efficient use of electricity, water, and paper.

Regarding waste management, UI exhibits commendable practices. Approximately 50-75% of organic waste is utilized, predominantly processed through dry aerobic digestion, with the remaining 10% directed to the UI waste bank. Inorganic waste treatment and hazardous waste recycling are also effectively managed, with 50-75% of inorganic waste treated and 75% of hazardous waste processed and recycled. In terms of water management, UI has implemented numerous conservation and recycling measures. These include biophores, underground water tanks, and an artificial lake as water reservoirs. The university ensures that 50-75% of its water usage is derived from conservation sources, with 80% of the campus area dedicated to water conservation. Additionally, 75% of the total water volume is recycled, supported by an on-site water treatment facility and runoff collection systems.

Transportation at UI is geared towards reducing environmental impact. The campus has allocated 7% of its area to parking, a significant increase from the previous year, and offers a free shuttle service eight times a day. The university has also reduced its vehicle fleet by half since 2017. The campus promotes the use of zero-emission vehicles and bicycles, with 800 zero-emission vehicles available, representing a 78% decrease compared to the previous year. The university has developed over 20 kilometers of bicycle paths and provides shuttle buses to reduce vehicle use on campus. The introduction of campus bikes, available for rent to students, further promotes sustainable transportation. These initiatives are complemented by the provision of handicapped-accessible walkways with lights and motion sensors. In the realm of education, UI demonstrates a strong commitment to sustainability. The university supports 59 student

groups focused on sustainability, has hosted 198 sustainability-related events, and produced 300 publications on the subject. These efforts are backed by substantial financial commitment, with 27% of the university's total budget allocated towards sustainability initiatives. This comprehensive approach to sustainability at the University of Indonesia not only reflects its dedication to environmental stewardship but also serves as a benchmark for other institutions aiming to enhance their sustainability practices. By integrating sustainable principles into various aspects of campus life, UI stands as a leading example in the global effort to promote sustainable development in higher education [31-34].

3.2. Wageningen University & Research (WUR), Netherlands/EUROPE

Wageningen University & Research (WUR) in Wageningen, the Netherlands, has achieved significant recognition by being voted the world's most sustainable institution for the seventh time in both the overall and European rankings, according to the 2023 GreenMetric rating [35]. Achieving an impressive sustainability score of 9500 out of 10000, WUR integrates sustainability into its core research and teaching subjects. The Green Office Wageningen is instrumental in facilitating and supporting sustainable initiatives among students and faculty, engaging the community through various events and digital platforms like Instagram, Facebook, and LinkedIn. Under its Multi-annual Environmental Plan 2020-2022, WUR has set comprehensive sustainability targets across multiple domains. In the realm of energy, WUR is committed to achieving energy neutrality by 2030, with specific goals including a 2% annual energy saving and a reduction in natural gas usage. This commitment is evidenced by the establishment of solar farms, the utilization of 26 windmills in Lelystad for electricity generation, and the ambitious plan of powering all buildings and greenhouses with Aquifer Thermal Energy Storage (ATES) systems for heating and cooling purposes. More than 10,000 solar panels installed on campus buildings and grounds, along with wind energy, contribute to a significant portion of the university's energy needs.

Waste management at WUR aims for a 50% reduction in recyclable garbage, residual waste, and material consumption by 2030. In 2020, 98% of the university's waste was processed through 'useful recovery' methods, including recycling and energy recovery. Specialized waste units on campus facilitate the segregation of organic, paper, plastic, and other types of waste, promoting the repurposing of materials like paper cups and towels. Water management is another key focus area, with the university aiming to reduce water consumption and eliminate chemical pollution in effluents. Water-saving technologies are installed in new buildings, and regular inspections ensure the quality of water discharged into the sewage system. Efficient water treatment and purification processes, including the recovery of chemicals, are actively employed.

Biodiversity and soil management are integral to WUR's sustainability efforts. The Green Campus Vision guides the biodiversity policy, with regular assessments of the campus's flora and fauna. Soil quality is monitored consistently, and sustainable practices are incorporated into new construction projects, which prioritize features like insulation, thermal energy storage, green roofs, and solar panels. Air quality and asbestos management are also addressed, with the university committed to periodic emission testing and the systematic removal of asbestos-containing roofs and structures. In terms of procurement and mobility, WUR sets ambitious goals for emission-free business cars and sustainable supply chains. The university promotes eco-friendly modes of transportation, including electric vehicles, bicycles, and public transportation, aiming for a significant reduction in mobility emissions by 2030. Overall, WUR's holistic approach to sustainability encompasses energy efficiency, waste reduction, water conservation, biodiversity protection, sustainable construction, air quality improvement, and responsible procurement and mobility practices. This comprehensive strategy not only positions WUR as a global leader in sustainable practices within the academic sector but also serves as an exemplary model for institutions worldwide aiming to enhance their environmental footprint [36-40].

3.3. The American University in Cairo (AUC), Cairo/AFRICA

The American University in Cairo (AUC) in Egypt has garnered the title of the most sustainable university in Africa for the third consecutive year, as per the GreenMetric 2023 survey, achieving a sustainability score of 7970 out of 10000 in the Africa region rating [41]. This distinction highlights

AUC's extensive and multifaceted approach to sustainability, encompassing various domains such as buildings, landscape, water, energy, waste, transportation, and climate impact. At the forefront of AUC's sustainability efforts is its robust academic commitment, exemplified by the offering of 451 sustainability courses in the 2020-2021 academic year and the availability of a master's degree program in sustainability. The university has 13 sustainability-focused graduate programs spread across 32 departments, demonstrating a comprehensive integration of sustainability into its curriculum. Additionally, AUC's commitment to research in this field is substantial, with a budget of $23.5 million allocated for sustainability research and a dedicated Center for Environment and Sustainability Research.

In the realm of campus infrastructure, AUC has implemented an energy management system in its buildings, leading to a 50% reduction in ventilation and heating requirements. The architectural design of these buildings incorporates features such as large openings and wooden panels in windows to maximize natural ventilation and lighting while minimizing heat ingress, saving up to 40% in cooling energy. The installation of solar energy panels has contributed to a reduction of 77 tons of CO2 emissions. Moreover, the university is undertaking LEED certification efforts for its buildings, which feature green roofs, solar heating, energy-efficient doors and windows, motion sensors, counters, and sustainable landscaping with native flora. The university's landscape strategy includes 60 acres of gardens, 20 of which were designed by a renowned landscape architect. Emphasis is placed on air filtration and carbon emission reduction, with most of the trees and plants being cultivated in the university's agricultural research center. In 2021, the landscape and composting efforts led to the sequestration of 168 metric tons of carbon dioxide.

Water management at AUC involves limiting monthly water usage and utilizing treated wastewater for landscaping purposes, meeting 50% of the campus's overall water needs. The energy needs of the university are predominantly met by a cogeneration facility using natural gas, with energy usage monitored monthly and having seen a 19% reduction since the onset of COVID-19. Waste management includes 48 distinct waste stations across the campus and 35 filtered drinking water stations, which have eliminated the use of 7.4 million disposable water bottles. The transportation system at AUC offers 13 different routes to the university, including a shuttle service and a car-sharing program, with free parking for those participating in the latter. Addressing climate impact, AUC has released a carbon footprint report and implemented measures to reduce air conditioning, lighting, catering, and transportation emissions. The university also actively engages its student body in sustainability, evidenced by the existence of 25 student unions, the publication of 16 sustainability e-newsletters, and the organization of 47 related activities. Furthermore, AUC has established a special center dedicated to supporting students with disabilities, ensuring an inclusive and accessible learning environment. This comprehensive approach adopted by the American University in Cairo not only underscores its leadership in sustainability within the African region but also sets a benchmark for global institutions in integrating sustainable practices across various operational and academic aspects. By prioritizing sustainability in education, infrastructure, energy, water, waste management, transportation, and climate action, AUC demonstrates a commitment to fostering an environmentally conscious and responsible academic community [42-46].

3.4.Lincoln University, New Zealand/OCEANIA

Lincoln University in Lincoln, New Zealand, has been recognized as the most sustainable institution in Oceania for the years 2020, 2022, and 2023 according to the GreenMetric rankings [47]. In the 2023 Oceania regional rating, the university achieved a commendable score of 8425 out of 10000, reflecting its commitment to sustainability. Lincoln University has set two overarching long-term sustainability goals: to be a leader in sustainability education, research, and practice, and to achieve carbon neutrality by 2030, progressing towards zero carbon emissions by 2050. The first goal is divided into three key areas: education, research, and demonstration. In education, Lincoln University focuses on operationalizing and monitoring sustainability teaching activities, ensuring the graduation of competent individuals in sustainability, and encouraging participation in professional development. It aims to implement two sustainability laboratory projects each term and continuously enhance these educational objectives. Research initiatives at Lincoln University include supporting multidisciplinary sustainable research

projects annually, conducting comprehensive sustainability research, and developing the GreenMetric framework.

The demonstration aspect of this goal is realized through the Lincoln University Multi-Crop Energy Farm and two living lab studies conducted on university farms. These initiatives aim to reduce the carbon footprint through high-efficiency measures. The second goal encompasses green infrastructure, energy, water and biodiversity, transportation, and waste management. Green infrastructure initiatives involve conducting carbon audits, replacing fossil fuels with efficient heating systems like solar energy, benchmarking against sustainability criteria, assessing the cost of building life, and implementing sustainable asset management practices. In energy management, the university ensures energy efficiency in new infrastructure and utilizes renewable energy sources. It focuses on decommissioning a coal boiler, employing certified renewable energy solutions, and clearing obsolete structures. The university commits to quarterly reporting on campus energy production from renewable sources, increasing renewable energy usage, decreasing energy consumption per user, raising awareness about energy usage, and decommissioning diesel generators by 2030.

Water and biodiversity efforts include completing a landscape master plan and prioritizing projects such as the arboretum project and tree planting. Lincoln University also monitors water usage quarterly and engages in rainwater collection, greywater usage, and maintaining an artificial pond. Transportation initiatives at Lincoln University involve imposing a tax on air travel, transitioning to a 100% carbon-free university vehicle fleet by 2024, introducing a car-sharing app, providing special parking for electric vehicles, using carbon-free vehicles for field trips, offering bicycle storage, surveying transportation habits, promoting digital meetings, and increasing shuttle routes and hours. In terms of waste management, the university is committed to changing staff behavior and culture, making marketing materials more sustainable, reducing food waste by 75% by 2023, labeling recycling bins, implementing residential assistant and student housing programs, setting waste contamination targets, and training students in waste management. The university also focuses on consistent waste management across all areas, including lab waste, trash disposal training, minimizing packaging, eliminating single-use and petroleum-based plastic packaging, and promoting ecologically responsible waste disposal among students and employees. Through these comprehensive sustainability initiatives, Lincoln University not only advances its environmental stewardship but also sets a benchmark for other institutions in Oceania and beyond [48-51].

3.5. University of California, Davis (UC DAVIS), United States/NORTH AMERICA

The University of California, Davis (UC Davis), situated in Davis, California, has been recognized as the most sustainable university in North America for the seventh time, according to the 2023 GreenMetric rankings [52]. Scoring 9425 out of 10000 in the North American regional rating for 2023, UC Davis demonstrates a comprehensive approach to sustainability, encompassing 12 key areas: buildings, climate, food and beverage, labs, zero waste, procurement, diversity, equality and inclusion, energy, land management, nitrogen footprint, transportation, and water. UC Davis has achieved significant strides in sustainable building practices, with 40 buildings on the Davis campus receiving LEED certification and numerous older buildings undergoing energy retrofits. These buildings are equipped with sensor LED lighting, cool roofs, efficient windows, water-saving toilets and faucets, and strategies to educate campus users about energy conservation. The university aims to be carbon neutral by 2025 and has undertaken measures like switching off heating and cooling systems during holidays to reduce energy consumption. The university's infrastructure includes a wastewater treatment facility, an electrical substation, a central heating and cooling plant, water wells, surface water distribution, a public transportation system, and a combined heat and power plant in Davis, with a similar facility in Sacramento. Transitioning from fossil fuels to renewable energy sources is a key goal, involving efficiency improvements in the central heating system, the use of renewable and clean energy on campus, electrification of infrastructure, solar power plants, and carbon sequestration. In terms of food and beverage, UC Davis supports sustainable food choices, with 25% of campus food being sustainable. Initiatives like trayless cafeterias, hydration stations, and discounts for bringing their containers are part of a broader strategy that includes student food access, sustainable agriculture, campus-produced renewable foods, and food waste diversion.

UC Davis has also achieved its target for sustainable research laboratory evaluation. The university's commitment to waste reduction is evident in its goal to reduce per capita waste by 50% compared to 2015/16 by 2030, aligning with the zero-waste policy. This involves implementing reduce-reuse-recycle procedures, water filling stations, discounts for container use, and training programs. Reuse initiatives include outlets selling donated items and a biennial sale of abandoned bicycles. The campus recycles conventional materials like paper, cardboard, plastic, and compostable items, and participates in national waste-sorting events. The university's procurement practices focus on environmentally friendly products, with 74% of cleaning supplies being "green." Steps include purchasing less harmful products, establishing a system for identifying eco-friendly products, reducing courier numbers on campus, and replacing inefficient equipment. Diversity, equity, and inclusion are integral to UC Davis's sustainability efforts, with the Office of Diversity, Equity, and Inclusion setting the campus vision for these initiatives. Programs like the UC Fair Pay/Fair Work Plan and the Food Rescue Network are part of this commitment. Energy efficiency is a priority, with the university aiming to reduce energy usage by 2% per year and ensure that each building produces 100% clean energy by 2025. The campus has numerous solar panels, both ground-mounted and rooftop/parking, and is implementing energy efficiency projects like the replacement of the underground steam heat distribution system and a smart lighting system.

Land management at UC Davis involves maintaining 5300 acres with 14000 trees of more than 100 species, and 20% forest cover. The university's landscape includes orchards, vineyards, fields, pastures, and a living landscape adaptation strategy. Water management is a key focus, with the campus using approximately 15% of its water for landscape irrigation and 36% for agricultural irrigation. Efforts include transitioning to less water-intensive landscaping, efficient irrigation infrastructure, smart irrigation saving millions of gallons of water, mulch application to prevent evaporation, carbon sequestering landscapes, habitat mitigation areas, and wetland reserves for habitat protection. The university also boasts an arboretum, community garden, vineyard, student farm, and oak forest. UC Davis is the only U.S. institution to have measured its nitrogen footprint, underscoring its commitment to understanding and mitigating its environmental impact comprehensively.

In terms of transportation, the university aims for 50% of all new fleet vehicles to be zero-emission or hybrid by 2025, and a 10% reduction in private vehicle commuting. Already, a significant portion of the fleet is zero-emission or hybrid, and most staff and students use alternative commuting methods. Initiatives include on-campus housing enhancements, sustainable transportation infrastructure, bicycle rentals, repair stations, and expanded shuttle services. Water management strategies at UC Davis are aimed at reducing water usage by 36% by 2025. Actions taken in response to the 2014 drought, the use of recycled water in cooling towers, retrofitting a research fishery well, replacing outdated water armatures, and reducing irrigation are part of the comprehensive water conservation efforts. The Arboretum Waterway Maintenance and Improvement Project further exemplifies the university's commitment to sustainable water management. Through these extensive and varied sustainability initiatives, UC Davis not only leads in environmental stewardship in the North American region but also sets a global example for integrating sustainable practices in higher education institutions [53-56].

3.6. University of São Paulo (USP), Brazil/LATIN AMERICA

The University of São Paulo (USP) in São Paulo, Brazil, has been lauded as the most sustainable university in South America for the seventh time, according to the 2023 GreenMetric ranking [57]. Achieving an impressive score of 9425 out of 10000, USP leads the region in sustainability practices, examining its approach across eleven distinct categories: water and effluent, land use, sustainable buildings, energy, green spaces, and ecological reserves, transportation, greenhouse gas emission, fauna, management, solid refuse, and environmental education. Water conservation at USP is a key focus area, with the implementation of water-efficient fixtures such as low-flow faucets, toilets, and shower heads. The university also emphasizes rainwater harvesting, wastewater treatment, and reuse for non-potable purposes, complemented by leak detection, repair initiatives, and educational programs to promote water conservation awareness.

Land use strategies at USP involve the conservation of green spaces and ecological reserves. The campus dedicates 124 hectares to its ecological reserve out of a total area of 791 hectares. Sustainable landscaping practices include the planting of native trees, establishment of botanical gardens, use of efficient irrigation systems, and management of rainwater runoff through permeable surfaces. Additionally, sustainable agriculture methods promoting organic farming and biodiversity are actively pursued. In terms of sustainable buildings, USP strives for energy efficiency by maximizing natural lighting and ventilation, using energy-efficient appliances, and incorporating sustainable materials in construction. The university is also active in renewable energy generation, installing solar panels on campus rooftops and open spaces, and using energy-efficient lighting systems and motion sensors to control lighting. Faculty and students engage in research, workshops, seminars, and campaigns to raise awareness about renewable energy, energy conservation, and management.

The green spaces on campus are managed to promote biodiversity, facilitate wildlife movement, and conserve natural vegetation. USP employs environmentally friendly techniques such as composting and mulching to enhance soil health and water retention. The ecological reserves are used for conservation, restoration, research, and education about biodiversity, with collaboration from conservation organizations and public participation. USP's transportation policies support public transport, car-sharing, ride-sharing, and electric vehicle infrastructure, including charging stations. The university encourages alternative modes of transportation, providing incentives for sustainable commuting, and implementing policies to reduce private car usage on campus. Efforts to reduce greenhouse gas emissions include the application of energy-efficient technologies, carbon offsetting, and sustainable transportation and waste management strategies. For fauna conservation, USP preserves natural habitats on campus, conducting monitoring and research on biodiversity, and supporting wildlife corridors and green areas. Ecological restoration is a key component of the university's sustainability efforts. Overall, USP's comprehensive sustainability initiatives across various domains underscore its commitment to environmental stewardship and serve as a model for universities striving to integrate sustainable practices into their operations and culture [58-60].

4. RESULTS and DISCUSSION

Across the globe, universities are increasingly recognizing the critical importance of addressing environmental challenges and are actively integrating sustainable practices into their operations. This shared commitment to sustainability is evident in several key areas, reflecting a common approach among leading academic institutions worldwide. Firstly, universities are focusing on reducing greenhouse gas emissions and conserving vital resources such as energy and water. This commitment extends to promoting efficient waste management and recycling, alongside implementing sustainable transportation solutions. These efforts demonstrate a universal recognition of the environmental impact of university operations and a concerted effort to minimize this impact. Another significant similarity is the embrace of interdisciplinary collaboration. Universities understand that sustainability is a multifaceted issue that requires a holistic approach, encompassing various academic disciplines and stakeholders. To this end, many universities have established dedicated research centers and institutes with a focus on sustainability. These entities serve as hubs for collaboration and knowledge sharing, bringing together experts from diverse fields to address complex environmental issues.

Incorporating sustainability into the curriculum is another common topic. Universities offer various courses and initiatives designed to educate students about sustainable development and environmental stewardship. By integrating sustainability literacy into their educational offerings, these institutions are preparing students to be change agents in their communities and future professions. Students are encouraged to apply sustainable practices in their personal lives and professional careers, fostering a culture of environmental responsibility. Lastly, the formation of partnerships and networks is a crucial aspect of global sustainability efforts in higher education. Universities are engaging in collaborations to share best practices, undertake joint research projects, and collectively advance sustainability goals. These global networks facilitate the exchange of information and experiences, allowing universities to learn from each other and accelerate progress toward a more sustainable future. In summary, universities

worldwide share a common commitment to tackling environmental challenges and preparing future generations for responsible global citizenship. Their efforts in reducing emissions, conserving resources, fostering interdisciplinary collaboration, embedding sustainability in education, and forming global partnerships highlight a unified approach to creating sustainable university campuses. This research underscores the key actions considered essential to sustainability in the academic sphere and outlines recommendations for the ongoing development of university campuses in this critical field.

In university campuses, implementing sustainability measures is paramount for fostering an environment conducive to learning and ecological stewardship. Campus and infrastructure strategies such as enhancing green spaces and creating artificial water bodies are critical for improving biodiversity and environmental quality. Furthermore, the establishment of facilities catering to the diverse needs of the campus community, including those with disabilities, health centers, and robust safety systems, underscores a holistic approach to sustainability that integrates ecological, health, and safety considerations, thereby reflecting the academic institutions' commitment to creating a nurturing and responsible campus environment.

- Enhance campus green space and forest plantings to improve environmental quality and biodiversity.
- Create artificial pools and ponds to develop sustainable ecological areas, enhancing water quality and providing habitats for aquatic and terrestrial wildlife.
- Secure plant, animal, and wildlife genetic resources in dedicated conservation facilities for biodiversity preservation and educational purposes.
- Select and establish climate-appropriate flora specific to the campus region, promoting ecological resilience and sustainability.
- Develop accessible campus facilities for individuals with disabilities and special needs, ensuring inclusivity and ease of access.
- Establish comprehensive health facilities for campus users, offering medical services and wellness programs for physical and mental well-being.
- Implement robust safety and security measures, including emergency response systems and surveillance, to ensure a safe campus environment.

In university campuses, addressing energy and climate change is crucial, necessitating the adoption of sustainable and efficient practices. Key recommendations include implementing energy-efficient appliances, utilizing renewable energy sources, and incorporating green building designs to reduce environmental impact and carbon emissions. These measures, complemented by innovative solutions like vertical horticulture, sunshades, and green roofs, not only enhance campus sustainability but also contribute to the broader goals of environmental stewardship and carbon neutrality, positioning universities as leaders in the global effort towards a sustainable future.

- Implement energy-efficient appliances to reduce energy consumption and extend appliance lifespan.
- Utilize alternative energy sources like wind, solar, and thermal to decrease reliance on fossil fuels.
- Apply green and smart building principles in construction and renovation for enhanced energy efficiency.
- Aim to reduce greenhouse gas emissions, including carbon dioxide, to minimize the university's carbon footprint.
- Establish a clear zero-emission target roadmap to set and achieve sustainability goals.
- Develop innovative and effective university policies to address climate change challenges comprehensively.
- Integrate vertical horticulture on appropriate windowless facades to enhance urban green space.
- Utilize sunshades and light shelving to reduce energy usage in cooling and lighting.
- Use recyclable, bio-based, and biodegradable materials in construction projects to support sustainable development.

- Install awnings, coverings, and solar panels in parking lots to provide shade and generate renewable energy.
- Fit solar panels on suitable building rooftops to increase the campus's renewable energy production.
- Incorporate green roof designs in on-campus buildings for insulation, biodiversity, and aesthetic benefits.

In university campuses, effective waste management is a key component of sustainability, necessitating thoughtful and comprehensive strategies. Essential actions include reducing paper and plastic usage, implementing a robust reduce-reuse-recycle program, and expanding waste collection facilities, all aimed at minimizing environmental impact. Additionally, the safe treatment and disposal of various types of waste, including organic, inorganic, and toxic, are imperative for maintaining ecological integrity and public health, underscoring universities' vital role in fostering responsible waste management practices and promoting a sustainable campus environment.

- Reduce the use of paper and plastic by encouraging alternatives like thermos usage to minimize waste.
- Implement a comprehensive reduce-reuse-recycle (3R) waste management program on campus to foster sustainable waste practices.
- Expand and increase campus waste collection areas, integrating them into outdoor furniture for convenience and aesthetic appeal.
- Ensure safe storage, treatment, and disposal of toxic waste to protect the environment and public health.
- Develop a robust refuse recycling program to efficiently manage and recycle various types of waste materials.
- Treat organic, inorganic, and toxic waste effectively through specialized processes and facilities for minimal environmental impact.

In the context of university campuses, water sustainability is of paramount importance, necessitating the adoption of strategic measures for efficient usage and conservation. Key recommendations include implementing water conservation and recycling programs, creating manmade wetlands and natural water bodies, and installing greywater treatment systems, all aimed at reducing freshwater consumption and enhancing ecological health. Additionally, the adoption of water-saving technologies, effective sewage disposal, and the use of purified water for horticulture are crucial for maintaining environmental standards and fostering a sustainable campus ecosystem. These practices not only contribute to water resource management but also embody the university's commitment to environmental stewardship and sustainable development.

- Implement water conservation and recycling programs to efficiently manage and reduce water usage on campus.
- Create manmade wetlands and natural water bodies to enhance campus biodiversity and support water purification.
- Install greywater treatment systems in campus buildings for recycling wastewater for non-potable uses.
- Ensure proper sewage disposal to maintain environmental and public health standards.
- Incorporate water conservation mechanisms, such as low-flow fixtures and efficient irrigation systems, to minimize water wastage.
- Collect and utilize rainfall for irrigating man-made reservoirs, reducing reliance on freshwater sources.
- Use purified water for horticulture to conserve fresh water and promote healthy plant growth in campus landscaping.

Sustainable transportation within university campuses is a crucial aspect of their overall environmental strategy, necessitating specific initiatives to foster eco-friendly mobility. Key recommendations include promoting the use of zero-emission vehicles, substituting conventional service vehicles with electric

alternatives, and installing sufficient electric vehicle charging stations. Additionally, encouraging sustainable commuting practices such as public transportation, carpooling, and cycling, and enhancing the accessibility and inclusivity of campus transportation infrastructure are essential. These measures, aimed at reducing reliance on private vehicles and fostering a culture of sustainable transportation, not only contribute to a significant reduction in the campus's carbon footprint but also enhance the overall health and sustainability of the campus environment.

- Encourage the use of zero-emission vehicles on campus to reduce environmental impact.
- Substitute service vehicles with electric alternatives to promote sustainable transportation.
- Install electric vehicle recharge stations to support campus users' use of electric vehicles.
- Promote sustainable commuting practices among college students and staff to decrease reliance on private vehicles.
- Reduce the number of private automobiles and parking spaces on campus to discourage personal vehicle use.
- Increase the frequency and duration of shuttle services to offer convenient, eco-friendly transportation options.
- Expand accessible pedestrian routes on campus for people with disabilities and those with infant carriages.
- Develop bicycle and scooter paths to facilitate safe and sustainable mobility for all campus users.
- Propose a rental and maintenance station to encourage and support bicycle use on campus.

In the domain of education and research, universities play a pivotal role in advancing sustainability through a comprehensive approach that integrates sustainable practices into their academic fabric. Establishing a dedicated department for sustainability, incorporating sustainability courses into curricula across various disciplines, and increasing sustainability-focused academic activities are essential strategies. Furthermore, fostering collaborations with governmental bodies and releasing public sustainability reports enhances transparency and promotes the development of effective sustainability strategies, highlighting the crucial role of universities in shaping a sustainable future and fostering a culture of environmental stewardship within and beyond their campuses.

- Establish a dedicated department for sustainability to coordinate and integrate sustainability initiatives across the university.
- Incorporate sustainability courses into university curricula to educate students on environmental stewardship and sustainable practices.
- Increase academic activities related to sustainability, such as publications, seminars, and panel discussions, to foster research and dialogue.
- Create a sustainability concentration at undergraduate, graduate, or doctoral levels to provide specialized knowledge and skills.
- Enhance the number of sustainability-related activities, including student organizations and community service projects, for practical student engagement.
- Secure research funding, establish a budget, and define a long-term vision for sustainability research and development.
- Develop and maintain a university sustainability website as a central information resource on sustainability initiatives and achievements.
- Regularly release a public sustainability report to showcase the university’s sustainability efforts and progress.
- Collaborate with governmental bodies like the Ministry of Environment, Urbanization, and Climate Change to form an inspection council for shared expertise and resources.

To deepen the understanding of sustainability within higher education, a detailed study was conducted on universities recognized for their sustainability efforts across different continents. This research meticulously examined the sustainability practices of these institutions, identifying six fundamental categories essential for developing a sustainable campus. These categories were designed to cover the broad spectrum of sustainability, including energy conservation, waste management, and community

engagement, among others. To provide a clear model for other universities aiming to enhance their sustainability practices, the study organized the sustainability efforts of six leading university campuses into a comparative framework, presented in Table 3. This framework, carefully structured with headings and subheadings, offers an organized overview of each university's alignment with the established sustainability criteria. It is intended to not only highlight the specific sustainability initiatives of these institutions but also serve as a benchmark for other universities seeking to assess and improve their sustainability efforts. By presenting this comparative analysis, the study aims to foster a better understanding of effective sustainability practices and encourage their adoption across the higher education sector. The structured overview provided by the framework allows for easy comparison and serves as a benchmark for institutions worldwide to pursue comprehensive sustainability strategies, contributing to the global movement towards more sustainable campuses. Through this approach, the study supports the ongoing dialogue on sustainability in higher education, promoting a culture of environmental stewardship and social responsibility.

Table 3. *2023 Greenmetric Regional Leading Universities Sustainability Benchmark (1/2)*

	University	UI	WUR	AUC	LIN COLN	UC DAVIS	USP
	Region	Asia	Europe	Africa	Oceania	N.America	S.America
Campus and Infrastructure	Greening	✓	✓	✓	✓	✓	✓
	Artificial Pool	✓	✓	✗	✗	✓	✓
	Biodiversity Conservation	✗	✓	✗	✓	✗	✗
	Eco-friendly Landscaping	✓	✓	✓	✓	✓	✓
	Facilities for the Disabled	✗	✓	✓	✓	✓	✗
	Health Facilities	✓	✓	✓	✓	✓	✓
	Safety Measures	✓	✓	✓	✓	✓	✓
Energy and Climate Change	Energy efficient device	✓	✓	✓	✓	✓	✓
	Renewable energy source	✓	✓	✓	✓	✓	✓
	Green and smart building	✓	✓	✓	✓	✓	✗
	Reducing carbon footprint	✓	✓	✓	✓	✓	✓
	Zero emission policy	✗	✓	✓	✓	✓	✓
	Climate change policies	✓	✓	✓	✓	✓	✓
	Vertical garden	✓	✓	✗	✓	✓	✗
	Sun shading and light shelf	✗	✓	✓	✓	✗	✗
	Sustainable building materials	✓	✓	✓	✓	✓	✓
	Parking lot design	✗	✓	✓	✓	✓	✓
	Solar panel on the roof	✓	✓	✓	✓	✓	✓
	Green roof application	✓	✓	✓	✗	✓	✗
Waste Managment	Reducing paper and plastic	✓	✓	✓	✓	✓	✓
	3R program	✓	✓	✓	✓	✓	✓
	Waste collection areas	✓	✓	✓	✓	✓	✓
	Toxic waste management	✓	✓	✓	✓	✓	✓
	Waste recycling	✓	✓	✓	✓	✓	✓
	Waste treatment	✓	✓	✓	✓	✓	✓

Table 3. *2023 Greenmetric Regional Leading Universities Sustainability Benchmark (2/2)*

	University	UI	WUR	AUC	LIN COLN	UC DAVIS	USP
	Region	Asia	Europe	Africa	Oceania	N.America	S.America
Water Managment	Water conservation-recycling	✓	✓	✓	✓	✓	✓
	Artificial pool and pond	✓	✓	✗	✗	✓	✓
	Gray water recovery	✓	✓	✓	✓	✓	✓
	Sewage disposal	✓	✓	✓	✓	✓	✓
	Water-saving device	✓	✓	✓	✓	✓	✓
	Rainwater harvesting	✓	✓	✓	✓	✓	✓
	Use of treated water	✓	✓	✓	✓	✓	✓
Transportation	Zero emission vehicle	✓	✓	✗	✓	✓	✗
	Electric service vehicles	✓	✓	✗	✗	✓	✗
	Electric charging stations	✓	✓	✗	✓	✓	✗
	Shared vehicle	✓	✓	✓	✓	✓	✓
	Reducing vehicle parking	✓	✓	✓	✓	✓	✓
	Improving service delivery	✓	✓	✓	✓	✓	✓
	Accessible roads	✓	✓	✓	✓	✓	✓
	Bicycle paths	✓	✓	✓	✓	✓	✓
	Bicycle rental and repair area	✓	✓	✓	✓	✓	✗
Education and Research	Sustainability Office	✗	✓	✓	✓	✓	✗
	Sustainability curriculum	✓	✓	✓	✓	✓	✓
	Sustainability academic	✓	✓	✓	✓	✓	✓
	Department of Sustainability	✗	✓	✓	✓	✓	✗
	Sustainability events	✓	✓	✓	✓	✓	✓
	Sustainability vision	✓	✓	✓	✓	✓	✓
	Sustainability website	✗	✓	✓	✓	✓	✗
	Sustainability report	✓	✓	✓	✓	✓	✗
	Total : 49	**41/49**	**49/49**	**42/49**	**45/49**	**47/49**	**35/49**

5. CONCLUSION and RECOMMENDATIONS

In the context of advancing sustainability on university campuses, stainability on university campuses, as can be seen in the table, certain features such as protection facilities, sun shading and light shelves, and electric service vehicles, though currently implemented by only a few universities, warrant broader consideration and adoption. Protection facilities, essential for safeguarding the health and safety of the campus community, play a crucial role in ensuring a secure learning environment. Their importance is magnified in sustainable campus designs where the well-being of students, faculty, and staff is a priority. Therefore, integrating such facilities into more university campuses would not only enhance security but also contribute to the overall sustainability goals by promoting a safe and healthy academic environment. Sun shading and light shelves represent innovative architectural elements that significantly contribute to energy efficiency. By controlling and optimizing natural light, these features reduce the reliance on artificial lighting, thus lowering energy consumption and associated costs. Given their effectiveness in energy conservation and enhancing indoor environmental quality, their adoption in more universities could greatly advance campus sustainability efforts. Incorporating these features in new constructions or retrofitting existing buildings can be a strategic step towards reducing the carbon footprint of university campuses. The use of electric service vehicles is another sustainable practice currently limited to a few universities. Transitioning from fossil fuel-based vehicles to electric ones is a crucial step toward reducing greenhouse gas emissions and combating climate change. As universities often have numerous service vehicles for maintenance, security, and transportation, switching to electric vehicles can significantly diminish the environmental impact of campus operations. This transition not only aligns with global sustainability targets but also positions universities as leaders in adopting green technologies. In conclusion, while the implementation of protection facilities, sun shading and light shelves, and electric service vehicles is currently limited to a select few institutions, there is a compelling case for their broader inclusion in university sustainability plans. By adopting these practices, universities can enhance their environmental stewardship, reduce their carbon footprint, and set an example for sustainable campus management.

Promoting greener and more environmentally responsible approaches in campus planning, construction, and operations through sustainable design activities is crucial for reducing ecological footprints, resource consumption, and environmental impacts. The integration of sustainable design principles, encompassing energy-efficient systems, renewable energy utilization, water conservation strategies, eco-friendly materials, and the promotion of healthy interiors, is essential. Not only do these practices curtail operational costs and enhance the efficacy of campus facilities, but they also forge a healthier, more comfortable learning environment. Such sustainable design activities embody the institution's commitment to sustainability, motivating the campus community to embrace sustainable practices. These initiatives act as educational tools, showcasing sustainable technologies, and fostering opportunities for research, innovation, and interdisciplinary collaboration. By embedding these practices, campuses transform into living examples of sustainability, empowering individuals to adopt sustainable behaviors and promoting a culture of sustainability that extends beyond campus boundaries. In essence, sustainable design activities contribute significantly to building a more sustainable future by improving campus life quality and environmental preservation. Importantly, universities are not just centers of learning; they are pivotal in teaching and shaping a sustainable world. This role makes their commitment to sustainable design and practices not only commendable but fundamentally crucial for shaping a better future. Thus, it is crucial for universities to promptly and urgently embark on enhancing their sustainability practices, becoming exemplars for the wider community. This urgent action underscores our shared duty to protect our planet for future generations. It's a collective responsibility to safeguard our planet, reminding us all that the steps we take today shape the world we share tomorrow.

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Conservation and Restoration Works in England: Conversion of Barns

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Abstract

With a rich agricultural history, many barns in the United Kingdom have been facing neglect and abandonment in recent years. This study investigates the trends in the transformation of traditional barns into contemporary and usable structures in England. It evaluates the intersection between the preservation of architectural heritage and the needs of modern life.

The United Kingdom is one of the countries that have efforts to protect and preserve historic buildings. While it has signed various regulations and laws on the scale of the renovation of historical buildings, it has strong structures created through civil and official channels for the protection of the structures within the borders of its country. In addition, the framework of conservation efforts has been collected and documented by written sources. The country, which understands the importance of environmental and architectural heritage, hosts successful studies and practices on this matter. Interventions for barn structures with high potential on an interior scale are also within the scope of these studies.

This research focuses on six different barn transformation projects located in England. The basic approach to the evaluation of barn transformations is the degree of preservation, the old-new distinction, and the harmony between the structure and the new function. In this direction, evaluation tables created.

1. INTRODUCTION

In modern and civilized societies, it is considered a responsibility to preserve architecture that are considered cultural assets and have survived from the past to the present, and to pass them on to future generations. The preservation of historical artifacts has been a concern throughout history for various purposes and reasons. The decision to protect monuments, structures, and settlements is usually influenced by economic, social, and political conditions of the period, as well as religious and national sentiments. It is important to note that the monuments and structures deemed worthy of protection can change over time as societal conditions change.

Today, traditional architectural structures commonly found in rural areas have begun to lose their functions due to changing technology and production techniques in agricultural production and animal husbandry. Today, especially in developed Western European countries, village houses, huts, and barns are gradually losing their functions and becoming idle. The countries most affected by this situation are Germany, France, Belgium, and England. Among the countries in question, England, in particular, draws attention to its non-governmental organizations and advanced Conservation Laws and Legislation, as well as its conservation/re-functional efforts in this regard (Hersek, 2001)

At its core, barn conversion combines preservation and renewal. Due to their continuous interior space, barns allow for the adaptation of numerous functions. Integration of modern techniques and design principles preserves the historic features and character of these iconic buildings. Barn conversions should not be associated solely with the reclamation of spaces. These practices are directly related to the recovery of historical narratives, protection of agricultural heritage, and transfer of it to future generations by remaining in use.

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METHOD

In the study, six examples of barn transformations were analyzed. All examples are located in England. Projects were accessed via the Internet. The primary source is the 'Archdaily' website. Along with it, websites of the architecture firms also had been used as reference. Archdaily describes itself as 'the world's most visited architecture website.' It includes various architectural projects of different types and scales in its large database. In addition, direct interviews with companies, designers, and project owners are also included on the site. While accessing the selected projects, the search is limited to the keywords 'barn conversion' and 'England.'

The evaluation was made through tables created in the context of three ICOMOS charters with the guide PPS 5: Planning for the Historic Environment created by the United Kingdom Government. These regulations are the Venice Charter (1964), the Charter of the Built Vernacular Heritage (1999), and the ICOMOS Charter – Principles of Analysis, Conservation, and Restoration of Architectural Heritage (2003).
Lighting elements and furniture are not included because the nature of barn structures does not contain furniture or lighting elements and in this case, their preservation status cannot be determined. The evaluation was made within the framework of structural elements, interior elements, old building-new extension separability, preservation of original materials, and new function-structure harmony.

3. LEGAL PRACTICES AND ORGANIZATIONS FOR CONSERVATION AND RESTORATION IN THE UNITED KINGDOM

Listed buildings in the UK are protected under the primary legislation. Within the scope of it, regulations named ‘The Planning Act’ or ‘Listed Building and Conservation Areas’ dated 1990 are considered to be the first source in terms of protection of listed buildings. Demolition of a listed building and any alterations or changes that impact the unique character of an architecturally or historically significant building require legal permissions (1990 Act, Section 7). The criterion for approval is ‘the desirability of preserving the building or its setting or any features of special architectural or historic interest which it possesses’ (Sections 16 and 14 respectively and Article 85). Listed structures are ranked based on various factors, including rarity and completeness. Alterations for unlisted buildings on the preservation areas also need planning permission. In short, any intervention to historical buildings should proceed by informing local or national authorities, depending on the degree and importance of the building.
Applications for the protection of historic buildings in England are reviewed under the National Policy Framework (NPPF). Protecting heritage assets in accordance with their relevance so that they contribute to the quality of life of present and future generations is one of the NPPF's key goals. The draft offers instructions on how to apply for and receive the required permits for a listed structure. Furthermore, standards and design advice for remodeling and repair projects are included in the NPFF. The National Planning Practice Guidelines (NPPG) on the application of the Planning (Listed Buildings and Conservation Areas) Act 1990 supported the National Planning Policy Framework (NPPF), which took the place of all prior government policies on heritage protection in England in March 2012, including PPS5. However, advanced and detailed recommendations on the planning of the historic environment are given in the planning policy declaration called 'PPS5: Planning for the Historic Environment Guide'. Until a new guide release and replace PSS5, practice guide remains a valid and government endorsed document (Taylor, 2014).

Sections 5 and 6 of PPS5 highlight key points for interventions on heritage assets. Section 5 emphasizes the following practices for design, based on designing within a specific context:
1.The significance of nearby assets and the contribution of their setting.
2.The general character and distinctiveness of the local buildings, spaces, public realm and the landscape.
3.Landmarks and other features that are key to a sense of place.
4.The diversity or uniformity in style, construction, materials, detailing, decoration and period of existing buildings and spaces.
5.The topography.
6.Views into and from the site and its surroundings.

7.Green landscaping.
8.The current and historic uses in the area and the urban grain.

Table 1. *PPS5 Historic Environment Planning Practice Guide*

	PPS5 HISTORIC ENVIRONMENT PLANNING PRACTICE GUIDE SECTION 6. FURTHER GUIDANCE ON MAKING CHANGES TO HERITAGE ASSETS
REPAIR	*Original materials normally only need to be replaced when they have failed in their structural purpose. Repairing by re-using materials to match the original in substance, texture, quality and colour, helps maintain authenticity, ensures the repair is technically and visually compatible, minimises the use of new resources and reduces waste. *Even when undertaking repair, care is needed to maintain the integrity of the asset. *The removal of hard renders may cause more damage to the significance of the building than retention. *Doors and windows are frequently key to the significance of a building. Change is therefore advisable only where the original is beyond repair, it minimises the loss of historic fabric and matches the original in detail *Even the most minor repairs can sometimes have an impact on the archaeological interest of a heritage asset and may reveal new information relating to the significance of that asset. The recording of evidence revealed by such works may therefore be appropriate.
RESTORATION	*Restoration may range from small-scale work to reinstate missing elements of decoration, such as the reinstatement of sections of ornamental plasterwork to a known design, to large schemes to restore the former appearance of buildings with the addition of major missing elements such as a missing wing. Previous repairs may be historically important, and may provide useful information about the structure of the building, as will the recording of any features revealed by the work. New work can be distinguished by discreet dating or other subtle means. Overt methods of distinction, such as tooling of stonework, setting back a new face from the old, or other similar techniques, areunlikely to be sympathetic. *Restoration involving the stripping-off of later layers of work or abrasive cleaning is only likely to be acceptable where it can be shown that: 1.The later layers are not of significance in themselves. 2.They are damaging the original and other significant fabric. 3.By their removal there would be an enhancement to the significance of the building that outweighs the loss of the later addition. *Stripping off finishes such as plaster to expose rubble, brick or timber-framed walls never intended to be seen is likely to have an adverse effect on the building's significance through the loss of historic materials and original finishes and harm to the aesthetic. *Replacement of one material by another, for example on roofs, may result in a loss of significance and will in those cases need clear justification. Therefore, while the replacement of an inappropriate and non-original material is likely to be easily justified, more justification will be needed for changes from one type of thatch, slate or tile to another. *The reuse of original materials whenever possible will meet conservation and other sustainability objectives. *The legibility of names on war memorials is important and their re-cutting and/or re-painting in an appropriate manner are likely to be acceptable. For other inscriptions, conservation rather than restoration may be preferred, where the original script is significant. *If convincing evidence is available it may be appropriate to take opportunities to reinstate missing architectural details, such as balustrades and cornices or missing elements of a decorative scheme, using traditional methods and materials.
ADDITION AND ALTERATION	*When a building is adapted for new uses, its form as well as its external and internal features may impose constraints. Some degree of compromise in use may assist in retaining significance. *The plan form of a building is frequently one of its most important characteristics and internal partitions, staircases (whether decorated or plain, principal or secondary) and other features are likely to form part of its significance. Indeed they may be its most significant feature. Proposals to remove or modify internal arrangements, including the insertion of new openings or extension underground, will be subject to the same considerations of impact on significance (particularly architectural interest) as for externally visible alterations. *The sub-division of buildings, such as threshing barns and churches, that are significant for their open interiors, impressive proportions and long sight lines, may have a considerable impact on significance. In these circumstances the use of pods or other design devices that allow the entirety of the space to be read may be appropriate. *The introduction of new floors into a building or removal of historic floors and ceilings may have considerable impact on an asset's significance. Certain asset types, such as large industrial buildings, are generally more capable of accepting such changes without unacceptable loss of significance. *The insertion of new elements such as doors and windows, (including dormers and roof lights to bring roof spaces into more intensive use) is quite likely to adversely affect the building's significance. Harm might be avoided if roof lights are located on less prominent roof slopes. New elements may be more acceptable if account is taken of the character of the building, the roofline and significant fabric. *New features added to a building are less likely to have an impact on the significance if they follow the character of the building. Thus in a barn conversion new doors and windows are more likely to be acceptable if they are agricultural rather than domestic in character, with the relationship of new glazing to the wall plane reflecting that of the existing and, where large door openings are to be glazed, with the former doors retained or replicated so that they can be closed. *Small-scale features, inside and out, such as historic painting schemes,ornamental plasterwork, carpenters' and masons' marks, chimney breasts and stacks, inscriptions and signs, will frequently contribute strongly to a building's significance and removing or obscuring them is likely to affect the asset's significance. *Extant flooring materials will often be of interest in themselves. Additional care is needed on lower floors to ensure that archaeological interest below the finished surface is not adversely affected by proposed works. *Although some works of up-grading, such as new kitchens and bathroom units, are unlikely to need consent, new services, both internal and external can have a considerable, and often cumulative, effect on the appearance of a building and can affect significance. The impact of necessary services can be minimised by avoiding damage to decorative features by carefully routeing and finishing and by use of materials appropriate to the relevant period, such as cast iron for gutters and downpipes for many Georgian and Victorian buildings. * Where the proposal involves a change of use, particularly to single or multiple residential units, local planning authorities may consider that the impact on the building and its setting of potential future permitted development, such as conservatories, garden sheds and other structures associated with residential use, make the change of use proposal unacceptable in principle. Conditions preventing or limiting such future permitted development may make the change of use proposal acceptable. *Buildings will often have an important established and historic relationship with the landscaping that exists or used to exist around them. Proposals to alter or renew the landscaping are more likely to be acceptable if the design is based on a sound and wellresearched understanding of the building's relationship with its setting, both now and in the past.
WORKS FOR RESEARCH ALONE	*Any intrusive investigation may reduce the significance of an asset and impair the available resource for future archaeological investigation. It may also affect the historic and aesthetic values of the asset. *Metal-detecting on a scheduled monument for any reason requires a licence and intrusive investigation for research purposes will require scheduled monument consent.

Section 6 provides a guide for alterations to be made to heritage assets. Table 1 demonstrates the details of the guide. Although alterations divided into four main groups some assets might be in scope of more than one groups.
Additions and alterations to the outer shells of buildings require approval from local authorities. As for changes in the interior spaces, approval is only required for listed buildings. The protection of interior spaces is also subject to the 'Planning Act', supported by government policy and guidance. Regulations that do not require Listed Building approval include:

- Repairs that do not involve demolition or additions. Repairs must be limited to the required area. New material selections should be compatible with the existing ones. The entire process must photographed before and after and documented by taking detailed notes on what has been done. Since repairs also involve changes, local authorities should informed before repair work begins.

- Repairs that do not involve demolition or additions. Repairs must be limited to the required area. New material selections should be compatible with the existing ones. The entire process must photographed before and after and documented by taking detailed notes on what has been done. Since repairs also involve changes, local authorities should informed before repair work begins.

For all works on historic buildings, it is essential to engage the services of professional consultants who specialize in the conservation of historic buildings, both to specify the works and to liaise with the local authority (Taylor, 2020). It is possible that the original texture of the building may be unintentionally damaged, or a technical problem may arise during the operations performed. It is crucial to work with experts to protect the harmony between the new additions and the old building.

The United Kingdom is actively involved in protecting historical buildings, both through non-governmental organizations and official organizations. Examples of non-governmental activities include English Heritage and National Trust, while the country has also signed the ICOMOS statutes on an international level. See more at www.english-heritage.org.uk and www.nationaltrust.org.uk about the works of English Heritage and the National Trust. For the official actions, ICOMOS charters signed by UK represent a great example of the country's perspective for the protection of historic buildings.

Table 2. *ICOMOS Charters Related to Building Protection*

	CHARTERS SIGNED BY THE UNITED KINGDOM ARTICLES DIRECTLY RELATED TO STRUCTURAL PROTECTION
VENICE CHARTER (1964)	**Article 5.** The conservation of monuments is always facilitated by making use of them for some socially useful purpose. Such use is therefore desirable but it must not change the lay-out or decoration of the building. It is within these limits only that modifications demanded by a change of function should be envisaged and may be permitted. **Article 6.** The conservation of monuments is always facilitated by making use of them for some socially useful purpose. Such use is therefore desirable but it must not change the lay-out or decoration of the building. It is within these limits only that modifications demanded by a change of function should be envisaged and may be permitted. **Article 9.** The process of restoration is a highly specialized operation. Its aim is to preserve and reveal the aesthetic and historic value of the monument and is based on respect for original material and authentic documents. It must stop at the point where conjecture begins, and in this case moreover any extra work which is indispensable must be distinct from the architectural composition and must bear a contemporary stamp. The restoration in any case must be preceded and followed by an archaeological and historical study of the monument. **Article 11.** The valid contributions of all periods to the building of a monument must be respected, since unity of style is not the aim of a restoration. When a building includes the superimposed work of different periods, the revealing of the underlying state can only be justified in exceptional circumstances and when what is removed is of little interest and the material which is brought to light is of great historical, archaeological or aesthetic value, and its state of preservation good enough to justify the action. Evaluation of the importance of the elements involved and the decision as to what may be destroyed cannot rest solely on the individual in charge of the work. **Article 12.** Replacements of missing parts must integrate harmoniously with the whole, but at the same time must be distinguishable from the original so that restoration does not falsify the artistic or historic evidence.
CHARTER ON THE BUILT VERNACULAR HERITAGE (1999)	**4. Replacement of materials and parts** Alterations which legitimately respond to the demands of contemporary use should be effected by the introduction of materials which maintain a consistency of expression, appearance, texture and form throughout the structure and a consistency of building materials. **5. Adaptation** Adaptation and reuse of vernacular structures should be carried out in a manner which will respect the integrity of the structure, its character and form while being compatible with acceptable standards of living. Where there is no break in the continuous utilisation of vernacular forms, a code of ethics within the community can serve as a tool of intervention. **6. Changes and period restoration** Changes over time should be appreciated and understood as important aspects of vernacular architecture. Conformity of all parts of a building to a single period, will not normally be the goal of work on vernacular structures.
ICOMOS CHARTER- PRINCIPLES FOR THE ANALYSIS, CONSERVATION AND STRUCTURAL RESTORATION OF ARCHITECTURAL HERITAGE (2003)	**3.3** The value of architectural heritage is not only in its appearance, but also in the integrity of all its components as a unique product of the specific building technology of its time. In particular the removal of the inner structures maintaining only the facades does not fit the conservation criteria. **3.9** Where possible, any measures adopted should be reversible so that they can be removed and replaced with more suitable measures when new knowledge is acquired. Where they are not completely reversible, interventions should not limit further interventions. **3.10** The characteristics of materials used in restoration work (in particular new materials) and their compatibility with existing materials should be fully established. This must include long-term impacts, so that undesirable side-effects are avoided. **3.11** The distinguishing qualities of the structure and its environment, in their original or earlier states, should not be destroyed. **3.12** Each intervention should, as far as possible, respect the concept, techniques and historical value of the original or earlier states of the structure and leaves evidence that can be recognised in the future. **3.14** The removal or alteration of any historic material or distinctive architectural features should be avoided whenever possible. **3.16** Imperfections and alterations, when they have become part of the history of the structure, should be maintained so far so they do not compromise the safety requirements.

Various resources used in the preservation and transformation of buildings are substantial for the effective protection of architectural heritage. The common purpose of all charters and directives is to protect and preserve the original identity of the existing historic building to a broad extent. By doing so, the protection and continuity of cultural and architectural diversity on a global scale is ensured.

4. BARN CONVERSIONS IN ENGLAND

Conservation of traditional architecture must be considered not only in big cities with their old quarters but also in small settlements like small agrarian or mountain villages with their surrounding landscape (Hersek, 2023). Therefore farmhouses, cottages, and barns are among the building types hold great potential for conservation practices. Vernacular architectural examples are the primary representatives of societies' cultures and daily life. Houses, huts, and some temples are temple typologies that reveal the understanding of local architecture. However, barn structures can also be included in the traditional

architecture class. Barns are textbook exapmles of vernacular architecture: they are utilitarian, timeless and, within a specific region, uniform. They are adjusted to meet the requirements of particular locations and functions (Kalakoski & Thorgrimsdottir, 2022). Therefore they are important sources for understanding communal and regional architectural identities.

Peters (1981) define barns as 'a building for housing and threshing the corn and pulse corpse'. Barns can be used for various purposes such as storing hay, tobacco, agricultural products, or providing space for livestock activities. Due to the diversity of functions, different types of barn structures have been classified. As an example, Francaviglia (1972) divided barn types into two main groups based on roof and hay hood types. On the other hand, Lawson (1991) grouped barn types according to their basic internal forms such as 'Cruck From, Open Form, and Aisled Form' (Figure 1).

It is possible to come across different application examples in the reuse of barn structures. Kalakoski & Thorgrimsdottir (2022) evaluated the different application strategies adopted in barn transformation in five groups in their study. These are: conversion, repurposing, relocation, reinterpretation and imagination (Figure 2). This division can be considered as a reference point in examining refunctional examples. The group in which structures will be classified may vary depending on the condition of the building, its size and the new function to be adopted during the transformation. The most holistic approach will be beneficial in achieving successful results in terms of reuse and protection.

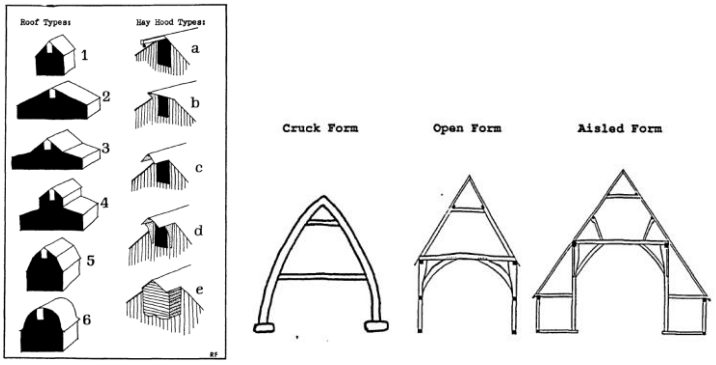

Figure 1. *Barn Types According to Outer shells & Internal Forms, [3]- [8]*

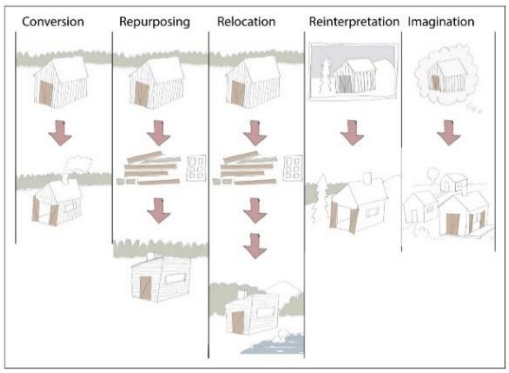

Figure 2. *Five Types of Architectural Responses to Barns, [7]*

Numerous agricultural structures are located in rural areas of England. Among these barns are one of the typologies subject to conservation, transformation, and re-functional practices. Changes to planning laws in 2014 mean you can convert a barn under permitted development rights. This government scheme allows certain projects to go through without the need for full planning permission, and in the case of a barn conversion, can be utilized to create up to five new residential dwellings. (Heather, 2023). After obtaining the necessary permissions, it is recommended that the process be carried out by a professional team.

A barn conversion is where you take an existing but disused barn and turn it into an office, new family home, holiday let, B&B, or even studio space for artists and photographers (Stephens, 2024). Barns provide ease of conversion to different functions compared to many building types, due to their wall-less interior partitions and ceiling heights. The six projects listed below are examples of the transformation of barn structures into different functions.

4.1. Redhill Barn

Redhill Barn built in 1810 and made of stone and located at South Devon, UK. The 199m2 retrofitted barn sits within a 25-acre site of green fields and is part of a wider long-term strategy, which is being developed by the clients and the practice, to regenerate and rewild the secluded site, turning an agricultural relic into the hub of a new ecological smallholding. The scheme creates a new kitchen garden, traditional orchard and series of wildflower meadows, interspersed with wild margins, hedge banks and areas of copse and scrub (ArchDaily, Redhill Barn/TYPE, 2021). As an example of agricultural engineering, the original building was designed as two floors, the lower floor for cattle and the upper floor for threshing storage. Built as part of a wealthy farm estate, the building fell into disrepair as it was isolated from other farm buildings and inaccessible by road. During the restoration process, no new openings were made to preserve the original facade and to restore its original light and space dynamics. A series of 'floating boxes' were installed throughout the interior, serving as the main rooms and allowing the barn to remain open and undivided (Figure 3). Arched pivot doors were also installed to allow for easy opening and closing of the large cattle openings. Contemporary floor and roof elements were designed to evoke the rhythm and simplicity found on the roofs of traditional agricultural buildings. The roof consists of small-section wood and steel connections, allowing the structure to sit higher than a traditional beam.

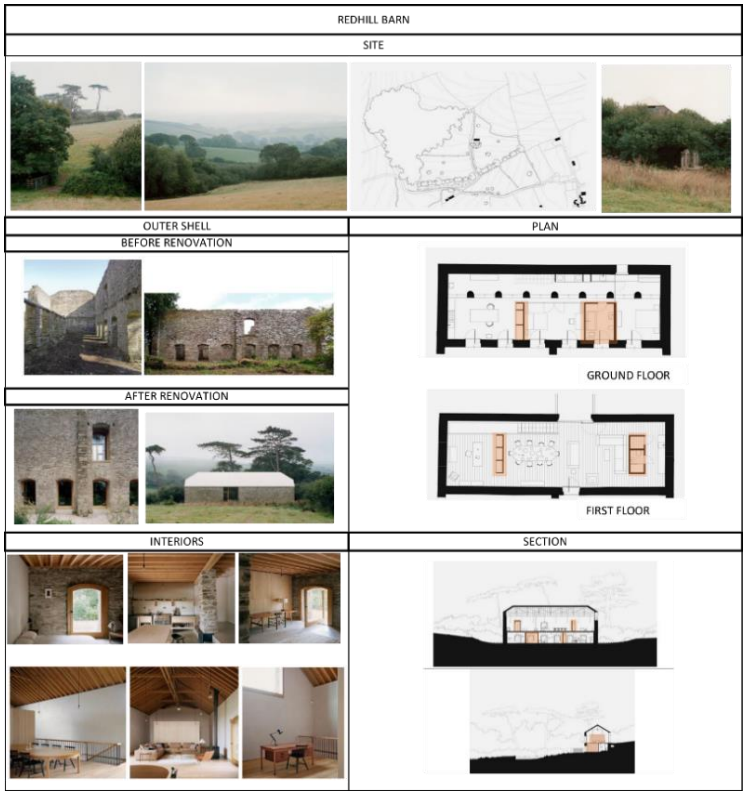

Figure 3. *Redhill Barn Visuals, [17]*

Various materials used to emphasize its structure, hierarchy, and history. The new construction is made of fir wood, while the original walls are built with stone and lime plaster. The boxes are covered with light sycamore cladding. The minimalist furniture blends with the interior's color scheme and function. The lighting fixtures follow a modern design.

4.2. Lake District Barn

A redundant stone barn and an adjoining agricultural shed transformed into a family home located in the Lake District National Park Cumbria, United Kingdom. Cumbria is a predominantly rural region. A family home in the Lake District National Park created from a redundant stone barn and an adjacent agricultural shed. The design uses regenerative design principles that minimise the use of extractive and high carbon materials, and instead uses natural materials which can be simply broken down, re-used or recycled without contaminating soils or taking up space in landfill, following cradle to cradle thinking (Type, 2021). The house has a well-preserved barn structure with thick stone walls that was converted into a living and dining area. Two new openings were introduced to frame views and improve the intake of daylight. The agricultural shed became a new wing with bedrooms and service areas (Figure 4).

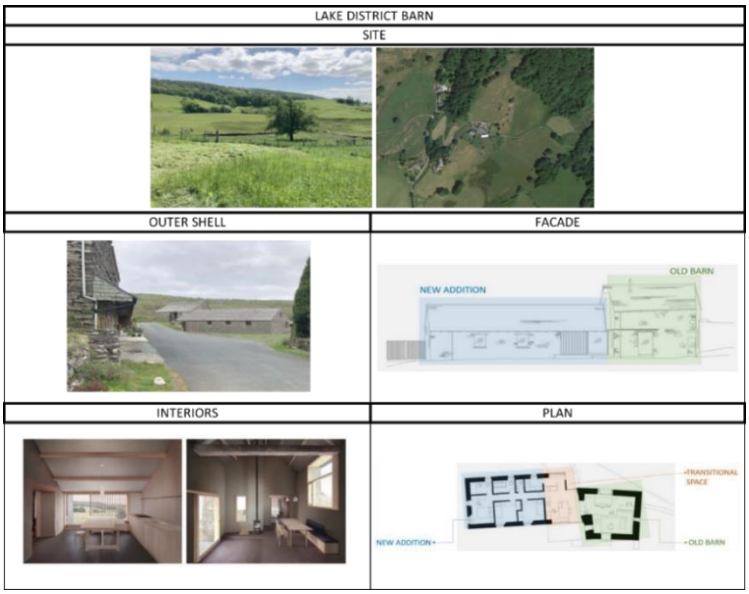

Figure4. *Lake District Barn Visuals, [18]*

The old barn and new wing are separated. The old structure was re-pointed while the new structure allows insects to colonize the facade. The kitchen forms a transparent connection with the old barn. The wooden furniture has simple lines and a lighter tone to contrast with dark colors on the floor and ceiling. Lighting elements have a plain and simple design.

4.3. Dutch Barn

The barn conversion project aimed to turn a functional agricultural building into a contemporary and spacious holiday home. Dutch Barn is located at Cotswolds, United Kingdom which is one of the largest protected landscapes in the country. The design celebrates the pure form and industrial qualities of the existing kit structure with an architectural intervention based on simplicity and minimalism that is carried through from the scale of the overall site, to the very smallest details (TurnerWorks, Dutch Barn, 2020). The outer shell was covered in matte black corrugated steel to add texture and rhythm to the building's 23-meter-tall elevation and curved roof.

The building features new openings that frame the surrounding landscape and has seven bedrooms, with six located upstairs to take advantage of the natural surroundings. Inside, the house is arranged on two floors (Figure 5). The ground floor layout is an open plan designed as a living space created for various activities. The vertical form of a double-story living space with a balcony on the upper floor is emphasized by a chimney and two-story glass.

Material used in the building include white walls and sliding doors complemented by fir wood, concrete, ceramic, and stainless steel elements. The furniture is predominantly fir with simple and clean lines and is designed as modules. Different types of elements are obtained by juxtaposing a single square module.

Lighting fixtures are predominantly white-colored and round-shaped, providing a simple contrast to the rectangular and angular appearance of the space.

Figure5. *Dutch Barn Visuals, [19], [20], [21]*

4.4. Ochre Barn

This barn conversion located at Walpole St. Peter, Norfolk, United Kingdom exemplifies the importance given to the preservation of the existing structure. Turner Works (2011) explains their interest on protection of the outer shell with these words on thier website ‘Having seen too many agricultural buildings destroyed by over-domestication, we were keen to leave the exterior of this old barn in tact whilst transforming the interior into a flexible living space’.

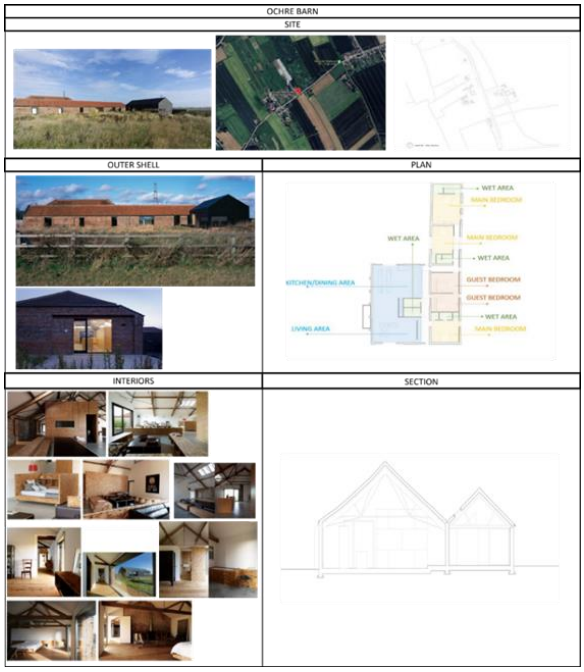

Figure6. *Ochre Barn Visuals, [22], [23], [24], [25]*

The building was originally a threshing barn and has two structures, one large and one small (Figure 6). To maximize space, furniture was designed to create space within the space. The kitchen units were detached from the wall to provide more space. Large-scale designs were preferred to provide different functions using the same furniture. Recycled materials were used throughout, with OSB plates being the most preferred. The white walls dominate the interior, but there is a noticeable brick wall in the master bedroom, which continues after the white parapet in the children's room.

4.5. Ancient Party Barn

The project is the original transformation of an 18th century barn structure. It is located at Folkstone, Kent, United Kingdom. The design brings a different approach to barn conversion projects by creating hermetic, introverted spaces located in 2,295 m² of open countryside. A series of industrial mechanisms fold and rotate the facades to provide expansive views of the landscape. They provide protection and security when closed. This high-tech kinetic mechanism does not damage the texture and character of the existing handmade wooden structure. One of the central spatial challenges was insertion of a mezzanine (for sleeping and bathing) into the main volume. A tapering brick chimney supports the corner of the mezzanine, and incorporates a cantilevered, waxed steel staircase and an open fireplace. This hybrid device interrupts the regularity of the three-bayed barn and delineates the different programmes within (ArchDaily, The Ancient Party Barn / Liddicoat & Goldhill, 2016).The kitchen is comprised of newly produced and recycled furniture. A small closure made of steel scissors at the top of the cabinets creates space for the storage unit. There is a small kitchen unit in the living area at the other end of the barn. Next to this unit, there is a furnace with a copper chimney (Figure 7).

Wooden beams and posts of the original building are preserved throughout the place. This practice continues in the bedroom as well. There is a wide range of material selection. A wide variety of materials such as parquet, concrete, wood cladding, paint, steel, and brick are used in the interior. Furniture selection is eclectic. Furniture and objects from many different periods are located in the same space. There is a more consistent choice of lighting elements. White, enamel lighting elements were used in the living area. In the bedroom, an antiqued glass fixture was preferred.

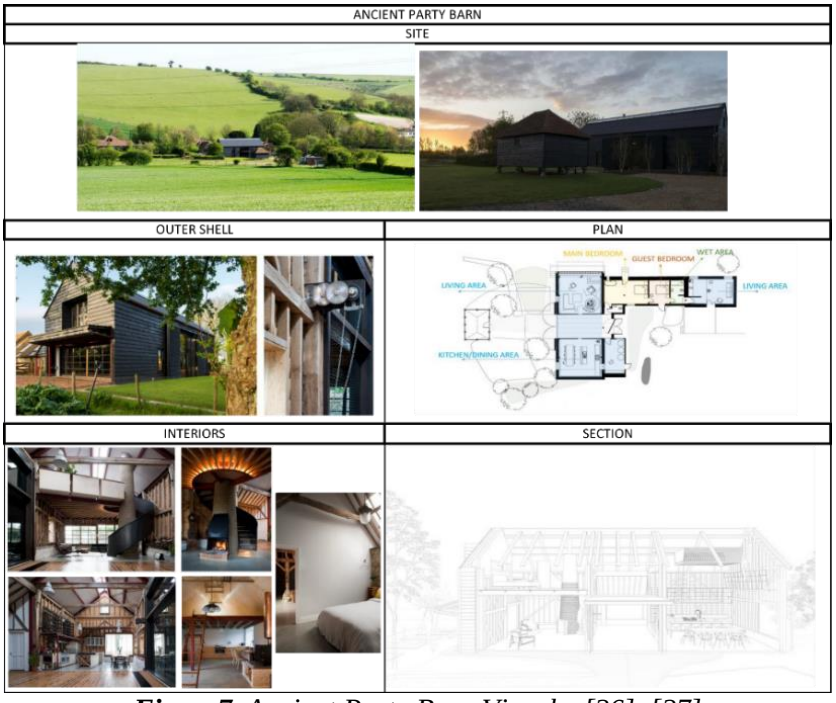

Figure7. *Ancient Party Barn Visuals, [26], [27]*

4.6. Christ Church Visitor's Centre

Christ Church College, Oxford, has requested that the historic thatched barn in Christ Church Meadows converted into a visiting centre. The center includes a shop and café. With the transformation, the barn gained a new function and the Priest House, which was previously used as a tourist shop, was restored. The Christ Church campus is situated adjacent to a meadow that is home to longhorn cattle and is classified as a Grade 1 listed area. Purcell (2020) defines their conservation strategy in the project as 'We simultaneously developed a design to extend the thatched barn in a way that eloquently integrated it within its historic context. Extensive consultation with stakeholders, Historic England and the local council informed the final proposals'.

Figure8. *Christ Church Visitor Centre [28], [29], [30]*

Within the meadow, there is a 19th-century thatched barn which was previously used as a store by the facilities department for many years. The barn's structure has been extensively modified, with two large additions added to provide adequate space for a ticket office, shop, seminar room, and other visitor facilities. Furthermore, new work areas have been designed for maintenance and gardening activities, which are located right next to the visitor center (Figure 8). By using traditional building materials such as wood, thatch, slate and stone, the new additions were made to blend in with their surroundings. The orientation of the additions has been adjusted to help frame the view of the surrouning meadow and Christ Church.

Considering the renovation status of six buildings, it is imperative to examine the relationship between 'old' and 'new.' While the features described as old characterize the original and genuine parts of the building, the parts described as new represent the parts added to the structure later. There are two perspectives to consider when evaluating the relationship between something old and something new in a given context: The separability of the old building and the additions and the harmonization of the relationship between the new function assigned to the old structure and the building's intrinsic potential.
For measuring the separability degree of old buildings and new additions, all the elements that were later brought to the building on the scale of interior and exterior spaces were examined. In this evaluation, while there is an equal grouping on the interiors, the outer shell is considered to present mostly successful protection (Table 3). Dutch Barn, the interior and exterior shell have been completely renewed, so there is no trace of the old; Lake District Barn, on the other hand, can be classified as less successful compared to other examples, as it gives the impression that the interior spaces have been completely renewed. Ochre

Barn and Ancient Party Barn are considered to be successful examples that preserve the original texture in the interior to a high extent, allowing all the elements added later to stand out. Redhill and Christ Church, on the other hand, show separation on a spatial scale rather than a holistic one.

Table 3. *Separability of Old Building and New Additions*

	SEPARABILITY OF OLD BUILDING AND NEW ADDITIONS					
BUILDING	INTERIOR SPACES			OUTER SHELL		
REDHILL BARN						
LAKE DISTRICT BARN						
DUTCH BARN						
OCHRE BARN						
ANCIENT PARTY BARN						
CHRIST CHURCH VISITOR'S CENTRE						

KEY:	COMPLETELY RENEWED	PARTIALLY INTERVENED	ORIGINAL

The evaluation of the old structure and new function compatibility was assessed under three groups. These are:

1. **Compatible:** The original characteristics of the structural elements are preserved, the original characteristics of the interior elements are preserved, and the characteristics of the original materials are preserved.
2. **Partially Compatible:** The original characteristics of most of the structural elements, interior elements and original materials have been preserved, but some elements have been renewed in accordance with their original structure.
3. **Incompatible:** Divided and identified as having lost the original characteristics of the majority of its structural elements, interior elements and original materials or having undergone incompatible renovation interventions.

In line with this evaluation, it is thought that the compatibility between the new function and structure is generally handled successfully, that is, in a harmonious manner (Table 4). While Rehdill Barn, Dutch Barn, Ochre Barn, and Ancient Party Barn are considered examples where structure and function are compatible with each other, Lake District Barn and Christ Church Visitor's Center are considered partially compatible due to some losses within the structure. The evaluation criterion used here is that if the function is suitable, there will be no loss in the structure.

Table 4. *New Function – Old Building Compatibility*

BUILDING	NEW FUNCTION - OLD BUILDING COMPATIBILITY
REDHILL BARN	
LAKE DISTRICT BARN	
DUCTH BARN	
OCHRE BARN	
ANCIENT PARTY BARN	
CHRIST CHURCH VISITOR'S CENTRE	

KEY:	COMPATIBLE	PARTIALLY COMPATIBLE	INCOMPATIBLE

5. CONCLUSION

The six projects examined are examples of the transformation of barn structures at different scales with different approaches. The main purpose of transformation is; The aim is to preserve the barn and keep it in use, thus ensuring the cultural transfer of a unique building typology to society. In this regard, the structures' compliance with the conservation criteria listed in PPS5, the Venice Charter, the Built Vernacular Heritage Regulation, and the Regulation on the Analysis, Protection, and Structural Restoration of Architectural Heritage were evaluated in different categories. It should be emphasized that when the evaluation criteria change, the result to be achieved may also change.

In the evaluations made, lighting elements and furniture were not included because the nature of barn structures does not contain furniture or lighting elements and in this case, their preservation status cannot be determined. This evaluation appraised under three different groups:

1. **Completely Renewed:** It refers to units that have been completely changed and defined with new materials.
2. **Partially Intervened:** It represents original textures and units that remain in use through addition or repair.
3. **Original:** It refers to the original textures and units that have not undergone any intervention.

In terms of preservation of structural elements, five buildings were evaluated as fully preserved; Redhill Barn is classified as partially preserved (Table 5). This is because Redhill's roof collapsed completely and therefore a new roof was added. The preservation of the original identities of the structural elements for all six barns is considered successful.

The preservation of the original identity of the interior elements is considered to be less successful than the building envelope (Table 6). It can be stated that this situation is affected by the fact that the barns do not have a rich infrastructure in terms of interior partitioning. Many barns do not have horizontal and vertical partitions. On an indoor scale, their most characteristic features are their length and roof structure. However, the floors of all barns appear to be covered with different materials. In this case, it can be stated that the original ground is not protected. In the evaluation, Dutch Barn was classified as having completely lost its original identity. While covering the building envelope with black corrugated metal prevents obtaining information about the original building materials, the interior has been completely renewed with contemporary coatings. For this barn, not even the rafters are visible.

Table 5. *Preservation Status of Original Elements*

	PRESERVATION STATUS OF ORIGINAL CONSTRUCTIONAL ELEMENTS		
BUILDING	**OPENINGS (DOOR, WINDOW)**	**ROOF**	**EXTERIOR WALLS**
REDHILL BARN			
LAKE DISTRICT BARN			
DUTCH BARN			
OCHRE BARN			
ANCIENT PARTY BARN			
CHRIST CHURCH VISITOR'S CENTRE			

KEY:	COMPLETELY RENEWED	PARTIALLY INTERVENED	ORIGINAL

Table 6. *Preservation Status of Original Interior Elements*

	PRESERVATION STATUS OF ORIGINAL INTERIOR ELEMENTS			
BUILDING	**FLOOR**	**CEILING**	**WALLS**	**WOODWORKS**
REDHILL BARN				
LAKE DISTRICT BARN				
DUTCH BARN				
OCHRE BARN				
ANCIENT PARTY BARN				
CHRIST CHURCH VISITOR'S CENTRE				

KEY:	COMPLETELY RENEWED	PARTIALLY INTERVENED	ORIGINAL

While an equal distribution is noted in the preservation of original materials at the outer shell scale, partial preservation is more common in the interior (Table 7). The existence of the original texture on a spatial scale was evaluated in the buildings considered to have been intervened. For example, leaving one wall in the bedroom completely belonging to the barn, but arranging the other walls with new materials can be considered an approach that falls into the intervened category. In this category, Dutch Barn and Lake District in particular were evaluated as unsuccessful because they covered all the original materials on both the inner and outer shell scale. Ancient Party Barn, on the other hand, was evaluated as successful with its features such as leaving even the beams exposed in protecting the interior materials.

The preservation of the form of the original building was evaluated at the scale of the interior spaces and outer shell. Evaluation of the interior was made in terms of perceiving the volume and ceiling height of the original building. In the outer shell, whether or not an add-on was introduced and the texture change made by adding new material to the shell was taken into consideration (Table 8).

Table 7. *Preservation Status of Original Materials*

	PRESERVATION STATUS OF ORIGINAL MATERIALS					
BUILDING	**INTERIOR SPACES**			**OUTER SHELL**		
REDHILL BARN						
LAKE DISTRICT BARN						
DUTCH BARN						
OCHRE BARN						
ANCIENT PARTY BARN						
CHRIST CHURCH VISITOR'S CENTRE						

KEY:	COMPLETELY RENEWED	PARTIALLY INTERVENED	ORIGINAL

The evaluation criterion for the structures grouped as partially preserved on an interior scale is the interruption of the original volumes of the barn structures by adding horizontal or vertical extensions. Since it is inevitable to make these divisions in line with new functions, all the structures examined were considered partially preserved in terms of preserving the internal spatial form and size. However, it should be emphasized that the degrees of internal partitioning in buildings are different. Ancient Party Barn, Christ Church Visitor's Centre and Redhill has more seamless interior spaces in terms of dimension compared to the Lake District, Dutch and Ochre Barn.

Table 8. *Preservation Status of Form and Size of the Original Building*

	PRESERVATION STATUS OF FORM AND SIZE OF THE ORIGINAL BUILDING					
BUILDING	**INTERIOR SPACES**			**OUTER SHELL**		
REDHILL BARN						
LAKE DISTRICT BARN						
DUTCH BARN						
OCHRE BARN						
ANCIENT PARTY BARN						
CHRIST CHURCH VISITOR'S CENTRE						

LEJANT:	ORIGINAL	PARTIALLY INTERVENED	COMPLETELY RENEWED

While ensuring that the unique identity of a building is preserved and remains in use, interventions should be limited to a certain extent. From a general perspective, the practices that are considered correct and the manners that are more appropriate to avoid are listed as follows, taking into account the PPS5, Venice Charter, the Charter of the Built Vernacular Heritage and the ICOMOS Charter – Principles of Analysis, Conservation, and Restoration of Architectural Heritage of the buildings that constitute the evaluation criteria in the study (Table 9).

Table 9. *Intervention Types as per Charters*

INTERVENTION TYPES AS PER CHARTERS	
ACCEPTABLE INTERVENTIONS	**UNACCEPTABLE INTERVENTIONS**
Renovation by Preserving the Mass and Color Relationship	Intervantions to Change Mass and Color Relationships
Readible and Separable New Additions	Usage of New Elements Exactly Same wit the Old Fabric of the Building
New Function Selection Compatible with the Original Structure	New Function Selection Non-Compatible with the Original Structure
Adopting a Modern Approach Instead fo Unity of Style	Acting with Concern for Unity of Style
Interventions with Reversible Approaches	Interventions with Non-Reversible Approaches
Preserving and Considering the Patina of the Building	Applications Not Respect the Patina of the Structure
Highlighting Distinctive Architectural and Historical Features	Not Highlighting Distinctive Architectural and Historical Features

It is important to limit interventions to a building according to an acceptable list to avoid causing more harm than good to the structure. When making changes to the building, care should be taken to maintain its original texture. For instance, partitions created within the building should not disrupt its spatial volume, and any new materials used should be appropriate to the building's original language. The materials should also be selected in a way that emphasizes that they were added later.

On a broader perspective assesment of the structures can be grouped under two headings: barns can be considered successful in terms of conservation principles and barns can be considered successful in terms of functional changes. Among all the case examples in the study, the applications that are considered successful are the conversion projects that approach the original identity with the most respectful attitude

and the least intervention, both on the outer shell and on the interior scale. While the barns that can be examined successful by conservation principles can be listed as Ancient Party Barn, Ochre Barn, and Redhill Barn, the most successful example in terms of functional application are regarded as Ancient Party Barn and Christ Church Visitor's Centre. The only building that stood out in both categories was the Ancient Party Barn. Thus, it is possible to consider the Ancient Party Barn as the most successful structure in this study. Because new materials and technologies were integrated into an old structure in a compatible and separable manner. Also, the design achieved harmony in the co-existence of the new and the old, while successfully distinguishing them from each other. The Ancient Party Barn had the highest preservation rate of its original identity among the six buildings examined.

Conservation efforts are valuable for buildings of all sizes, especially vernacular structures that represent the architectural and cultural understanding of societies. This study can serve as a reference for future practices in the protection of huts, houses, or agricultural structures, which are considered to have low conservation value compared to large palace or mansion-type buildings.

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Theory Building in Multi-Paradigmatic Discipline of Industrial Design

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Abstract

The complex and multidimensional nature of industrial design activity requires the consideration of multiple perspectives in its exploration. Therefore, design theories have often been developed using various perspectives from various disciplines. While this has facilitated the expansion of knowledge in the field, the expansion is often comprised of singular theories that claim universality despite their limited scope, resulting in conflicting and contradictory theories. As a result, the inability to establish communication between different theories appear as a significant barrier to cumulative knowledge building in the discipline. The study explores the discipline of industrial design in terms of paradigm conceptualization, a criterion for distinguishing what is considered scientific or not, in the philosophy of science of the 20th century. Since a nomothetic theory cannot be built in multi-paradigmatic disciplines, a research strategy for industrial design has been proposed, suggesting the hybrid use of activity theory and grounded theory. This strategy aims to construct partial theories that facilitate communication among different paradigms and support the cumulative knowledge in the discipline.

1. INTRODUCTION

In the capitalist mode of production, where the needs of individuals are represented and satisfied through a social need concept and products, industrial design emerges as a creative activity. Taking place within a complex hierarchical system, this activity is executed in various ways in alignment with organizational strategies. Industrial design, involving numerous decisions made under uncertainty, inherently carries a certain amount of subjectivity. The uncertainty and subjectivity inherent in industrial design practice are perceived as risk factors for the commercial success of products. Since industrial design is primarily a commercial activity, this perception prompts theorists to seek ways to mitigate uncertainty and impose universal rules on design practice to make it rational and systematic. The effort to apply criteria of objectivity and universality, exclusive to natural sciences, to industrial design and to develop a nomothetic theory while ignoring the complexity and diversity of the discipline has persisted to this day, deepening the gap between theory and practice. The absence of a practice-based theory has been a recurring concern in the literature [1], [2], [3], [4], [5] with critiques directed at studies attempting to develop theory in the field but often becoming disconnected from practical applications. The diversity in objectives, tools, methods, and outcomes within the versatile and complex design field renders each activity unique. This uniqueness leads to a tension between practice and traditional methods of theory generation, posing a significant challenge in design research - specifically, the difficulty in developing a theory grounded in the practice of the discipline [2].

To establish a comprehensive body of knowledge and theory in design fields, it is essential to understand the relationships between the independent elements [6]. Understanding these relationships requires clarity on the boundaries between main disciplines, sub-disciplines, singular frameworks, and contexts shaping the construction of design theories [6]. Current design theories strive to comprehend design as a unified phenomenon, aiming to identify the fundamental steps common to all design processes or the essential

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elements all designed products must possess [7]. However, an existing theoretical framework can only partially integrate such diversity [7]. The absence of such a theoretical framework leads to contradictions and conflicts among theories built in the discipline. While each theory may be scientifically sound and internally consistent, the inability to establish communication among these theories which are based on various paradigms impedes the cumulative knowledge building. Although studies that propose recommendations for improving design practice or suggest that certain types of activities are more valid than others by solely focusing on specific elements of the activity contribute to the expansion of knowledge in the field, they do not necessarily contribute to knowledge accumulation. Design theories should generate cumulative knowledge [8]. Consequently, one of the significant problems in design theories is the inability to establish communication among different studies. The lack of communication among different studies in design theories stems from the multi-paradigmatic nature of design and the absence of a theoretical framework to analyze various paradigms together.

Therefore, in this study, the multiparadigmality in industrial design has been justified based on the dynamics of the practice, and a research strategy proposing the hybrid use of grounded theory and activity theory has been suggested for theory building through practice. The proposed research strategy is also believed to lead to the development of a theoretical framework that supports the cumulative knowledge building since it enables the analysis and interpretation of the diversity in design practices and elements of design activities and facilitates communication between different paradigms.

2. KNOWLEDGE PROBLEM

The questions of what knowledge is and how actual knowledge can be achieved belong to the specialized branch of philosophy known as epistemology until the 17th century and have been among the fundamental issues discussed in the history of thought since ancient times—meanwhile, sciences such as mathematics and geometry act as intermediaries for philosophers trying to understand the universe. However, in the 17th century, with the emergence of empirical sciences, science became an institutionalized activity independent of philosophy [9]. The debates on distinguishing between science and non-science also began in the 17th century, with positivists excluding forms of knowledge not based on observation and experimentation, non-quantitative, non-inductive, and unverifiable, from science.
In positivist thought, knowledge is relegated to an instrumental role, with its sole criterion being the function it serves in establishing dominance over nature [10]. The remarkable success of natural sciences in transforming nature for human purposes provides the basis for natural scientists to reject different modes of knowledge that follow methods different from theirs. Positivists reduce science to the rules and procedures applied in physics and its various branches, withholding the label of 'science' from any theoretical effort that does not align with the principles they abstract from physics [10]. Thus, embracing positivist thought and asserting their status as sciences, humanities, and social sciences begin to imitate the natural sciences. On the other hand, Dilthey [11] argues that positivists' attempts to explain social reality using the concepts and methods of natural sciences are distorting and falsifying reality. According to Dilthey [11], the initial step is to reject the idea of a universal reality. Nevertheless, humanities and social sciences developed in the shadow of natural sciences throughout the 19th century and a significant portion of the 20th century [12]. Bauman [12] notes that, during this period, the dark corners of doubt go almost unnoticed amidst the dazzling magnificence of technological success originating from the natural sciences. These apparent successes prove too persistent and insidious for those tempted to waste time contemplating or challenging the sustainability of natural scientists' approaches to studying social life [12].

Industrial design also arises as a consequence of the Industrial Revolution, representing one of the most prominent achievements of natural sciences. As Western science is rooted in positivism, emphasizing experimentation and rationality, and Western capitalism thrives on the technical application of this scientific knowledge, the advancement of these sciences is economically incentivized [13]. The notion that the continuity of growth relies on the principle of calculability, coupled with the increasing societal significance of machines, sets the stage for the emergence of applied knowledge types as scientific categories [14]. In the early 19th century, the term "applied sciences" referred to the utilization of scientific knowledge in technological advancements, as evidenced by conceptualizations such as

"angewandte wissenschaft" or "*science appliquee aux arts"* [15]. Primarily, these terms were used to describe fields such as engineering and health sciences [15]. However, until the 20th century, the concept of applied sciences was not a research category but a subset of positive science proposed for dissemination through teaching [15]. The 19th century witnessed not only the emergence of new scientific fields under the influence of modernism but also radical transformations in professions that had existed for centuries. Changes in the mode of production laid the groundwork for the emergence of new activities. One such example, industrial design, is perceived merely as an activity involving the application of art to machine products in its early stages [16]. In the 20th century recognizing industrial design activity's distinctive thinking and practices, it gradually establishes itself as a distinct profession [17].

Particularly after the 1960s, the increasing significance of the industrial design profession for companies' competitiveness reveals the motivation to harness its inherently creative and often implicit nature under the efficiency principle of capitalism. According to Taylor, tacit knowledge is not ideal; knowledge about objects and production methods should be acquired and objectified through scientific reasoning [18]. This perspective propels contemporary industrial design researchers, inspired by the natural sciences, to seek an ideal form of activity devoid of subjectivity, thus unveiling the first primary paradigm defined in the field, the modern paradigm. The *Design Methods Movement* began in 1962 with a grand narrative, driven by the belief that science-based advancement in design would contribute to creating a better world [19]. The movement had a significant impact on the growth of academic attention towards design leading to the establishment of design studies [20]. But Christopher Alexander [21] one of the pioneers of the movement, expresses regret in the preface of his book *Notes on The Synthesis of Form*, highlighting the futility of separating design research from design practice.

Especially in the twentieth century, as the fragility of the foundations of natural sciences became evident, scientists' attitudes toward epistemological problems transformed. Old questions, once considered answered definitively, resurface [22]. Categorical distinctions such as knowledge, artistic knowledge, scientific knowledge, philosophical knowledge, scientific method, etc., and the divisions between natural sciences and human sciences are reconsidered, leading to a restructuring of their relationships [22]. Discussions about the nature of science and the methods for attaining scientific knowledge intensify. This process makes distinctions between natural sciences, humanities, and social sciences more apparent. Various branches of science scrutinize their ontological and epistemological assumptions, developing research methodologies tailored to their specific subjects. The dominance of modern thought, prevailing from the 17th century to the 20th century, gives way to postmodern thought, characterized by its critical stance.

The interpretivist tradition brings about a profound transformation, distinguishing 20th-century thinkers from their predecessors, as they abandon the pursuit of an objective reality. Scientific theories, akin to language games, construct frameworks of meaning; therefore, understanding—ensuring comprehensibility within a particular framework of meaning—involves presenting an explanation that solves a puzzle in the most suitable manner [23]. Social phenomena create an immaterial world beyond the scope of natural laws, and their comprehension relies solely on the framework of purpose-action relations [24]. In analyzing these phenomena, deterministic laws of nature should yield to an interpretive approach that takes into account the purposeful actions of individuals [24].
Design researchers tend to pursue their work from within one of these two paradigms: positivist and interpretivist [25]. The ontological, epistemological, and methodological differences between positivism and interpretivism, the two major research paradigms relevant within the scope of the discussion in the study, are illustrated in Table 1.

Table 1. *Research Paradigms* [26].

Research Paradigm	*Ontology*	*Epistemology*	*Methodology*
Positivism	Objective reality	Reality can be measured	Quantitative
Interpretivism	Multiple realities created by individuals	Reality needs to be interpreted	Qualitative

The criteria set forth by the positivist approach to science, which defines objectivity as confronting the research object devoid of values, beliefs, interests, and emotions, cannot be applied because this criterion does not align with human nature [27]. Historical, social, and cultural conditioning shape our perspective on objects, making knowledge relative under these conditions. Therefore, it cannot be asserted that it is the method that distinguishes science from non-science [27]. In the interpretivist approach, the demarcation problem holds a significant place. The question of what distinguishes science from non-science, if not the method, shifts the focus of 20th-century philosophy of science debates. In this context, Kuhn's paradigm conceptualization is observed to be in harmony with the interpretivist approach to science.

During the post-modern period, it became evident that design problems resisted scientific methods [28]. The roots of this resistance were analyzed by Rittel, who characterized the nature of design problems as 'wicked' problems, while the issues tackled by the scientific method are 'tamed' [28]. The lack of practical response to the modernist design discourse [29], especially after the 1970s, prompted industrial design theorists to search within the realm of post-modernist thought. The transformation in the mode of production during the post-modern period, transitioning from a supply-side economy to a demand-side economy, lays the economic foundation for recognizing the human factor in industrial design. Emphasizing the human factor, post-modern paradigms cannot transcend modernist thinking since they derive from the traditional distinction of modern epistemology that divides reality into subjective and objective realms [30]. Despite being contradictory to the pluralism of postmodernism, it is observed that the human-centered paradigm elaborated by Krippendorff [31] still claims to be the dominant paradigm. However, industrial design's complex and multidimensional nature requires multiple perspectives in its exploration. The requirement becomes evident in design research as it borrows theories from other fields through analogy. The absence of established paradigms essential for conducting scientific studies results in multiparadigmality, even if theories are borrowed from different fields, and facilitates the development of specific theories. However, this multiparadigmality is not questioned as an indication of multiple realities within the discipline; it arises from design researchers seeking a paradigm in other fields to provide a solid foundation for their research.

3. PARADIGM

The concept of paradigm refers to the accepted and unquestioned presuppositions shared by the scientific community [23]. Thomas Kuhn, in his 1962 book "The Structure of Scientific Revolutions," introduced the term that addresses the challenge of delineating the boundaries of science and responds to the demarcation problem. Kuhn [32] illustrates that by examining specific historical processes in more established sciences like physics, for instance, before the establishment of the first universally accepted scientific paradigm (Newton's paradigm), there were as many electrical theories as there were scientists investigating it. Spending a year with a community mainly consisting of social scientists allowed Kuhn to observe the differences between natural scientists and social scientists [32]. As a physicist, Kuhn expressed that he found it challenging to comprehend their profound disagreements regarding scientific problems and methods during his collaboration with social scientists. Kuhn [32], initially assuming that similar disagreements were not present in natural sciences, sought to identify the source of this difference and came to realize that the concept he called "paradigm" played a crucial role in science [32]. The absence of a paradigm hinders the initiation and, more crucially, the advancement of fundamental research in a field, as foundational assumptions need to be redefined with each attempt. Kuhn [32] illustrates that by examining specific historical processes in more established sciences like physics. For instance, before the establishment of the first universally accepted scientific paradigm (Newton's paradigm) existed as many electrical theories as scientists investigating it. Despite being scientific, there must be a universally agreed-upon framework to ensure in-depth exploration beyond basic assumptions. However, once a paradigm is adopted, a scientist no longer needs to reconstruct the entire field from scratch and justify every concept introduced based on the initial principles during their most significant studies [32].

According to Kuhn [32], the main feature of the first stages in the development of most sciences is the constant competition of many different views. He characterizes this period as the pre-scientific phase,

marked by the coexistence of various paradigms. As a significant scientific achievement emerges, the number of competing schools typically diminishes to a single one, marking the commencement of an adequate scientific practice. This allows community members to embrace a field-specific foundation readily. When the new science discourse supersedes the old one and suppresses alternative views, it is defined as a paradigm shift. Kuhn suggests that multiple paradigms in a field indicate its immaturity or lack of scientific status.

Taking this into consideration, industrial design researchers label any emerging paradigms in design as a "paradigm shift" [28], [29], [31], [33], [34], [35], [36], [37], [38], [39]. Pursuing a nomothetic theory in the field overlooks the multiple realities inherent in design. Aside from industrial design, which is a relatively new and developing discipline, it is worth noting that according to Turner [40], even in the broader context of social sciences, there has never been a theory that approaches the level of comprehensive and explanatory power seen in Newton's or Darwin's theories. Although theories such as those of Marx and Freud have emerged in the historical process, it is seen that these theories still need to produce results or become a dominant paradigm [40]. For this reason, the theories in question are described as "pseudo-scientific" by philosophers of science such as Popper and Lakatos [40].

The disciplines that include human factor/subjectivity, which Bhaskar defines as conceptually dependent where reality is socially constructed, there is no reality; instead, there are semi-realities [41]. In contrast to natural sciences, which typically adopt an explanatory approach towards objects and do not encompass the category of purpose/reason [11], [12] these sciences need to be understood in a manner distinct from a mere explanatory form. The term "paradigm shift" disregards all other forms of design and asserts that the entire reality in the field can be unveiled with a single theory. Design approaches, described as paradigm shifts in the literature [28], [29], [31], [33], [34], [35], [36], [37], [38], [39] can be classified as partial theories as they reveal only one of the existing approaches to design, or as prescriptive theories since they introduce new suggestions to the field. However, they must catch up to the comprehensiveness a dominant theory claims.

With the advent of the pluralistic world of post-modernity, producing justifications to defend the superiority of one paradigm over another has become challenging [42]. Moreover, the assertion of a single paradigm in design fields is meaningless because even Kuhn [32] distinguishes applied fields. He suggests that disciplines whose raison d'être is based on a social necessity external to themselves may not necessarily need to agree on a paradigm to become a branch of knowledge and may be sufficient for them to adopt a particular paradigm. While industrial design has dramatically benefited from borrowing theories from more established disciplines, advancing design research requires a departure from the notion of a universal reality. It is essential to acknowledge and embrace the multiparadigmality of the field. Adapting to the existing paradigms, as observed in practical applications, is crucial for defining the direction of design research.

4. DESIGN RESEARCH AND THEORY CONSTRUCTION IN DESIGN

Design research is categorized into three types based on the problem being addressed: clinical research, applied research, and basic research [17]. Clinical research involves case studies with a focus on action. Case studies typically gather data that provides insights into problems beyond individual cases[17]. On the other hand, applied research concentrates on issues within a specific product class or particular situations[17]. The goal is not to develop a general principle to explain problems but to discover principles and operational modes explaining a specific set of phenomena[17]. A common aspect of applied research in design is the attempt to gather hypotheses from multiple cases, demonstrating the forms of reasoning effective in designing for that class [17]. Moreover, since applied research falls between clinical and basic research, it is generally mindful of applying fundamental principles to investigate a class of products and activities [17]. Using a general principle involves many other factors governed by additional principles [17]. Applied research focuses on the process, aiming for designers to work more efficiently through research [17]. Thirdly, basic research seeks to comprehend the principles governing and explaining phenomena. In general, this type of research is associated with design theory, aiming to provide a foundation for all other activities in the discipline of design [17].

On the other hand, design research can be defined across various scales, ranging from cognition to the overall functioning of the design process [43]. Micro-scale studies delve into the cognitive and mental models influencing design performance, whereas macro-scale studies take a broader perspective to outline the general characteristics of design activity [43]. Since basic research aims to produce theory, the research object is approached on a macro scale to make specific reductions. Medium-scale data also supports basic research to make sense of the information. On the macro scale, the research should emphasize information coordination, seeking, sharing, and representation within the design activity [43]. Design studies are related according to their purpose and scale, as in Figure 1. Figure 1, adapted from [17] and [43], highlights the strategy proposed for theory building in terms of objectives and scales.

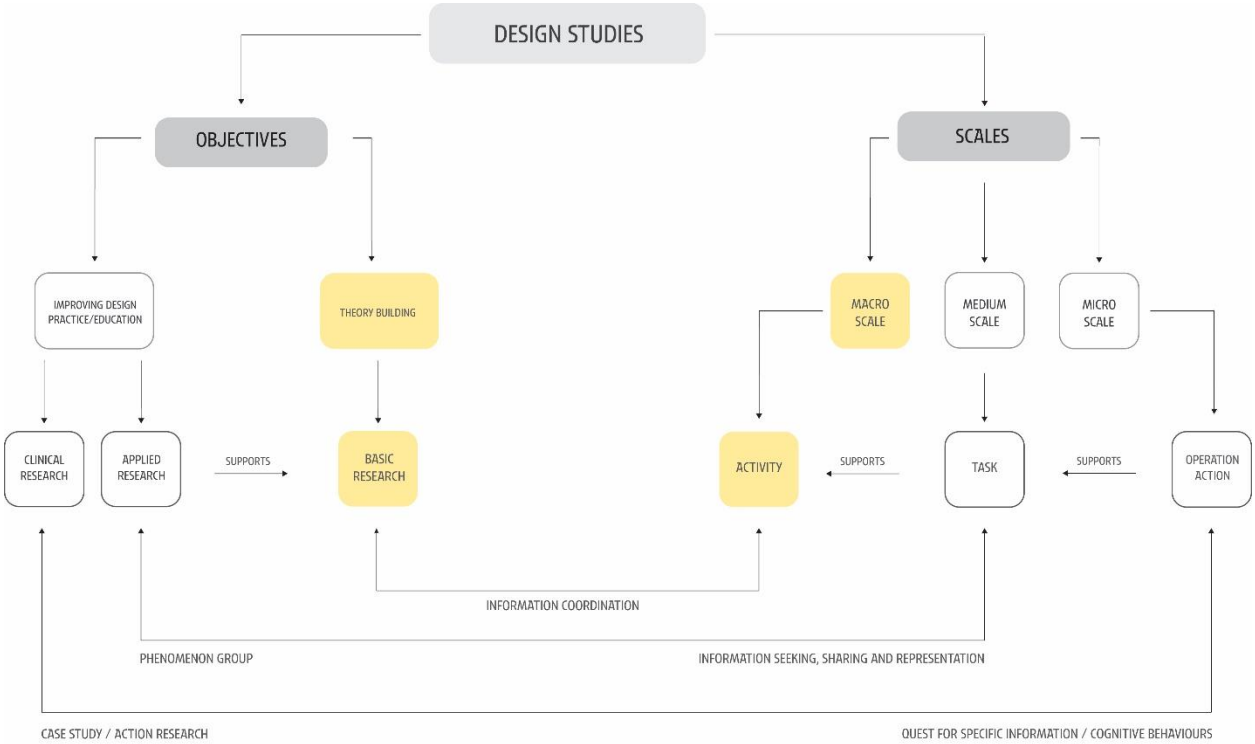

Figure 1. *Classification of Design Studies According to Their Objectives and Scales (Adapted from [17] and [43])*

Design theory differs from theories in other fields because it has to satisfy the requirements of two worlds: academic and professional [44]. In such disciplines based on human activity, 'making' knowledge is constructed rather than discovered and is expected to meet academic requirements and compatibility with practice [44].

Herbert Simon [45] also draws attention to the difference between design sciences and natural sciences in his book "The Science of Artificial." He explains how design activity occurs at the center of design sciences. Although he identifies the difference between natural sciences and design as "what things are" or "how things are," Simon [45] suggests focusing solely on the formalizable and explainable facets of design theory to ensure its acceptability in the academy, believing that the uncertainty inherent in design can be managed. Formalizing design by imposing specific rules implies neglecting the distinctive dynamics inherent in the design process. Simon's reduction of design to a rational decision-making process needs to be revised, as rational problem-solving represents just one facet of designing [31]. According to Krippendorff [31], since theory cannot be derived solely from invariances in design, conditions that can change through design should be considered when developing theory. Research that emerges from observations of designers' actions needs to consider how the theory can be redesigned [31]. In this context, Krippendorff seeks a solution to developing prescriptive theory. Both Simon and Krippendorff share the presupposition that considering the unique dynamics of design makes it challenging to reach universal generalizations. While Simon proposes a solution by concentrating solely

on the formalizable aspects of design practice, Krippendorff, somewhat disconnected from practice, suggests establishing rules for design through design theory. While Krippendorff [31] characterizing his paradigm as post-modern, both researchers maintain a modernist approach by not relinquishing the aspiration to construct a broad-scale theory.

A theory provides the most comprehensive, consistent, and simple model for connecting diverse and seemingly unrelated facts functionally and pragmatically. It is a way of revealing explicit, implicit, hidden, or unknown knowledge [46]. Theories provide a coherent description, explanation, and representation of observed or experienced phenomena [47]. Design is too complex and diverse to reveal all its realities with a single theory. Therefore, a gradual approach supporting the accumulation of knowledge in the field is needed to achieve consensus in design theories [7]. Therefore, theory building in design should be partial, focusing on theories that explain specific aspects of design practice through causal processes. Subsequently, more comprehensive theories can be constructed by integrating different elements from various partial theories [4].

5. PROPOSED RESEARCH STRATEGY

The positivist approach is characterized by believing that truth exists outside and is singular and definite. This epistemological assumption guides the researcher, aiming for absolute knowledge, towards an experiment-based methodology [38]. In the post-modern era, natural sciences' unassailable and uncontested power in the knowledge world began to diminish due to the criticism directed towards binding generalizations, universal explanations, grand narratives, and all forms of totalizing structures [22]. Contrary to the positivist approach, which places the known object against the knowing subject, qualitative research is an activity that repositions the observer in the world and adopts an interpretive approach to the world [49]. The constructivist/interpretivist paradigm defined by Denzin and Lincoln includes a relativistic ontology (multiple realities) and several different methodological procedures, where the main aim is to understand the relationship between people, their activities, and their physical environments [50].

Located within the constructivist/interpretive approach, grounded theory is a theory-building strategy that embodies the close relationship between theory and practice [51]. The difference distinguishing grounded theory from other types of research is its focus on building theory but on partial theories rather than grand theories that address more universal issues [52]. On the other hand, activity theory provides a holistic and contextual discovery method that supports qualitative and interpretive research in disciplines centered around human activity [53]. While grounded theory equips the industrial design field with analytical tools for constructing a partial and articulate theory based on practice, activity theory offers a qualitative framework for comprehending the variables within the entirety of industrial design activity.

5.1. Grounded Theory and Activity Theory

Grounded theory was initially developed by sociologists Glaser and Strauss [54]. Later, Glaser embraced the positivist approach to the theory, whereas Strauss [55] and Charmaz [56] represented distinct constructivist approaches. Coming from the positivist tradition, Glaser develops a purely inductive qualitative research method based on the ontological acceptance that social reality is the same as natural reality. In the Straussian approach to grounded theory, there is a rejection of positivist claims that an objective reality can be attained through pure induction. Strauss revisits the methodology from a pragmatist perspective, asserting that individuals construct knowledge by interpreting shared meanings [51]. This perspective assumes that reality is inherently dynamic and interpretive, exploring how individuals create meanings and take actions [56]. Thus, Strauss includes human agency, subjective and social meanings, and problem-solving practices within the scope of grounded theory [56]. In his constructivist approach, Charmaz [56] adds to Strauss's constructivist approach the discourse that the constructed reality is also built under existing structural conditions, that is, hermeneutic analysis and ethnographic methods. Grounded theory is a research strategy adopted to develop a theory on a topic neglected or superficially addressed in the literature [57], implying that the theory is grounded in data. While in other methods, analysis begins after data collection is completed, in grounded theory, the

researcher initiates the search for meaning by questioning the data in the early stages of data collection [54], [55].

Referring to Kuhn's puzzle analogy, Charmaz [56] states that, unlike quantitative research, in qualitative research, researchers add pieces to the puzzle during the research. At the end of the study, they create a brand new puzzle. In grounded theory, the landscape is viewed from a wide angle, like a camera with multiple lenses. The lens is changed several times to zoom in on scenes, creating a new landscape [56]. The researcher realizes that certain classifications are possible during data analysis and discovers patterns [58]. Repetitive regularities in the data should be a process of first dividing the data into parts and classifying them based on similarities [52]. Merriam [52] exemplifies this classification process: "Consider sorting two hundred food items in a grocery store. These two hundred items can be considered pieces of information that form the groundwork for analysis. By comparing one item with another, these two hundred items can be divided into categories. For example, if you start with a cereal with the second ingredient, orange, it will be discussed whether it is similar to the first. If they are not similar, this time, there are two categories in which the third item can be placed. If the third item is also different, we have three categories..."

When it comes to human activity, this process naturally becomes complicated. Analysis and description of human activity must consider the inherent uncertainty and nonlinear dynamics (chaos) in activity regulation [59]. When analyzing design activity, data can be studied at numerous scales and frameworks, from cognition to consciousness, from intuition to material conditions, sectoral requirements to organizational structures, design processes, and the designer's relationships with other actors. Since it is impossible to classify and make sense of all these data using only grounded theory tools, getting support from activity theory is proposed to create a qualitative framework in the theory-building process.

In the broadest terms, activity is the purposeful, goal-oriented modification of the environment; it is a form of human-specific agency [60]. What makes the activity human-specific, unlike other entities that contribute to the transformation of the environment, is that the activity is goal-oriented; the goal is consciously determined [60]. When designing an activity, the subject considers one’s knowledge, one’s goal, the ways and means of achieving the goal, that is, the harmony between ones will and the laws of nature, and designs one’s actions accordingly. Nikiforov's starting point is to develop an approach that empirically reveals different aspects of human activity. He proposes focusing on three essential elements in the activity analysis: the conditions under which action is taken, the goal, and the means to achieve this goal [60]. Activity theory examines the unique dynamics of each activity. It enables the holistic analysis of the relationship between the variables in question by placing them in a specific framework.

Like all known modes of operation, design is a problem-solving activity that requires organizing information into a specific representation [61]. Design problems are searched for a few objects that offer satisfactory or optimal solutions, in which a design strategy radically reduces potential objects in a wide area [62]. The design output results from processing information about the object's characteristics, such as appearance, material composition, production methods, functionality, etc. [63]. Design information can be defined as data acquired, used, and transformed during the product development process [63].

The design space is already constrained by other dynamics that affect the activity before the cognitive decisions of the designer. According to Mostow [64], a comprehensive design model should address the following aspects of the design process: design conditions, the object (the object describes not the properties of the object but how these properties are manipulated), design decisions, management of the design process, and the role of information in design (how it is acquired, processed and used). In this context, studies, on the one hand, aim to understand the tools required by designers for specific tasks, the integration of tools into the design process, information flow, and the environment created by design support systems, and on the other hand, investigates how design processes can be restructured for optimal utilization of tools [62].

Depending on the purposes of the study, utterly independent research topics can be derived from the same activity, and different representations of the same activity can be created [65]. Dividing the activity into

various components and conducting the analysis from part to the whole by establishing necessary relationships is a crucial part of the systemic-structural analysis of the activity. The hierarchical activity scheme includes four levels: activity, task, action, and operation [66]. A task, which plays a crucial role in the analysis of activity, is understood as a part of the activity directed towards achieving a specific goal, constrained by a certain time frame, and it is a logical system containing cognitive and behavioral actions [67]. In activity theory, cognition is understood as a process and a structured system of actions [68]. When cognition is considered a process regulating human behavior, the activity becomes the research subject and is depicted as a hierarchically organized structure consisting of conscious, goal-directed actions. When understood as a structured system of actions, activity is the object of research; it is not based on operations and actions but draws attention to the general characteristics of activity on a macro scale. According to Vygotsky, activity is an object of research, and units of analysis are components divided and integrated into a dynamic whole [67]. Such an understanding of activity makes it possible to classify different human activities and develop theories about these activities [68].

The research strategy proposed for theory building in design, derived from the hybrid use of certain approaches of grounded theory and activity theory, both of which are belong to the interpretive research paradigm, is summarized in Figure 2.

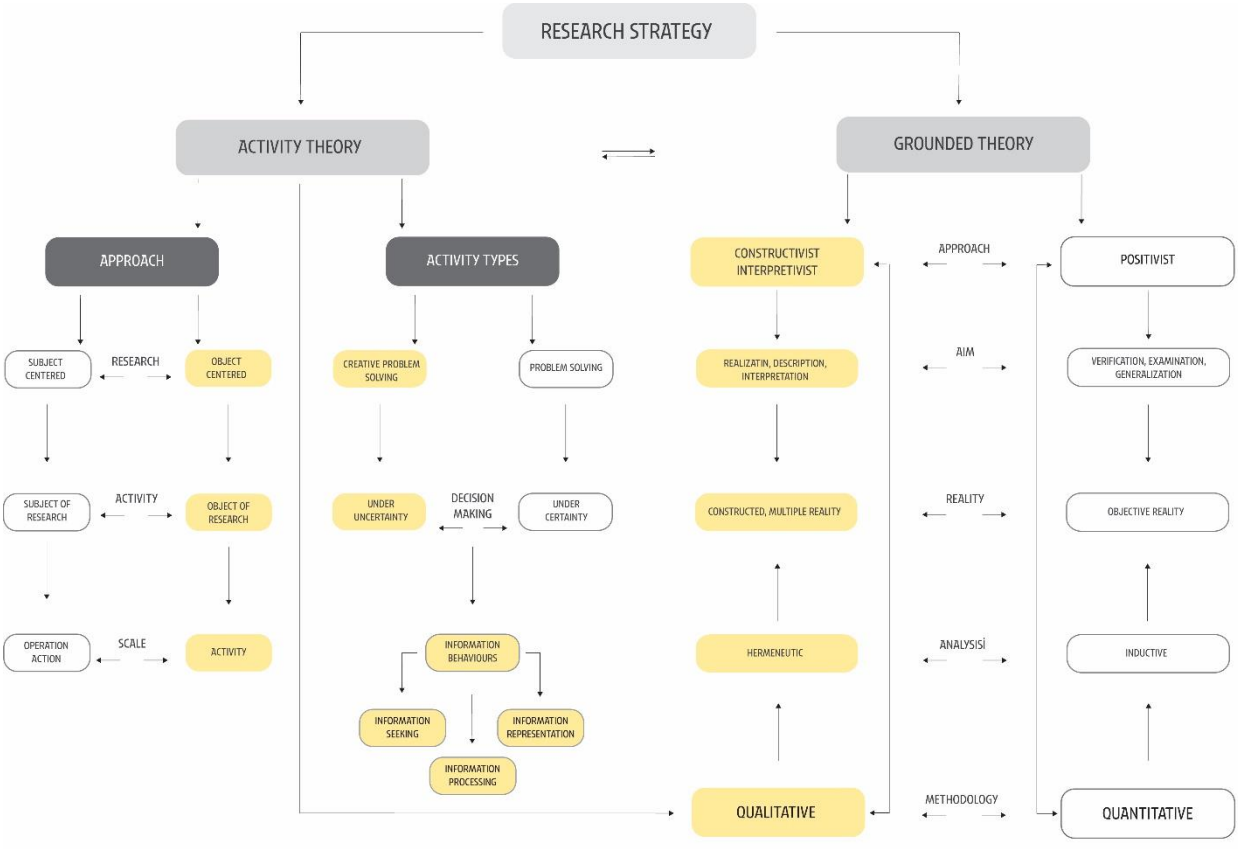

Figure 2. *Research Strategy Proposal / Grounded Theory and Activity Theory (Authors)*

Activity theory is identified as being used in two ways in the field of design: as a qualitative research framework to understand and explain design tools and processes, and as a basis for micro-level clinical research aimed at understanding or improving the design process [69]. When used as a qualitative framework, activity theory's contribution is primarily to examine and understand different variables that may have affected the design process, the designers' choices, or the design outcome of a project [69]. The review of the literature on activity theory's application in industrial design ([69], [70], [71], [72], [73], [74]) indicates that activity theory is mostly used in micro-scale clinical research to understand or develop the design process. These may have been used as a tool for developing design practice or as a qualitative research framework, but in both cases, there is an orientation towards the internal dynamics of design. In other words, in these studies, design is not the subject of research but rather the object. So far, no research

aimed at understanding the activity in terms of its holistic dynamics or aimed at theory building has been found. However, in activity theory, depending on the research objective, activity can be approached at different scales. When design activity is considered as the object of research, the aim is to improve the design process, and cognitive processes of activity are taken into account. Such research is conducted in the form of case studies. But theory building becomes feasible only when the research is object oriented and conducted on a macro scale, as depicted in Figure 1, i.e., at the level of activity, and design activity is regarded as the object of research.

In the proposed research strategy depicted in Figure 2, the activity theory is highlighted in terms of its potential applicability to theory building in industrial design for theory development depending on the nature of the activity and the scale of research. The interpretive, qualitative research strategy of grounded theory, which is considered suitable for multi-paradigmatic theory building in design, is also highlighted. While the constructivist/interpretive approach of grounded theory, recommended for partial theory building, offers analytical tools to capture various activity patterns, the object-oriented approach of activity theory supports the interpretation of similarities and differences within these patterns.

6. CONCLUSION

Conventional methods of constructing theories in industrial design have often yielded valuable yet partial perspectives on design knowledge. This is primarily due to their reliance on the principles of a single dominant paradigm, as outlined by Kuhn, or a particular way of comprehending design phenomena. The reality is that the majority of practitioners, despite discipline's assertions, do not adhere to a single paradigm. Instead, they utilize a combination of paradigms and participate in a diverse array of activities, incorporating both positivist and interpretivist approaches depending on the circumstances they encounter. They pragmatically adopt whichever tool or approach they deem necessary in any given situation.

The issue lies not in whether the current paradigms provide enough categories to encompass the wide range of design practices, but rather in the limitation of this type of theorizing to fully accommodate such diversity on its own. There cannot be a single paradigm of design, but rather, there could be numerous paradigms that are empirically verifiable through practice. The existence of such a vast array of theories makes the idea of a unified theory impractical. However, when the complexity and multiplicity of reality require plurality in paradigms, it does not preclude communication among them.

Ignoring the multiplicity of realities in design practice to build a comprehensive theory assumes viewing design not as a discipline, but rather as a research field independent of its academic structure; education, profession and research. However, as Wang and Ilhan stated, design knowledge isn't a distinct "third area" of knowledge apart from the sciences and humanities, as proposed by Cross [75]. Instead, the central challenge in defining design as a discipline lies in understanding not the content of its knowledge, but its creative act, including any general knowledge that aids in the creative process, as it shapes its identity within the larger cultural context [75].

In the multi-paradigm perspective, theory building aims not to reach a reality but to reach the scope of reality [47]. Considering that each design process is unique and unrepeatable [76], it seems that it is not possible to reach a universal pattern in a design theory based on practice. To get the scope of reality in the discipline, various paradigms of the practice must be evaluated on the same basis that the proposed research strategy offers. Grounded theory facilitates the development of a qualitative research matrix, which is adept at identifying common and distinguishing parameters influencing design activities, regardless of whether they belong to the same paradigm or not, and it permits the application of the constant comparative method. Meanwhile, activity theory aids in interpreting the meanings of these parameters specific to the activity and the various relationships among these factors. However, the inevitable limitation in every scientific research is the number of activities from which the researcher can access data in design research based on practice that focuses on theory development. It is believed that the model created for analyzing industrial design activities through the hybrid use of grounded theory and activity theory can overcome this limitation due to its openness to articulation.

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Conflict Management in Collaborative Learning in Architectural Education

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Abstract

Construction is a collaborative process where different stakeholders work together for the same goal. Although teamwork is one of the essential points of the construction process, architectural education is mostly designed as an individual process or as a team consisting of architecture students. There are many advantages for architecture students to work in a collaborative environment from different professions. However, as in professional life there are some negative features of teamwork such as conflict. It has been stated that performance of a construction process can be improved by managing the relationship between the stakeholders, and conflict resolution has an important effect on the quality of relationship.This study is conducted to analyze the conflict management styles of architectural students in an interdisciplinary collaborative project-based environment. The project was designed with teams of students that are from the department of architecture and computer engineering. Rahim's ROCI-II scale is used to define five styles of handling conflict which are integrated, obliging, dominating, avoiding and compromising. When the results are analyzed , it has been found out that most of the architecture students choose integrating and compromising conflict management styles

1. INTRODUCTION

Construction is a sector in which many stakeholders from different proficiencies work together around the same goal [1, 2, 3]. The stakeholders of construction work together through a very complex process therefore the collaboration among them is crucial. Architecture is mostly perceived as a single designer problem solving activity, but it is more a collaborative process [4]. When different stakeholders from architecture, engineering and construction work together as integrated teams, the process becomes more efficient by avoiding rework [5]. Collaborative working in construction has many advantages however, it is very important to manage the relationship and conflicts that arise because of different perspectives. It has been stated that the performance of a construction process can be improved by managing the relationship between the stakeholders, and conflict resolution has an important effect on the quality of the relationship [1].

Although architects and engineers work together as a team in the professional environment, in universities the architectural education is not designed to experience working in collaborative interdisciplinary teams. The collaborative characteristic of the construction process makes it necessary for architecture students to experience a collaborative process in their education. Thus, teamwork in architecture courses can be interpreted as a representation of professional life where design is a collaborative activity [6]. Researchers suggest interdisciplinary project-project-based experiences for design students to prepare them for a collaborative professional environment. Also, when we analyze the situation from the perspective of the students, in Ali's[7], research students stated that collaborative learning is extremely important as a prospective to real-life situations and they generally described the collaborative process as "positive". Also, many researchers [8,9] found out that collaborative learning in architecture has a direct effect on learning by increasing the motivation of the students. The researchers stated that there is a need for a multi-discipline collaboration in architecture and engineering education [7]. Some researchers stated that at least one year of collaborative interdisciplinary project provide experience for students [3] Also, the study of Chioccio et al. [3] shows that even short term projects can provide interdisciplinary experi-

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ence in terms of conflict and collaboration. Interpersonal conflict can be divided into two categories as task conflict and relationship conflict. Task conflict involves conflicts related with the completion of a goal while relationship conflicts are emotional and personal. Conflict can both have a negative and a positive effect on the process and it has been stated that while task conflict can have a positive effect on the process, relationship conflicts have negative effects [1]. In this study, task conflicts are taken as a base for the questionnaire.

This study is conducted to analyze the styles of conflict used by architecture students during teamwork. The main aim of this study is to clarify the most frequently used conflict management style- that can be used as an input when designing collaborative learning environments in architecture schools and to enable architecture students to explore their conflict resolution styles for their personal development- by architecture students. The research is conducted for a one term collaborative learning process with the group of first year engineering and architecture students. Since there is no research based on conflict management styles of architecture students in a teamwork using the Rahim's ROCI-II scale, the Rahim Organizational Conflict Inventory is used to define five styles of handling conflict which are integrated, obliging, dominating, avoiding and compromising [10]. The findings of the study can be an input to design new collaborative courses in the following years of architectural education and also add courses that focus on managing the communication and conflicts between different stakeholders of the construction process.

2.COLLABORATIVE LEARNING IN ARCHITECTURE

Collaborative learning is a strategy in which small groups of students of different capacities work together to learn a subject and also help other team members to learn [9]. Because architecture is a collaborative profession, collaborative learning in architectural education has the advantage of being close to professional life. The traditional education in architecture is teacher-centered but collaborative learning is opposed to this approach and is learner-centered [8]. The study of Emman et al. [8] found out that collaborative processes in architectural education increase the motivation of the students. Also, this learning approach creates an environment where students share their knowledge and increase their learning capacity by using learning tools.

Ceaser Pelli stated that even if the students are ready for the practice of architecture, they see themselves as individual designers [8]. Crosby [4] states that architecture studios deal with the individual but architectural practice mostly requires collaborative work [8]. Also the collaborative design process is very important in developing a dialogic practice between different stakeholders of construction work. However, architectural education mostly focuses on craft and professional vision. It is important for students to learn how to deal with a number of variables and conflicting values from different stakeholders for their professional life [2]. In design education, it is stated that teamwork can lead to development in students by building interpersonal and critical thinking, moving students to active learning, improved peer learning and development in lifelong learning [11]. In the research of Emam et. Al [8], a case study is conducted to make a comparison between traditional teacher centered teaching approach and collaborative learner centered approach in terms of effectiveness in teaching and learning processes. It has been found out that collaborative learning is effective in increasing the motivation of students and creating an environment to help students share knowledge.

There are many advantages of working in a collaborative environment for an architecture student such as being an active problem solver, public presence, learning group expectations, collaborative work instead of being competitive with peers [8]. The nature of architectural education is focused on a project based and open ended problem where each student has his own approach to solve, many conflicts can arise when they work as a team. Also it has been stated that collaborative learning in architecture has a positive impact on academic integration, social ties between students, behavioral integration through participation, managing the design process, managing the time, problem solving and critical thinking [9]. Thompson et al. [12] stated that teamwork and collaborative practices in architecture have many advantages and disadvantages, however the feedback collected from students is mostly positive. It is said that working in groups is valuable and that the application and development of interpersonal skills are

important for professional life.. , Naturally, because developing interpersonal skills are challenging, there are concerns about free-loading students within the group.

Besides collaborative learning in design education , there is also a crucial need for interdisciplinary collaborative learning. The aim of the interdisciplinary process in education can be defined as "deepen learning and teaching in order to acquire a more holistic picture of the complex phenomena of nature, society and real life" [13]. Collaborative learning is adapted to faculty of architecture as working in teams for the projects is often used, but interdisciplinary collaborative learning is not frequently used.

Construction is a process in which many stakeholders from different professions are involved. To improve the performance of the project, the relationship between these stakeholders should be managed carefully. When the professional work environment in construction is analyzed, it can be seen that collaboration is very crucial for construction work because management problems, communication problems and coordination issues extend the construction time. Besides extended duration in construction, collaboration has a positive effect on the quality of the process [3]. Also Arditi and Günaydın [5] stated that "lack of cooperation may result in inconsistent design, which then may cost extra time and money throughout the construction process". In multidisciplinary teams as design, stakeholders often have conflicting design options and have negotiation about these options, therefore having teamwork skills are essential for the players of the game [11]. Since construction is a complex process, conflicts between these stakeholders cannot be avoided [1].

As in the construction process, conflicts arise in collaborative learning environments. The study of Tucker and Abbasi [11] found out that most of the reasons for dissatisfaction from teamwork can be categorized as unfair assessment, individual differences in the team, conflicts that arise from the process of design, team formation and task design. Working in multidisciplinary teams raises the type of conflicts however, integrating different disciplines in construction is a very important opportunity for students to learn from each other and also experience challenges that can arise in the professional working environment [7].

In Turkey, different professions work together in the design and construction process, and they are educated in different faculties; this in turn makes collaborative learning more difficult. It has been stated that bringing individuals from different professions together has the advantage of developing insights to complex systems. The research of Ali [7] concluded that although many conflicts arose, the students from different professions found the collaborative learning process very useful and generally defined the experience of working with a student from another discipline as positive.

3.CONFLICT IN COLLABORATIVE LEARNING

However, most researchers [2,4,8,9,11] stated that collaborative learning in design and architecture has a positive effect and important advantages for professional life, it is important to manage this process. If conflicts during teamwork are not managed appropriately, they can be harmful for the relationship and affect the team performance in a negative way. The term conflict has many definitions. For example Rahim and Magner [10] defines conflict as such "conflict is a process manifested in incompatibility, disagreement, or dissonance within or between social entities". Conflict can be defined as a kind of disagreement that is caused by limited sources of the organization [14]. Also Wall and Callister [15] defined conflict as ''a process in which one party perceives that its interests are being opposed or negatively affected by another party''. In this study conflict can be defined as "a process that comes out in disagreement or dissonance between individuals that work for the same project".

Jehn [16] stated that there are basically two types of conflicts being task-focused and relationship focused . Both types have an effect on the outcome of the project by decreasing mutual understanding and spending time by conflict resolution. Jehn also stated that there is a third type which is called process conflict. These three types of conflicts sometimes can be related to each other. For example, if a task or process conflict cannot be solved, it then becomes a relationship focused conflict. Kurtzberg (2005) defined three kinds of conflicts which are task based conflict, relationship based conflict and process based conflict. Task based conflict is related to the discussions about the work being done, relationship based

conflict is related with the interpersonal relations within a team and process based conflict is related with how the work is done. Different types of conflicts affect the outcome of the project in a different way. Task and process oriented conflicts might have a positive effect on the outcome, but relationship focused conflicts have a negative effect. The research of Jehn [16] showed that groups that have a high level of relationship focused conflict, have lower performance than the other groups. It has been found out that relationship conflict has a negative correlation with performance. In this study, students have a common goal which is given to them as a brief of a project. The aim of the project is same for all students so the task based conflicts are eliminated but relationship based conflicts cannot be eliminated because at some point of the process if the process based conflict cannot be solved, as Jehn [16] stated, they can turn into relationship based conflicts.

Many researchers stated that if the conflict cannot be managed effectively, there will be some negative effects of conflict in a team such as, reduced creativity, decreased individual satisfaction and decreased team performance [3]. Kurtzberg [17] stated that interpersonal interactions, as conflict, influence the creative process. The disagreements about a problem can lead individuals to think of different possible solutions through the process. Also researchers demonstrated that conflicts in a creative process, like architecture, can bring new perspectives and viewpoints to the design problem. The study of Kurtzberg [17] has remarkable conclusions on the effect of conflict on the creative process. It has been stated that relation based and process conflict have a negative effect on the perceived creativity. Besides, task conflict has a negative effect on creativity on the first day, it has a positive effect after the day of the conflict.

Rahim [10] stated that there are functional and dysfunctional outcomes of the conflict in an organization. Functional outcomes are improving decision making process, encouraging innovation and creativity, finding synergistic and alternative solutions to the problems, enhancing individual and team performance and encouraging team and individual to clarify their position. However there are many functional outcomes, there are dysfunctional outcomes of the conflict that lead to job stress and dissatisfaction, reducing the communication lines, creating an environment of distrust and suspicion, damaging the relationship, reducing the job performance and increasing resistance to change [18].

4. CONFLICT MANAGEMENT STYLES

While conflicts that arise during the collaborative process may have a beneficial outcome, it is critical to manage these conflicts that will have an important effect on team performance. Effective conflict management has a positive effect on the team performance, satisfaction and team viability [18].There are many studies which are focused on the causes of conflict in teams. The research of Abbasi et al. [18]focuses on the team conflict among design students. This research concluded that there were four different causes of conflict in student design teams as non-contributing team members, differences among team members, dominant team members and lack of communication among team members.

Although task conflict has a positive effect on the performance and is helpful for the team, how you manage the conflict is a critical determinant of the performance of the team [3]. Mostly, researchers focused on conflicts between groups which have different goals but based on effectiveness of the group productivity conflict in groups with a common goal is also important [16]. When people that have a common goal have a conflict, they do not conflict about the goal, it is about the process of reaching that goal. As Jehn [16] stated, studies show that conflict can have a positive effect for the task-related organizations because the members have a common goal. Usually, people cannot work effectively even if they have a common goal and experience conflict.

Conflict management styles also have an important effect on the relationship of the two parties [1]. Conflict management styles can be defined as integrating, compromising, dominating, obliging and avoiding styles. Integrating has high concern both on self and the others so it can be called as win-win style. It has a positive effect on the quality of relationship . Obliging style represents high concern for others and low concern for self, it is not a win-win situation but it is stated that this has a positive effect on the relationship. Compromising style means that both parties should sacrifice their interests. Although it seems as an optimal style for satisfaction of both parties on some level, it is not. Losing interest increases dissatisfac-

tion therefore compromising has a negative effect on relationships as a conflict management style. Both dominating and avoiding conflict management styles have a negative effect on the relationship because of the low concern for the other party [1]. It has been stated that conflict resolution is related with the level of anxiety and depression because conflict resolution style is important for the individuals related with the social environment [18].

5. METHODOLOGY

This research is based on a project that is held both in the department of architecture and in the department of computer engineering. The project was to design a sustainable urban furniture that gives opportunity to people to gain tickets or to charge their batteries etc. There were 41 architecture students and 18 computer engineering students in the project but the questionnaire was applied only to architecture students to have an idea about conflict resolution styles in interdisciplinary collaborative learning. Although it has been stated that questionnaires have some disadvantages for studying conflict management such as, sensitivity of the subject, validity of the questionnaires and self-serving bias, it can be an appropriate method for the subject conflict [19]. The validity of the questionnaire problem is solved by using a questionnaire existing in the literature.

There are many questionnaires defined in the literature for styles of conflict management starting with the Conflict Management Survey (CMS) in 1969. Rahim [20,21] constructed a scale for measuring the five styles of handling conflict which are independent and called ROCI-II. The questionnaire consists of 28 items with a 5-point Likert scale that are defined and analyzed for integrating, avoiding, dominating, obliging and compromising styles. Although Rahim's scale was conducted in 1982, there are more than 300 journals in all professions that used this method after 2016. Rahim used a scale that classifies interpersonal conflicts as; concern for self and concern for others. This classification is firstly used by Blake and Mouton [22]. Five styles of interpersonal conflict can be defined by using the scale of concern for self and concern for others. Integrating style involves high concern for others and high concern for self., obliging style involves low concern for self and high concern for others, dominating involves low concern for others and high concern for self, avoiding style involves low concern for others and low concern for self and finally compromising style involves moderate concern for self and moderate concern for others [21].

In the implementation part of the questionnaire, the recommendations of Nauta and Kluwer [19] are taken into account without using the word 'conflict'.. All students that are from architecture and computer engineering are first year students. The questionnaire is given only to architecture students in Turkey. The questionnaire was in English, so it is translated into Turkish and checked for accuracy. The scale of Rahim [20] is selected in this study to measure the conflict management style because this scale is widely used by the researchers [1].

6. FINDINGS AND ANALYSIS

The questionnaire consists of 28 questions and a five-point Likert scale was used to demonstrate students' perceptions. When the Cronbach's reliability test is applied to the research it has been found out that the study is highly reliable with the Cronbach's alpha 0,79. When the results of the questionnaire are analyzed, the results are as listed and can be seen at Figure 1:

Only 1 student out of 35 concluded as using the avoiding conflict management style.
5 students out of 35 concluded as using the dominating conflict management style.
15 out of 35 students concluded as using the integrating conflict management style.
10 out of 35 students concluded as using the compromising conflict management style.

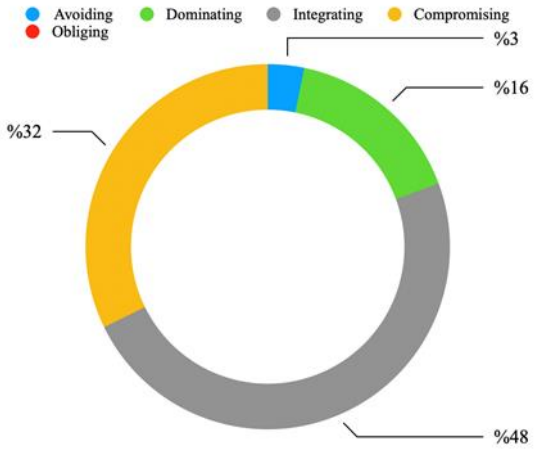

Figure 1. *Conflict Management Styles*

When the answers of the students are analyzed, it can be seen that first year architecture students mostly focused on the integrating and compromising conflict management styles. These results are consistent with the study of Lu and Wang [1], that focuses on the conflict management styles of owners' and contractors' employees working for the construction project. In both studies it has been found out that the most commonly used conflict management style is integrating, following with the compromising conflict management style.

Also in this study, it has been found out that the least used conflict management style is avoiding, which is consistent with the study of Lu and Wang [1]. Avoiding conflict management style is very rare and found out that only one student is using this conflict management style to solve the conflicts between team members. The obliging conflict management style is not found out as a chosen management style for any of the students. It can be interpreted as high concern for others and low concern for self is not an option for them. According to the literature [1]-, integrating conflict management style has a positive effect on the relationship quality. Integrating has a potential of exploring differences between parties and ended the conflict with a common solution. While compromising is selected as the second most used conflict management style by architecture students, compromising is harmful for the relationship quality in the interpersonal level [1] and it is not recommended to manage conflicts effectively. But this result can differ according to the organizational culture. For the following research, it is suggested that compromising conflict management style can be analyzed based on the organizational culture of the construction sector.

7. CONCLUSION

Construction is a sector where many stakeholders work together in a very complicated process. Because of the complicated and stressful nature of the process, many conflicts can arise among these stakeholders. If these conflicts cannot be managed carefully, they can have a negative effect on the performance of the project. The conflict resolution process should start at architectural education to prepare the students for professional life. Also, the collaborative nature of architecture is very important for practicing the relationship between different stakeholders. It has been stated that performance of a construction process can be improved by managing the relationship between the stakeholders, and conflict resolution has an important effect on the quality of relationship .

There are many studies that focus on conflict management in architectural practice, however, there are very few studies about the conflict in architectural education. The importance of this study is focusing on the conflict management styles of students in a multidisciplinary environment which is very close to professional life.

The results of this study are analyzed to find out the most frequently used conflict management style of architecture students in a first year project-based studio. It has been found out that architecture students tend to adopt integrating and compromising conflict management styles in Turkey. Avoiding conflict management style is the rarest used management style according to the findings.

The results cannot be generalized, but they can help us design more interdisciplinary collaborative learning environments in schools of architecture and help architecture students to understand their conflict management styles for personal development.

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Iconic Buildings Constructed with Competition Projects in Turkey in The 20th Century

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Abstract

Iconic buildings, which stand out among the architectural elements that are part of the city identity, expressing the uniqueness and character of cities, are the buildings that integrate with cities, come to mind first when defining them, and carry symbolic value. These buildings can be historical and cultural heritage buildings constructed centuries ago, or they can be buildings constructed according to the functions, technologies and architectural styles that emerged, developed and changed with the 20th century. Architectural project competitions organized open to national and international competitors have become a frequently preferred method in constructing these buildings. Within the scope of the study, the iconic buildings built as a result of architectural project competitions, which emerged as a local dynamic in Turkey's 20th century architecture, are analyzed. From among the competition projects built between 1930 and 2000, with a subjective perspective, the most well-known buildings that have gained a place in the city memory, as an architectural icon in defining the city, have been selected and analyzed in terms of their architectural characteristics and the symbolic values they add to the city. In addition to the fact that these buildings were designed by a well-known architect, their architectural characteristics, functions, social, political and symbolic values they carry and their location in the city have turned them into iconic buildings for the city.

1. INTRODUCTION

City identity, which refers to all the elements that define the uniqueness, character and spirit of cities, is a concept that defines the city to the outside world and includes historical and cultural heritage elements, social texture, geographical features and many other elements as well as architectural items. Among the architectural items that are a part of city identity, iconic buildings that carry symbolic value in cities come to the forefront. Iconic buildings of cities generally mean buildings that represent an important part of a city in terms of history, culture, social and architecture and that are integrated with that city. In addition to being the most well-known and visited buildings, these buildings are also considered by people as symbols of cities. These types of buildings usually attract the attention of everyone in every period, are considered as a sign for the city they are located in, and create visual value for the city dwellers with their forms as well as their functions. For example, the Eiffel Tower in Paris, Big Ben (Elizabeth Tower) in London, the Opera House in Sydney, the Sagrada Familia in Barcelona and the Burj Al Arab in Dubai have become globally recognized symbols not only of their cities but also of their countries. Such iconic buildings become part of city identity and add cultural, social and architectural value to cities.

Architectural project competitions are frequently preferred as a method of constructing these iconic buildings in cities. Competition culture in architecture is a very old tradition and the first known example dates back to the 5th century BC. The Acropolis War Memorial, built in 448 BC, is a building that was built as a result of a public vote. In 1401, it is known that the door of the Florence Cathedral, which is accepted as the symbol of the Renaissance in Florence, Italy, and its dome in 1419 were obtained through a competition project [1]. Later, a competition was organized for the construction of the "Spanish Steps" in Rome in 1723 [2];[3]. According to Sudjic [4], architectural project competitions in the modern sense

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date back to the 18th century, when Thomas Jefferson proposed a competition for the design of the Washington Capitol. The White House in Washington (1792-1830), the London Parliament (1836-1870) and the Eiffel Tower (1886-1889), which can be considered among the most iconic buildings of our day, are examples of buildings that were obtained through competitions [1]. When we look at the iconic buildings in Europe and America today, it is seen that some of them were also obtained through competitions. 45 examples of these "iconic" buildings from the 15th century to the present day from different cities around the world are summarized in Figure 1. The studies of Spreiregen [5] and Haan and Haagsma [1], who examined global examples of architectural project competitions, were the sources for the selection of these buildings. These examples include some of the most iconic buildings of 20th century architecture such as the Centre Pompidou, the Gateway Arch, the Jewish Museum and the Sydney Opera House.

Within the scope of the study, the iconic buildings obtained as a result of architectural project competitions, which emerged as a local dynamic in Turkey's 20th century architecture, are analyzed in terms of their architectural characteristics and the symbolic values they add to the city. From among the competition projects applied between the years 1930-2000, with a subjective point of view; the most well-known buildings that have a symbolic value at the city scale, that have gained a place in the city memory, and that come to mind first as an architectural item in defining the city have been selected.

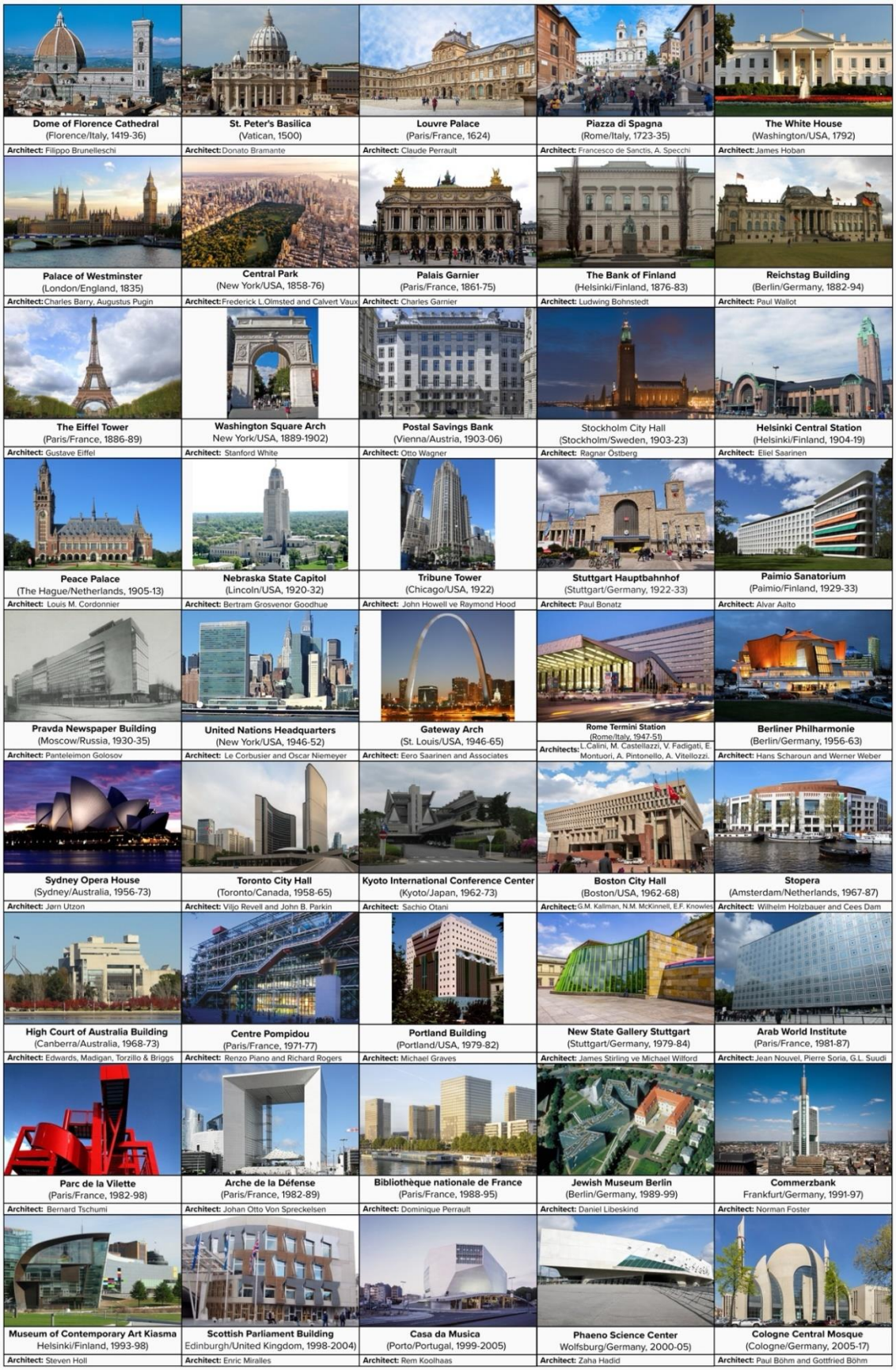

Figure 1. *Iconic buildings obtained through competition projects in different cities of the world from the 15th century to the present day*[1]

[1] Images taken from https://en.wikipedia.org

2. ARCHITECTURAL PROJECT COMPETITIONS IN TURKEY

Competitions were seen as a tool that was taken very seriously in the realization of the cultural breakthroughs made in the early years of the Republic. The fact that obtaining buildings through competitions is seen as a Western method is one of the most important factors in the adoption of competitions. Especially in the early years of the Republic, architectural project competitions were not only a way to obtain a project, but also played an effective role in the dissemination and adoption of modern architectural discourse and construction in Anatolian cities. These competitions contributed to the formation of a modern architectural identity in Anatolian cities and constituted an important part of Turkey's 20th century modern architecture.

Competitions, which can be handled in a wide framework from the scale of a single building to the scale of zoning plans, are the locomotive for the development of the architectural profession in Turkey, the integration of international movements into the local environment and the change of the face of cities. Thanks to competitions, academic architects have the chance to put into practice a subject they have mastered theoretically, while architects working in the private sector have the chance to reflect their ideas freely without investor pressure. In fact, it is possible to say here that practice feeds theory, theory gives direction to practice and mutual benefit is achieved. For young architects who are new to the profession, competition projects are seen as a tool that provides the necessary opportunities to become visible in the sector, gain prestige and get new jobs. In addition to the benefits of being selected as the first or winning first place in the competition, just being a competitor provides architects with the experience of developing ideas, strengthening their design skills, and working together with different disciplines (such as investors, politicians, planners, engineers, etc.). Architects such as Sedat Hakkı Eldem, Emin Onat, Turgut Cansever, Behruz Çinici, Hayati Tabanlıoğlu, Doğan Tekeli, Sami Sisa, Merih Karaarslan, Şaziment-Neşet Arolat, Erdoğan Elmas, who are known as important names in terms of the profession and history of architecture in Turkey today, started their careers with architectural competitions and gained their popularity through competitions.

Various documents give different dates for the beginning of architectural project competitions in Turkey. According to Cezar [6], the first competition in Turkey was organized in 1867 for the British Embassy Summer Residence in Tarabya. He states that the competition was organized in England due to the unfavorable conditions in the country at that time, but there is no information on its construction. According to Özkan [7], the first competition was the Turkish-German Friendship Foundation competition organized in 1916. Among the participants in this competition, which did not proceed to the building phase, were names such as Paul Bonatz, Teodor Fisher, Hans Poelzig and Bruno Taut. According to Batur [8], the first competition after the declaration of the Republic is the Ankara City Plan competition held in 1927. According to Mimar Journal [9], the first officially published national architectural competition is the Bursa Municipality Hal Building competition in 1930. Architect Hüsnü Bey's project was selected first among the four projects participating in the competition. Following this competition, which could not be practiced, the Elazığ (Elaziz) Municipality Cinema Hall competition in 1931, in which Architect Şevki Eşref won the first prize, is the first competition to be practiced.

The period from 1930 to 1945, the official start of the competitions, marks the end of World War II for the world, the end of single-party political life and the transition to multi-party-political life for Turkey, and for the competitions, the period when the government sees architecture as a cultural policy for modernization. With the emergence of Turkish architects on the scene in the competitions of this period, it is seen that designs in a modern style, far from ornamentation reflecting ideology, are preferred.

The period 1945-60, from 1945 until the military intervention of May 27, 1960, is a period in which rationalist examples were shown in the International Style in terms of architectural styles. In this period, the Ministry of Public Works is the biggest employer in the architectural sector with its architectural project competitions. Among the competitions opened in this period, the Istanbul Palace of Justice in 1949, in which Sedad Hakkı Eldem and Emin Onat's project won first place, and the Istanbul Municipality Hall competition in 1953, won by Nevzat Erol, are very important in terms of architectural history. While the traces of a transition towards an international modernism can be seen with the Istanbul

Palace of Justice, with the design of the Istanbul City Hall, the International Style begins to be accepted and appreciated. The impact of the International Style is clearly seen in the design of many public buildings constructed after this building. Examples of these buildings include the Sakarya Government House (1955), Adıyaman Government House (1958), Kırşehir Government House (1958), Tekel General Directorate (1958), Ankara Cebeci PTT Central Station Building (1958), and General Directorate of State Hydraulic Works (1958).

After 1960, in parallel with increasing professionalism and a growing economy, more Turkish architects began to follow architectural discussions on a global scale [10]; the one-piece horizontal monoblock mass of the International Style became a common form in this period, which was handled as small and multi-part blocks [11]. While the effect of the International Style continued, brutalist approaches and local interpretations were also integrated into the designs. In addition, the period between 1960-80 was a period in which the number of competitions increased significantly and low-cost and economical alternatives were in demand.

In terms of architectural style, modernism lost its popularity after 1980 and was replaced by postmodernism. In terms of competitions, with the amendment made to the competition regulations in 1980, the requirement for the presence of the Chamber of Architects in the juries was abolished and the jury selections were left to the discretion of the administrations. This change in the nature of the jury was inevitably reflected on the competition projects and the selection of the awarded projects.

The 1980s can be seen as a more dynamic and exciting period in which repetitive building typologies and plan solutions were broken and a new way out was sought, and local syntheses emerged with Western movements. With the 2000s, the profile of participants in competitions changed and the number of young architects increased [12].

Although the number of competitions in the field of architecture in Turkey is quite limited when compared to the total number of building projects, when we evaluate the leading buildings of 20th century architecture, it is seen that the buildings obtained through competitions have found a wide place for themselves. As a matter of fact, in 2003, in its 311th issue, the Journal of Mimarlık organized a survey among its readers titled "20 Leading Works of Contemporary Architecture in Turkey (1923-2003)" (Türkiye'de Çağdaş Mimarlığın (1923-2003) Önde Gelen 20 Eseri) and published the results of the survey [13]. According to the results, it was seen that 7 of the 20 buildings with the highest number of votes were buildings that were obtained through competitions[2].

3. EXAMPLES OF ICONIC BUILDINGS CONSTRUCTED THROUGH COMPETITIONS IN TURKEY

Between 1930-2000, 672 architectural competition projects were opened[3] and 324 of them were applied. From this point of view, it is possible to say that the application rate of the projects is approximately 50%. Some of these competitions that have been applied have become the iconic buildings of the cities due to reasons such as their architectural styles, designs, functions, locations, and the social and cultural values they carry. These buildings are among the most symbolic and recognized buildings of their cities. These iconic buildings are analyzed in order of their architectural characteristics and the symbolic values they add to the city, in order of the date of the opening of the competition.

[2] The first 20 buildings (those built with the competition project are in bold): 1. Turkish Historical Society, Ankara, 1967 **2. METU Campus, Ankara, 1961-80 3. Sergievi, Ankara, 1934** 4. Zeyrek Social Insurance Institution, Istanbul, 1970 **5. Milli Reasürans, Istanbul, 1987** 6. Ankara Station, 1937 **7. Anıtkabir, Ankara, 1953** 8. Ankara University Faculty of Language and History Geography, 1937 9. Parliament Mosque, Square and Worship Library Complex, 1987 10. Hilton Hotel, Istanbul, 1954 **11. METU Faculty of Architecture, 1963** 12. Florya Presidential Naval Pavilion, Istanbul, 1936 13. BDDK Building, Ankara, 1976 14. Turkish Language Association Building, Ankara, 1978 **15. İller Bank, Ankara, 1937** 16. Istanbul University Faculty of Science and Literature, 1944 17. Emek İşhanı, Ankara, **1959 18. Büyükada Anatolian Club, Istanbul, 1959** 19. Demir Holiday Village, Bodrum, 1983 20. Atatürk Cultural Center, Istanbul, 1966.

[3] Based on http://www.mimarlarodasiankara.org/yarismalardizini/ page.

3.1. Ankara Exhibition House Building (Ankara Sergievi Binası)

In the first years of the Republic, in 1933, two projects were selected first in a competition open to international participation; since Paolo Vietti Violi's project was deemed too costly, it was decided to apply the project of the other winner, Şevket Balmumcu [14]. Built in 1934, the building carries the marks of Art Deco and Streamline Moderne movements with its geometric form and simple design, as well as its circular mass, clock tower and window arrangements (Figure 2). With its design, the building became the most modern and interesting building in the city at the time. German architectural historian Bernd Nicolai considered the Exhibition House as "the most outstanding work of modern architecture in Ankara" [15];[16]. Until 1946, the building was used for the same function and it was decided to convert it into an opera house and the conversion was carried out by the German architect Paul Bonatz under the influence of "II. Ulusal Mimarlık". During this conversion, the modernist lines in the design were greatly interfered with. Reopened in 1948, the tower was removed, window proportions were changed, various ornaments and porticoes were added (Figure 3). Although it was exposed to formal and functional changes, the building, as a public building of the Republican period, provides information about the architecture, economy and politics of the period. In addition, it gave its name to the square by being Ankara's first opera hall and by its symbolic qualities in the square where it is located. The square, which was known as "Hergelen Square, Fire Brigade Square" before this building [17], started to be called "Opera Square" afterwards.Today, it continues its existence and symbolism in the city under the name of Grand Theater/Opera (Figure 4).

Figure 2. *Exhibition House Building [18]*

Figure 3. *Opera House after conversion [19]*

Figure 4. *Grand Theater/Opera [20]*

3.2. Istanbul Port Galata Passenger Hall (İstanbul Limanı Galata Yolcu Salonu)

In 1936, three first prizes were awarded in an international competition, Rebii Gorbon's project was selected for application, and the building was completed and put into use in 1940 (Figure 5). During the construction of the building located on the Karaköy coast, the sea was filled and bored pile foundation was applied. Turkey's first modern sea passenger departure and reception hall, the building also has a symbolic significance within the nationalization efforts of the Republic [21]. The Passenger Hall (Figure 6), one of the symbols of modernist language in Istanbul, contains functional elements, unique qualities and monumental forms such as the Passenger Hall tower [22]. The building was actively used in the same function until 2014 and became one of the landmarks of Karaköy and the Bosphorus silhouette [23]. In addition to being one of the unique examples of Republican architecture, the building is also one of the witnesses of the changing social life with modernism. In addition, the Liman Restaurant, located on the terrace of the building, served the city until 1994 and became one of the important places of the city's social life. Registered in 2002 by the Conservation Committee (Figure 7), the building was demolished overnight in 2017 as part of the Galataport project. With this demolition, one of the symbolic buildings of the Republic and Istanbul was lost.

Figure 5. *Karaköy Passanger Hall [23]*

Figure 6. *Grand Hall [21]*

Figure 7. *Karaköy Passanger Hall [23]*

3.3. Grand National Assembly of Turkey (TBMM)

In 1939, a competition was organized open to international participation to design the symbol of the authority of the state. 14 projects participated in the competition; three projects were awarded the first prize as a result of the jury's evaluation. It was decided to apply Clemens Holzmeister's project, which was also admired by Mustafa Kemal Atatürk, and a long construction process began [24]. After Holzmeister's return to his country in 1948, the project was continued by his assistant Ziya Payzın and the TBMM building was completed and opened in 1961 (Figure 8). The building, which bears the characteristics of the "II. Ulusal Mimarlık" style with its monumentality, strong and durable expression, symmetry and materials used (Figure 9), is a monument symbolizing the ideals of the Republic [25]. In addition, the TBMM building is an important representative of modern architecture and is the political center of the country and the symbol building of Ankara (Figure 10).

Figure 8. *TBMM [24]*

Figure 9. *TBMM [26]*

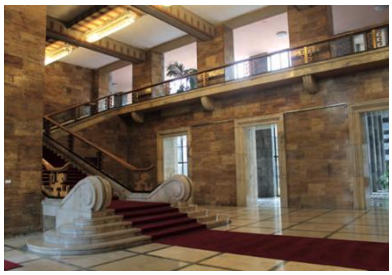

Figure 10. *Hall of Honor entrance [24]*

3.4. Anıtkabir

Anıtkabir was designed by Emin Onat and Orhan Arda, two of the most important architects of the Republic, who won the first prize in an international competition in 1941. It was built on an arid hill formerly known as Rasattepe. The building complex, located at the highest point of the hill, which was covered with thousands of trees after the completion of construction, covers an area of approximately 750 thousand square meters. The Anıtkabir building consists of columns surrounding a rectangular prism and carries the characteristics of the II. Ulusal Mimarlık movement with its monumental appearance, symmetry and use of materials [27]. In addition to many architectural elements referring to the ancient roots of Anatolia, ornaments from Seljuk and Ottoman motifs are also included in the building. Anıtkabir, the symbolic structure of the Republic of Turkey and Ankara, is an iconic example of the II. Ulusal Mimarlık movement as well as representing the values of the Turkish nation and the Republic. Anıtkabir, the final resting place of Atatürk, the great leader of the Turkish nation, is visited by millions of people every year. In addition, Anıtkabir is also the center of Turkish political life and programs are organized during national ceremonies and important days. (Figure 11).

Figure 11. *Anıtkabir [20]*

3.5. Çanakkale Victory and Unknown Soldier Monument (Çanakkale Zafer ve Meçhul Asker Anıtı)

The monument, also known as the Çanakkale Martyrs' Monument, was built in 1944 as a result of a competition. Feridun Kip, İsmail Utkular and Doğan Erginbaş's project was selected first in the competition organized to commemorate the martyrs of Çanakkale and keep their memory alive. The 42-meter-high monument, the foundations of which were laid in 1954, was opened to visitors on August 21, 1960; it was declared a "national park" in 1973. The Çanakkale Martyrs' Monument is one of the most important monuments in Turkey after Anıtkabir. With its symmetry, stone cladding and simple expressions, the monument carries the traces of National Architecture II. It is the first monument built with reinforced concrete system and was the first monument of this scale in Turkey at the time of its construction. Doğan Erginbaş, one of the architects of the design, stated that the monument represents the ascension of all martyrs from different countries. The form of the monument was inspired by the triumphal arch of Roman architecture and prehistoric dolmens. When the monument is viewed from a distance, the letter M for "Mehmetçik" can be seen. The monument commemorates the Turkish soldiers who were martyred in one of the bloodiest battles of history in Gallipoli during World War I [28]. This war is very important in terms of Turkey's history and world history and has caused many things to change on the stage of history. The monument is an iconic building that carries symbolic and spiritual values at the city scale, country scale and even global scale and has a memory for the whole world (Figure 12). It is the sad and at the same time proud memory of the place embodied in the structure. It is a meeting point where all hearts that have the same feelings with the Turkish nation beat together.

Figure 12. *Çanakkale Victory and Unknown Soldier Monument [20]*

3.6. Istanbul Open Air Theater (İstanbul Açıkhava Tiyatrosu)

The Istanbul Open Air Theater, designed by Nahit Uysal and Nihat Yücel, who won the competition in 1946, is located in the Harbiye district, the center of the city's culture and arts activities, where buildings such as the Lütfi Kırdar Congress and Exhibition Center, Istanbul Radio House, Harbiye Military Museum, Hilton Hotel, and Istanbul Congress Center are the symbols of modern Istanbul. The building was designed inspired by the forms of open air theaters in the Ancient Age [29]. The symmetry, simplicity and the use of cut stone in the design reflect the characteristics of the "II. Ulusal Mimarlık" movement. The Open Air Theater is one of the new building typologies brought by modernism in the 20th century as a continuation of the westernization movements that started in the 19th century. It is also one of the most important buildings in the Gezi Park, reflecting the modern and secular character of the young Turkish Republic and included in Prost's plan. It has played an important role in the adaptation of society to modern life through culture and arts activities. Hosting many festivals and concerts every year, Harbiye Open Air Theater is one of the most prestigious concert and event places in Istanbul (Figure 13).

The theater, which allows the audience to watch an open-air show and watch the Bosphorus view from the backstage, also provides a suitable environment for the activities of the artists in terms of acoustics. It is a symbolic building that has witnessed the culture and art life of Istanbul from the 1950s to the present day.

Figure 13. *Istanbul Open Air Theater [20]*

3.7. Anadolu Club Büyükada Hotel (Anadolu Kulübü Büyükada Oteli)

The Anadolu Club, headquartered in Ankara, was first established at the request of Atatürk as part of a Western lifestyle, and its Büyükada branch was opened in 1937. As a result of increasing needs, an architectural project competition was organized in 1952 to build a new building in Büyükada and the project of Turgut Cansever and Abdurrahman Hancı, two of Turkey's leading architects, won the competition. Applied between 1953-57, the building's white façade and prismatic block with a terrace roof overlap with Le Corbusier's principles of modern architecture (Figure 14). The design is also inspired by the pure geometric forms of the Turkish House and includes traditional architectural elements such as trellis [30]. In this way, modern architecture was integrated into the locality and a unique design was created. Awarded the 1957 Aga Khan Architecture Award, the design is one of the most iconic buildings in Büyükada.

Figure 14. *Anadolu Club Büyükada Hotel [20]*

3.8. Eskişehir Porsuk Hotel

Organized in 1956, the competition was won by Vedat Dalokay, one of the most important names of modern architecture in Turkey, and the project was completed between 1956-59. The building is in the style known as the "Hilton effect", an expression of the International Style that emerged first in hotel buildings and then in public buildings in the 1950s. The entrance block with its curvilinear roof and V-columns is the most unique part of the design [31]. The building has details that reflect the architecture, technique and technology (such as the installation floor, elevator use) of the period in which it was built. With its location in the city center and its architecture, it has become a part of the city identity as one of the landmarks of Eskişehir. It is a meeting and reference point for the city dwellers, one of the most memorable and effective architectural buildings of the city center (Figure 15). With its typology, it is one of the best examples of the hotels built in Anatolian cities in the 1950-60 period with the revival of the tourism sector in Turkey. The building is still in use with its original function.

Figure 15. *Eskişehir Porsuk Hotel [20]*

3.9. Izmir Municipality Hall (İzmir Belediye Sarayı)

Özdemir Arnas, Altan Akı and Erhan Demirok's project won the competition held in 1966 and the building was constructed between 1968-80 in one of the most important public squares of Izmir, Atatürk (Konak) Square, opposite the Clock Tower (Figure 16). Atatürk Square, where the building is located, is one of the three most important squares of Izmir (Gündoğdu, Cumhuriyet and Atatürk), defining the center of the city, connecting the two sides of the city, connecting with the commercial places in Kemeraltı, and is the most known and loved square by the citizens [32]. One of the public buildings that forms the boundaries of this square is the İzmir Municipality Palace (Figure 17). With its public function, location and architectural style, this building is one of the landmarks of Izmir and is the meeting point of the city. The design of the building, which is a special example of the International Style and Brutalism for Izmir, is similar to the Boston City Hall, which was built as a result of a competition in the USA in 1962 (Figure 1). However, after the October 30, 2020 Izmir earthquake, the building was evacuated due to the damage report and it was decided to demolish the building. Despite all the objections made after the decision, this iconic building of the city was lost in 2022.

Figure 16. *Izmir Municipality Hall on postcards [33]*

Figure 17. *Izmir Municipality Hall [34]*

3.10. Istanbul Harbiye Military Museum (İstanbul Harbiye Askeri Müzesi)

In 1967, Nezih Eldem's project was awarded the first prize in a competition with limited participants, and after a long application process, the building was completed in 1991. The museum was built in the former Harbiye Mektebi building complex, on Vali Konağı Street, one of the most lively streets of the Şişli district, in the void created by the section demolished in 1959 (Figure 18). The architect of the building, Nezih Eldem, is one of the pioneering modernist architects who possesses the material and detail knowledge of rational architecture with his academic identity, and an experimental and critical perspective [35] with his Italian background. The architecture of the museum, on the other hand, has unique details that Eldem designed in a modern style, free from stylistic worries. The majority of the exhibition elements in the museum are parts of the original design. In this building with a holistic architectural approach, which is rarely seen in the history of Turkish architecture, many details in the interior preserve their originality. With its holistic design, the building is one of the best examples reflecting the museology approach of the 1960-70s. At the same time, the 150-year-old historical building to which it is added is the building where Mustafa Kemal Atatürk and the founders of the Republic were educated. The concept of the museum is also very important in terms of showing how the country has reached today by passing through difficult conditions. The building is a landmark for the citizens and visitors to the city and continues to be used as a museum.

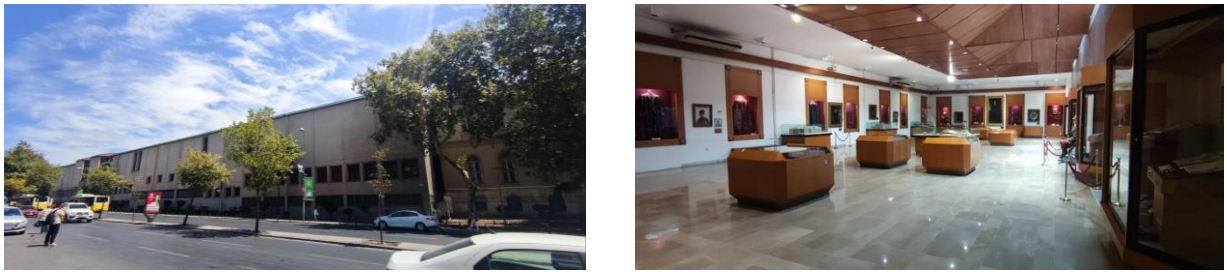

Figure 18. *Istanbul Harbiye Military Museum [20]*

3.11. Samsun Diyanet Site

In 1973, Vedat İşbilir and Sevinç Şahin's project won the competition and the building, known as Site Mosque, was built between 1976-85. The design, which is outside the traditional mosque form, consists of four arches on which a large reinforced concrete dome shell sits. The surfaces under the arches are covered with glass, allowing light to enter the interior [36]. The decorations in the interiors were also made by artists. This building, which goes beyond the classical style in mosque typology in terms of its modern design and the technology used, is also one of the iconic buildings of the city (Figure 19). In addition to its mosque function, the commercial places on the ground floor contributed to the dynamism of the center. One of these spaces, the tea house, has been a socializing place for university students for years. However, in 2021, its demolition was brought to the agenda within the scope of the Cumhuriyet Square conversion project, and the Chamber of Architects Samsun Office applied for conservation and registration. In 2022, after the registration request was rejected, the decision was taken to the judiciary. The future of the mosque is unclear for now.

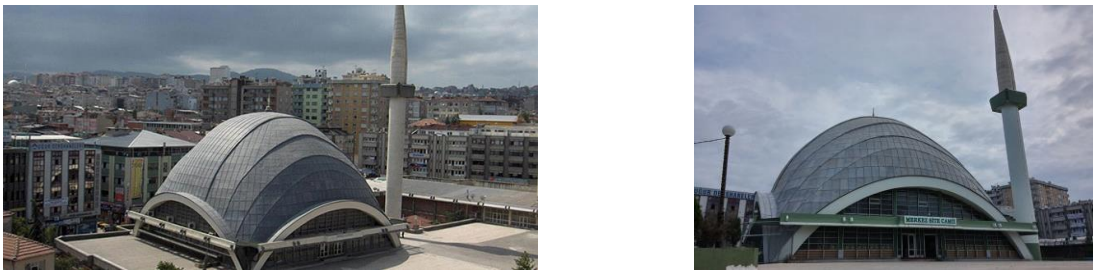

Figure 19. *Samsun Site Mosque [37]:[38]*

3.12. Atatürk Cultural Center (AKM Ankara)

In 1981, Coşkul Erkal and Filiz Erkal's project won the competition to design a symbolic and monumental building to commemorate the 100th anniversary of Atatürk's birth, and the building was constructed between 1985 and 1987. Designed in the form of a pyramid with a square base and a sectional pyramid, the building has an unusual architecture on the scale of Ankara and even Turkey (Figure 20). In addition to its function as a cultural center, the purpose of its building and its formal characteristics were also effective in turning AKM into an urban image. Due to the form of the building, unique details were developed in its structural solutions. Located in the hippodrome area on Istanbul Street in the Altındağ district of Ankara, the building includes a museum, library and exhibition halls. Over time, the building has moved away from its original function by being used only for city promotion days and book fairs; since the 2010s, the demolition of the building has been on the agenda due to its neglect. However, with the last planning made in 2021, it continues to exist within the "Başkent Millet Bahçesi" project.

Figure 20. *Atatürk Cultural Center [39]*

3.13. Atatürk Culture Center Presidential Symphony Orchestra Concert Hall and Choir Practice Buildings (CSO Ada Ankara)

In 1992, Semra Uygur and Özcan Uygur's project won the first prize in the competition, and the construction of the building, which started in 1997, was completed and put into service in 2021, 29 years after the opening of the competition. Located on Atatürk Avenue, overlooking Anıtkabir, it is one of the most important cultural buildings built in Turkey in recent times. With its bold use of basic geometric forms such as the triangular prism, sphere and oval, its monumentality, its incorporation of high techniques and technologies, and its care in material selection and craftsmanship, CSO Ada Ankara was honored with the Building Branch Award at the National Architecture Awards in 2022. The building, which has become a central focus on Ankara's culture and arts map, is also the first building in Turkey to be designed exclusively for symphonic music performance [40]. In addition to its contribution to city identity, the CSO complex has become one of the iconic buildings of the city with its function, architecture and belonging to the city.

Figure x. *CSO Ada Ankara [41]*

4. CONCLUSION

Iconic buildings, which stand out among the architectural elements that are part of the city identity, expressing the uniqueness and character of cities, are the buildings that integrate with cities, come to mind first when defining them, and carry the symbolic values of cities. These buildings may be historical and cultural heritage buildings constructed centuries ago, or they may be buildings built according to the developing and changing functions, technologies and architectural styles that emerged with the 20th century. Architectural project competitions organized open to national and international participants have been a frequently preferred method in constructing these buildings. The reasons such as the competitions being open to original ideas and bold designs, the selection of the "best" in terms of design and application as a result of the jury evaluation, and the integration of current techniques and technologies into the projects come to the fore in the preference of this method. As a matter of fact, when we look at the iconic and symbolic buildings in European cities in the 20th century, it is seen that some of them were built as a result of competitions (Figure 1). Similarly in Turkey, architectural project competitions, which emerged as a local dynamic in 20th century architecture, resulted in iconic buildings that have added symbolic value to cities. In this study, among the competition projects applied between 1930 and 2000, attention was paid to the selection of the most well-known buildings that have iconic value at the city scale, have taken place in the city memory and come to mind first as a visual element in defining the city. In addition to the fact that these buildings were designed by a well-known architect, their architectural characteristics, their functions, the social, political and spiritual values they carry, and their location in the

city have made them iconic buildings for the city. The TBMM Building and the Anıtkabir are examples of buildings that have become iconic on a national scale by transcending the city scale with the spiritual, social and political values they carry. It is possible to say that the Çanakkale Martyrs' Monument is an iconic monument that carries symbolic and spiritual value on a global scale and has a memory for the whole world. Karaköy Passenger Hall and Izmir Municipality Hall, which were examined in the study, were demolished by ignoring the values they carry on an urban scale and have not survived to the present day. The decision to demolish the Samsun Diyanet Site (Site Mosque) is on the agenda. These buildings should be evaluated as buildings that add symbolic value to cities and have a place in urban memory, and their existence in cities should be conserved.

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Examining the Contribution of Transparency Ratios to the Central Space in Mimar Sinan Mosques in Istanbul and Edirne

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Abstract

Mimar Sinan was an architect beyond his time by the innovations he brought into the field of architecture in the Ottoman period from the middle of the 16th century to the end. The mosques he built in this period have been analyzed by many researchers today, in terms of their aesthetic values, cultural features, and technical perfection. As far as the researches are analyzed, it has been understood that no analytical study on transparency ratios has been conducted. By the solutions which are brought by Mimar Sinan for the central and collective space, the carrying feature of the walls has decreased and thus the transparent surfaces disposed on the façade have increased. At this point, it is important to conduct analytical studies examining the transparency ratios in Mimar Sinan's mosque designs. In this study, it is aimed to determine the transparency ratios of a total of fifteen buildings, fourteen in İstanbul and the Selimiye Mosque in Edirne, which all have a central plan scheme, and also to analyze the contribution of these ratios to the central space. Within the framework of the stated purpose, the contribution of the transparency ratios of Mimar Sinan mosques in Istanbul and Edirne to the central space was investigated by comparative analysis method. The contribution of the transparency ratios to the central space of the Mimar Sinan mosques in Istanbul and Edirne is investigated by comparative analysis method within the scope of the framework of the stated purpose.

1. INTRODUCTION

Mimar Sinan, who had lived during the 16th century in the Ottoman Empire, became one of the most prominent architects of history with his legacy of monumental works. During the Classical Ottoman Period, he constructed many significant masterpieces that pushed Turkish mosque architecture to its peak. The Şehzade Mosque, the Süleymaniye Mosque and the Selimiye Mosque which are named as his apprenticeship, journeyman, and mastership works, are accepted as his most important artifacts. When the mosques he had built are examined, it is seen that Sinan tried to develop the concept of central space. Particularly by the Selimiye Mosque, the concept of central space, which had been going on since the pre-Islamic period, reached its peak.

When designing mosques, Sinan not only used the traditional plan schemes but also brought innovations to many of them and made big contributions to the development of the concept of central space. Accordingly, a total of fifteen mosques with the concept of central dome, of which fourteen are from Istanbul and the Selimiye Mosque from Edirne, are included within the scope of the study.

The transparency ratio refers to the ratio of architectural elements that transmit natural light such as windows used in the design of the space to the total surface area. The development of the structural system in the Classical Period mosques led to the opportunity to open more windows on the wall surfaces by transferring the load from the walls to the pillars. Accordingly, within the context of the hypothesis of the study, it is expected that the transparency ratio of the selected mosques should increase in correspondence to the development of space. In this study, the transparency ratios of fifteen buildings

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included in the content are stated and the connection between Sinan's perception of central space and these ratios is analyzed.

In this research, after reviewing the literature, the plans, sections and façade drawings of the selected buildings were obtained and their one-to-one scale plan and façade drawings were comprised by transferring them to the AutoCAD program. By using these drawings, the transparency ratios of the buildings were determined separately for each façade.

Following that, the total transparency ratios of the buildings were calculated by taking the ratio of the total surface area of the façades to the transparent surface areas as a percentage. Tables were prepared by using the comparative analysis method in line with the information obtained. In the next phase, the contribution of transparency ratios to the concept of central space was examined, by evaluating these tables which are ordered chronologically and according to the transparency ratios.

By reviewing the literature, the opinions of the researchers about the use of windows in Mimar Sinan's mosques are included in the study. Tezel states that Mimar Sinan uses walls as a curtain and lighting tool in his buildings, thus he changes the style of using fewer windows on the load-bearing walls. She says that he makes religious buildings luminous by bringing them off dark places [1]. Egli emphasizes that, the Edirnekapı Mihrimah Sultan Mosque is highly luminous due to the multiple number of windows inside the large arches in the drum of the central dome [2]. Bolak expresses that, in the Şehzade, Süleymaniye and Selimiye mosques, the degree of light, the size and the number of windows are increased. Additionally, he expresses that together with the development of architecture, the development of lighting is also achieved [3,4].

When the studies including the transparency ratio in historical mosques are examined, Ataköy's master's thesis titled "Daylight Illumination in Mosques and Case Studies" is encountered solely. In the study, the transparency ratios of Kılıç Ali Paşa Mosque, Bebek Mosque and Barbaros Mosque in Istanbul are determined by the façade drawings. As a result of the study, it is determined that the transparent areas in the building envelope play a role in the homogenous distribution of the light [5].

2. MIMAR SINAN MOSQUES WITH CONCEPT OF CENTRAL SPACE IN ISTANBUL AND EDIRNE

The type of plan that emphasizes the center of the building, consisting of a domed main space carried by pillars and expanded by vaults or domed sections towards the sides is called the "Central Plan Scheme". The first example of this plan type is the Degaron Mosque built in the Karakhanid Period at the beginning of the 11th century [6,7]. According to many historians, the concept of central space is thought to have started with the Talhatan Baba Mosque, a Karakhanid building. This scheme, which was first seen in Anatolia with the Tokat Garipler Mosque in 1074, a Danismentli monumental work, is not known to have been repeated until the Old Fatih Mosque in 1463 [8].

The Old Fatih Mosque was formed by adding one half and two small domes to the south side of the central dome. To achieve the symmetry of the Old Fatih Mosque from both directions, one half and two small domes were added to the northern direction, resulting in the Beyazıt Mosque in Istanbul. Üsküdar Mihrimah Mosque was formed by adding a half dome to the east, west and south sides of the central dome, and Şehzade Mehmet Mosque with four half domes was formed by adding a half dome to the north. Following the Şehzade Mehmet Mosque, six-pillar and eight-pillar mosques were built, and structural principles were established to completely eliminate the side naves. As a result, this line of development came to an end with the construction of the Selimiye Mosque, where the concept of a unitary and collective space without side naves and half domes reached its climax [9].

The mosque was formed by expanding the domed main space with three half domes in the east, west and north directions and two small domed sections in the corners. The central dome is carried by two pillars adjacent to the wall and two free-standing pillars. Later, the Şehzade Mosque was built in Istanbul between 1543 and 1548 [10]. The structure is formed by expanding the main domed space with a half

dome on four sides and four small domes at the corners. The central dome is carried by four free-standing pillars. It is understood that Sinan made different experiments in the process leading to the centralization of the domed main space, using three half domes in Üsküdar Mihrimah Sultan Mosque and four half domes in Şehzade Mosque [9]. The domed main space started to become more central with the addition of half domes in four directions.

Suleymaniye Social Complex was built in Istanbul between 1550 to 1557 [11]. Suleymaniye Mosque, located within the social complex, is formed by expanding the domed main space with two half domes to the south and north and five domed sections, large and small, on the side naves. The central dome is carried by four free-standing pillars. Süleymaniye Mosque is an improved and reformed repetition of the plan schemes of Hagia Sophia and Istanbul Beyazıt Mosque, with the addition of half domes to the south and north of the main domed space. The spatial integrity, which cannot be seen in the plan diagrams of these two buildings, was successfully achieved in the Süleymaniye Mosque by reducing and retracting the column between the main carriers, allowing the side naves to join the central space.

Sinan Paşa Mosque was built in Istanbul between 1553 and 1555 [12]. According to its restitution, the building is formed by expanding the domed main space with two small domed sections on each side. The central dome is supported by four pillars adjacent to the wall and two free-standing pillars. The mosque bears a great resemblance to Edirne Üç Şerefeli Mosque in terms of plan and covering system [12]. The building, which was repaired in various periods, was demolished in 1749, leaving large pillars on the north wall. The last congregation area of the building was added to the sanctuary and the arched openings in the last congregation area were closed by building a wall [13]. In the study, the building was evaluated according to the restitution situation in which the plan scheme was not distorted. With this mosque, it is understood that Sinan took the mosque scheme built in previous periods and reused it by bringing innovations. When the restitution plan is examined, it is seen that the sanctuary area of the building could not be fully centralized as it created a fragmented space with small domes on the side naves and useless triangular areas around the central dome.

Kara Ahmet Paşa Mosque was built in Istanbul Topkapı between 1554-58 [14]. The structure is formed by expanding the domed main space with four half-domed sections at its corners. The central dome is carried by six columns. The sanctuary area of the mosque, which is one of Sinan's six-pillar structures, is formed with large-sized half-dome sections at the corners, allowing the space to have a more holistic structure instead of being divided into side naves. This shows that this building is one of the important attempts to reach a unitary and collective space in concepts of central space.

Molla Çelebi Mosque in Istanbul was built in 1561-1562 [15]. The mosque was formed by adding four semi-domes to the corners of the domed main space and a semi-domed mihrab niche to the south. The central dome is supported by four pillars adjacent to the wall and two free-standing pillars. Like the Kara Ahmet Pasha Mosque, Molla Çelebi Mosque is one of Sinan's structures with six pillars. Unlike the Molla Çelebi Mosque, the addition of a mihrab niche emphasizes the mihrab direction as well as the central space.

Rüstem Paşa Mosque, famous for its tile revetments, was built in Istanbul in 1561-1562 [12]. The building is formed by expanding the domed main space to the sides with vaulted sections on the inside and domes on the outside. The central dome is supported by four free-standing pillars and four pillars adjacent to the wall. In the mosque, which is one of Sinan's eight-pillar structures, the naves next to the central dome have made the sanctuary area more fragmented. On the other hand, Sinan made significant progress in the centralization of the main space by using eight pillars to support the central dome, making it completely independent of the wall.

Edirnekapı Mihrimah Sultan Mosque was built in Istanbul between 1562-65 [12]. The mosque is formed by expanding the main domed space, supported by four pillars adjacent to the walls, with small domed sections to the sides. The building differs from Sinan's other buildings with the series of windows on the drum of the dome, which is raised by four large arches. Many sources emphasize that this is Sinan's building with the most windows [2].

Selimiye Mosque in Edirne, considered Sinan's peak work, was built in 1568-74 [16]. The mosque is formed by adding a mihrab niche to the south of the domed main space. The central dome is supported by six large-sized free-standing pillars and two pillars adjacent to the wall. Thanks to the pillars supporting the dome, the structural system has become completely independent from the wall; The worship area is gathered under the central dome, creating a unitary and collective space. Avoiding the use of side naves and half domes, which disrupt the integrity of the sanctuary area, enabled the central space concept to reach its peak in the Selimiye Mosque.

Eski Valide Mosque in Istanbul was built twice during the time Sinan was the chief architect. When the mosque was built between 1570-75, it had a hexagonal plan in the middle section. According to this plan scheme, the building was formed by adding four semi-domes to the corners of the domed main space and a semi-domed mihrab niche to the south. Later, in 1582, the building was enlarged by adding side naves with two domes on both sides of the mihrab to expand the sanctuary. In 1834, the portico dome adjacent to the mosque in the south corner was canceled and the sultan's lodge was added to this corner [17]. There are different opinions about the mosque's architect. Since it is known that Mimar Sinan was the chief architect during the first two construction periods of the building, it is believed that the mosque was built by him [18]. When looking at the restitution plans in Necipoğlu's book, it is understood that the building had a central plan type in both plan schemes of 1570-75 and 1582 [19]. The central dome is supported by four pillars adjacent to the wall and two columns. In the study, the plan and façade features of the building in 1582 were evaluated. The side naves added to both sides of the domed space during the second construction period of the building disrupted the integrity of the sanctuary.

Kadırga Sokullu Mehmet Paşa Mosque in Istanbul was built in 1572 [20]. The structure is formed by adding four semi-domes to the corners of the main domed space supported by six pillars adjacent to the wall. The use of half domes in the mosque, which is one of Sinan's six-pillar structures such as the Kara Ahmet Paşha Mosque and Molla Çelebi Mosque, contributed to the formation of a more collective and central space.

Zal Mahmut Paşa Mosque was built in Istanbul in 1577-80 [21]. The mosque is formed by expanding the domed main space with vaulted and domed naves on both sides and towards the entrance. The central dome is supported by two pillars adjacent to the wall and two free-standing pillars. The side naves added to the east, west and north of the domed space distorted the perception of the collective space. The use of four rows of windows on the side façades of the mosque differentiated it from Sinan's other works.

Azapkapı Sokullu Mehmet Paşa Mosque was built in 1577-78 [22]. The domed main space of the building, including the mihrab niche, is surrounded by a semi-dome in four directions and four squinches at the corners. The side naves are covered with a small dome at the corners and vaults in the remaining sections. The central dome is supported by a total of eight pillars, six of which are free-standing and two of which are adjacent to the wall. Looking at the placement of the half and small domes added to the four sides of the main dome, it can be thought that Sinan made different attempts to expand the sanctuary.

Kılıç Ali Paşa Mosque was built in Istanbul in 1580 [23]. The mosque is formed by adding two semi-domes to the south and north of the domed main space, and small domed and cross-vaulted naves to the east, west and north. The central dome is supported by four free-standing pillars. With this mosque, Sinan reused the basilical scheme he used in the Süleymaniye Mosque, which he built between 1550 and 1557, by adding a mihrab niche and front nave. The use of many semicircular arched windows on the side façades of Kılıç Ali Paşa Mosque creates a different appearance from the Süleymaniye Mosque.

Nişancı Mehmet Paşa Mosque in Istanbul was built between 1584-88 [24]. The building consists of a semi-dome in four directions, including the mihrab niche of the domed main space, and four squinches at the corners. The central dome is supported by eight pillars adjacent to the wall. When we look at the layout of the half and small domes added to the four sides of the main dome and the eight pillars plan scheme, it can be seen that it has similar features to the Azapkapı Sokullu Mehmet Paşa Mosque. On the other hand, the fact that the building has a recessed form on all four sides reflects a different architectural approach from Sinan's other works. In this structure, the absence of elements such as corner domes and

vault naves in the Azapkapı Sokullu Mehmet Paşa Mosque made the interior more centralized and ensured a holistic perception of the space.

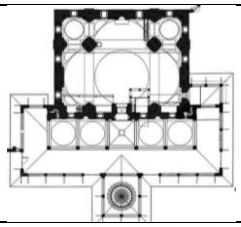
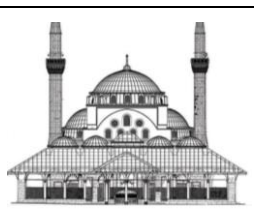
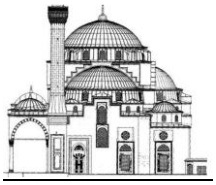
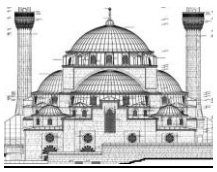
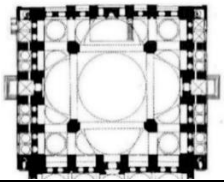
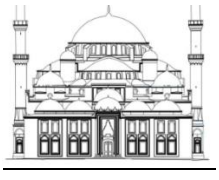
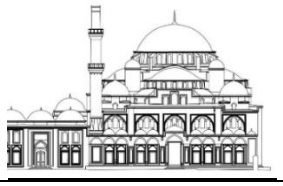
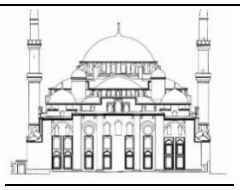
When we look at Sinan's buildings in Istanbul and Edirne with a central space approach in general, it can be seen that in the examples until the Selimiye Mosque, there is a unitary and collective space development that is attempted to be created with a plan, structure and cover system. When the line of development of Turkish mosque architecture is examined, it is understood that the concept of a unitary and collective central space has reached its peak when the approximately 31.5-meter main dome of the Selimiye Mosque was supported by free-standing pillars and the side naves were eliminated. When we look at the mosques that Sinan built after the Selimiye Mosque, it is seen that he repeated the schemes he had used before, bringing some innovations to the plan and façade layout.

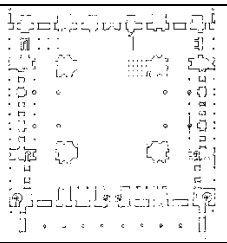
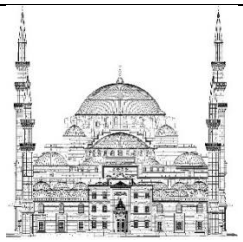
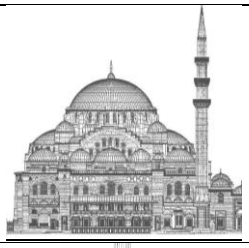
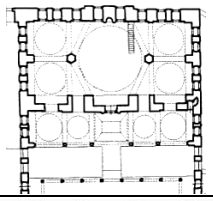
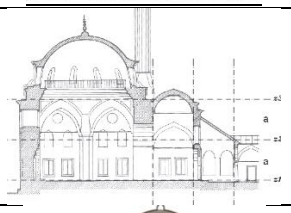
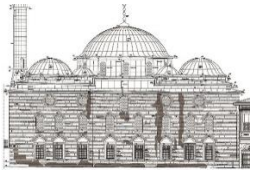
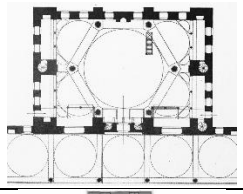
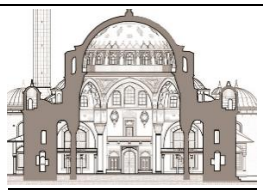
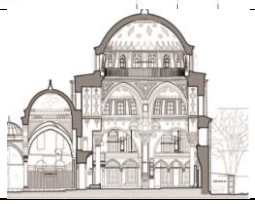
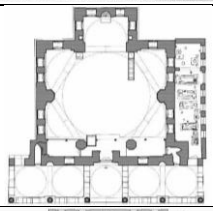
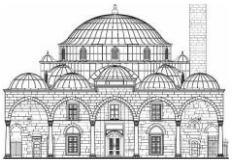
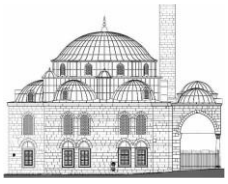
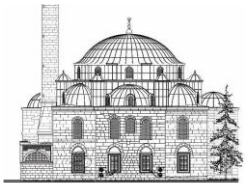
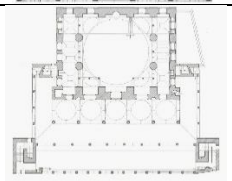
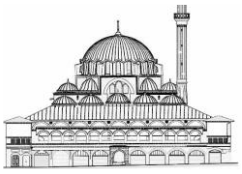
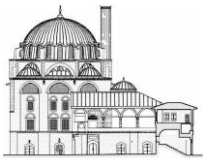
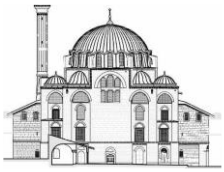
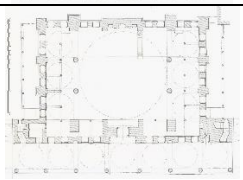
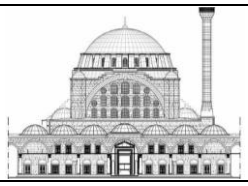
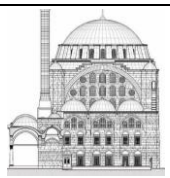
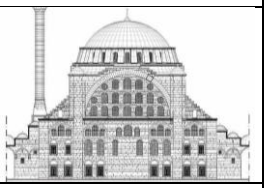
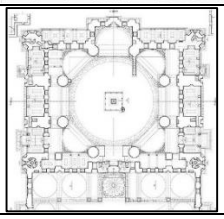
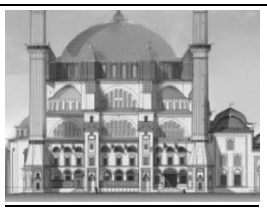
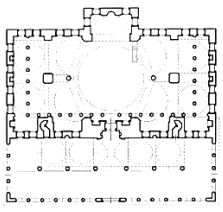
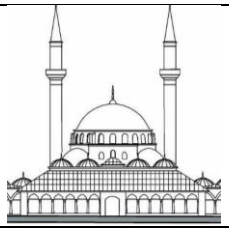
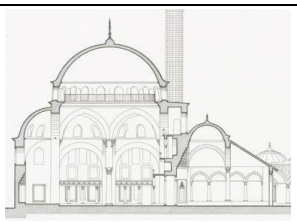
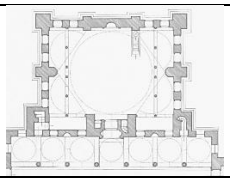
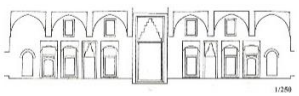
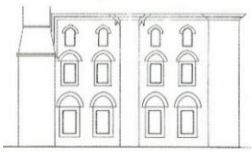
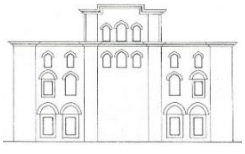
When we look at the façades of Sinan's mosques with a central plan scheme, there is a very plain and simple façade design. The façade design of the buildings is generally created by gradually elevating the main wall, dome drum, squinch, exedra, half dome, buttress and central dome. In some of the buildings, a hipped-roofed portico surrounds the last congregation area on the north side, which is the entrance. This portico layout is found in Üsküdar Mihrimah Sultan Mosque, Sinan Pasha Mosque, Rüstem Pasha Mosque, Edirnekapı Mihrimah Sultan Mosque, Eski Valide Mosque and Kılıç Ali Pasha Mosque. There are fewer and smaller windows on the entrance façade of the buildings compared to the other façades. The side façades are designed to be in symmetry with each other. While some buildings have more window openings on the mihrab façade, some have more window openings on the side façades.

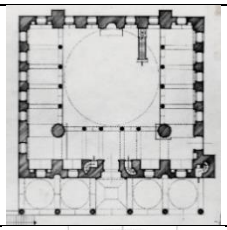
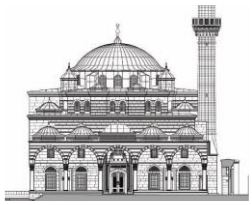
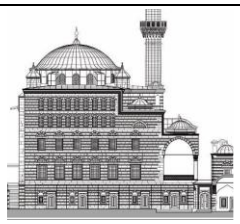
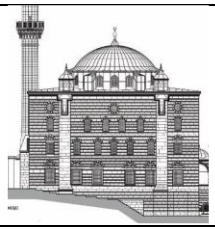
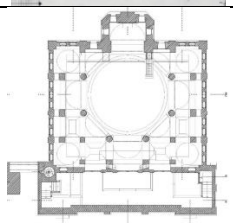
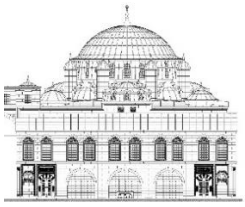
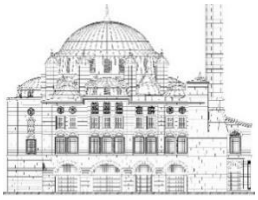
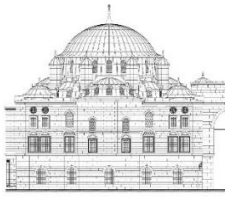
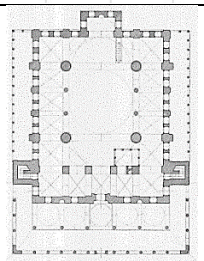
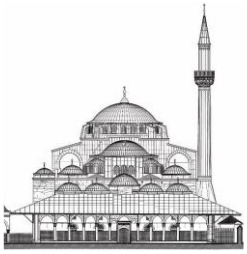
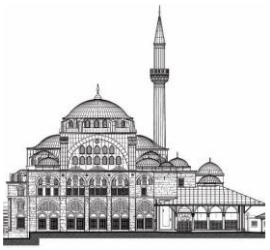
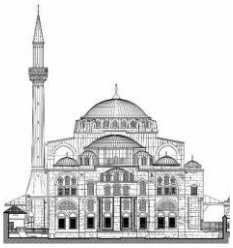
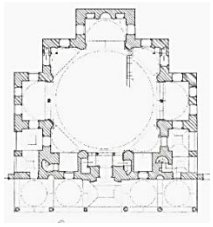
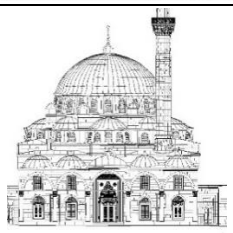
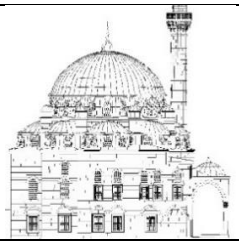
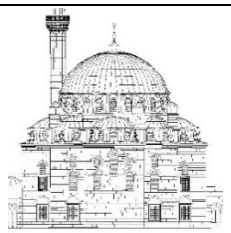
Unlike other buildings, there are two or three rows of windows at the lower level of the arch carrying the central dome in Üsküdar Mihrimah Sultan Mosque, Süleymaniye Mosque, Edirnekapı Mihrimah Sultan Mosque, Selimiye Mosque and Kılıç Ali Paşa Mosque. Windows are generally placed on three floors in the main walls of the buildings: lower, lodge and upper levels. Zal Mahmut Paşa Mosque and Kılıç Ali Paşa Mosque have a window arrangement on four floors on the side and mihrab façades, while Kara Ahmet Paşa Mosque and Molla Çelebi Mosque have a window arrangement on two floors. Unlike other buildings, there are large windows extending over two floors on both sides of the portal entrance of Kara Ahmet Paşa Mosque and Rüstem Paşa Mosque. Rüstem Paşa Mosque and Kılıç Ali Paşa Mosque differ from other mosques by having large semicircular windows on the side and mihrab façades.

When we look at the window openings in the covering system of the buildings in general, it is seen that arched windows are used on the skirts of squinches, exedra, central domes and semi-domes. Plans, sections and façade drawings of the buildings were obtained from the archives of Ali Saim Ülgen and the General Directorate of Foundations, the theses of Gürbüz, Özyalvaç, Mohtasıb, the websites of PC Yapı Mimarlık Restorasyon, FOCUS Restorasyon Mimarlık and Avunduk Architecture Offices and Erzen's book [25, 26, 27, 15, 28, 29, 30, 31, 32]. Table 1 was created from the obtained plan, section and façade drawings.

Table 1. *Plans, sections and façades of drawings of the mosques in the study*

Name of Building	Plan	Entrance Façade / Section	Side Façade / Section	Mihrab Façade
Mihrimah Sultan Mosque (Üsküdar), 1540-1548 [25,27]				
Şehzade Mosque, 1543-1548 [15,28]				

Süleymaniye Mosque, 1550-1557 [26]				
Sinan Paşa Mosque, 1553-55 [29,32]				
Kara Ahmet Paşa Mosque, 1554-58 [30,32]				
Molla Çelebi Mosque, 1561-62 [15]				
Rüstem Paşa Mosque, 1561-62 [15,25]				
Mihrimah Sultan Mosque (Edirnekapı), 1562-1565 [15]				
Edirne, Selimiye Mosque, 1568-1574 [31]				
Eski Valide Mosque, 1570-75 [15, 25]				
Kadırga Sokullu Mehmet Paşa Mosque,1572 [25,32]				

Zal Mahmut Paşa Mosque, 1577-80 [15,25]				
Azapkapı Sokullu Mehmet Paşa Mosque, 1577-78 [26]				
Kılıç Ali Paşa Mosque, 1580 [15,25]				
Nişancı Mehmet Paşa Mosque, 1584-1588 [26]				

3. CONTRIBUTION OF TRANSPARENCY RATES OF MIMAR SINAN MOSQUES IN ISTANBUL AND EDIRNE TO THE CENTRAL SPACE

Transparency ratio generally refers to the ratio of windows or other transparent architectural elements used in the design of a building or space to the total wall area. This ratio is used to assess the visual connection between the interior and exterior of a building and its light transmission. Buildings with a high transparency ratio allow more natural light to enter the interior spaces and better visibility of the views outside. Transparency has a significant impact on the functionality and aesthetics of architectural design.

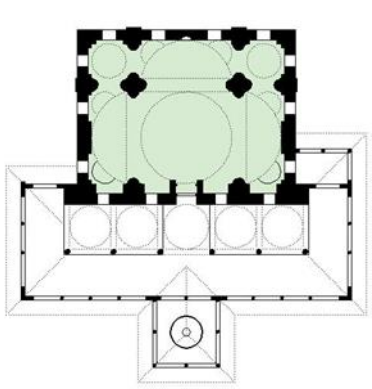
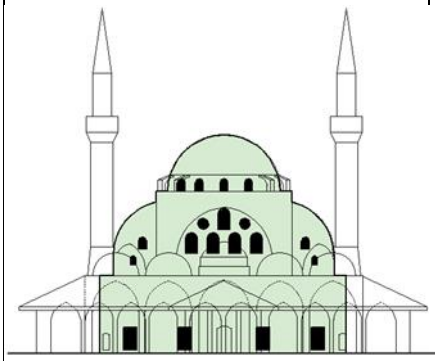
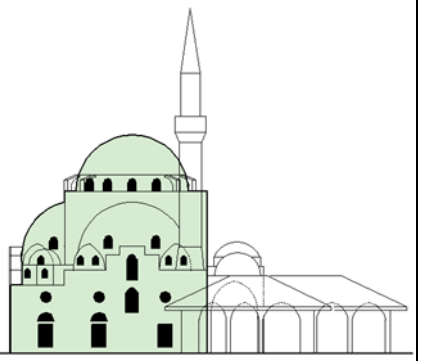
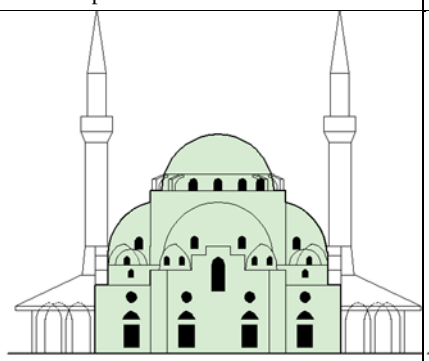
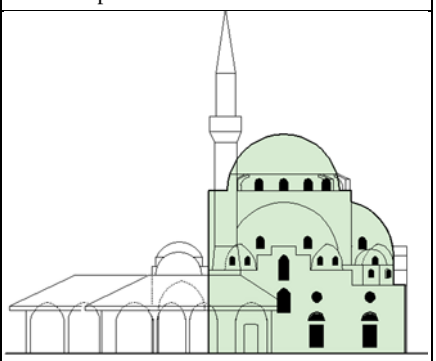
The transparency ratios of the buildings were determined from the plans, sections and façade drawings obtained from the literature review. These drawings were transferred to the AutoCAD program and the plan and façade drawings were schematically created in one-to-one scale. In the façade drawings, the boundary lines of the façade and cover elements forming the interior space were determined and the surface areas of these façade lines were calculated. Afterwards, the frames of the windows illuminating the interior space on the four façades of the buildings were drawn as polyline and the surface areas were determined for each façade individually by assigning hatching to these frames. The ratio of these surface areas to the total surface area of the façade was calculated as a percentage.

Since the windows in the main walls are located in the same plane as the façade plane, it is possible to access the actual dimensions of the transparent surfaces through the façade drawings. On the other hand, some of the windows in the dome, half dome and transition to the dome in the covering system are located on different planes than the façade planes. This means that the projection areas of these windows in the façade drawings constitute less transparent surface areas than their actual dimensions. In particular, windows placed at an angle of 45 degrees to the façade are not visible in the drawings because they do not project onto the façade plane due to their positions. To obtain more accurate data, in this study, the actual surface areas of the windows in the covering system were drawn schematically and distributed

equally or almost equally to all façades. With this method, the transparency ratios of all buildings were determined.

In the sample calculation in Table 2, the twenty windows in the central dome of Üsküdar Mihrimah Sultan Mosque were placed on the façades as four each in a one-to-one scale, provided that the position and symmetry of the windows are not disturbed. In the building, which has three half domes, four windows in each half dome are distributed on the façades as 1-2-1 respectively. The three windows in each of the six squinches were placed on the façades as 1-2. Accordingly, while the surface area of the mihrab façade is approximately 511.5 m², the total surface area of the windows placed on this façade is approximately 45.5 m². The ratio of the surface area of the windows to the surface area of the façade was calculated to be approximately 8.9%. This ratio represents the transparency rate of the mihrab façade. The transparency ratios of all other façades were determined by the same method. The transparency rates of the mosque were calculated as 7.8% on the north façade, 7,9% on the east façade, 9,1% on the south façade and 6.9% on the west façade. Similarly, the total transparency rate of the façades was determined by taking the ratio of the total surface area of the four façades to the total transparent surface area as a percentage. This ratio was calculated as approximately 7.9%. These calculations are detailed in Table 2. Similar calculations were made for the façades of the other fourteen buildings and the information obtained was converted into tables. The plan and façade drawings of the buildings created in the AutoCAD program and the transparency ratios determined from these drawings are given in Tables 3 and 4.

Table 2. *Transparency rates of Üsküdar Mihrimah Sultan Mosque*

Plan of the Building	North Façade (Entrance)	East Façade
	 The surface area of the façade: ~ 514.8 m2 Transparent surface area: ~ 39.9 m2	 The surface area of the façade: ~ 439.9 m2 Transparent surface area: ~ 34.8 m2
Total Transparency Ratio Calculation of Façades The total surface area of the façades: 514.8+439.9+511.5+439.9=1906.1 m2 The total area of transparent surfaces: 39.9+34.8+46.6+29.8=151.1 m2 (151.1x100) /1906.1= ~ 7.9% Transparency Rates All fronts ~7.9% North Façade ~7.8% East Façade ~7.9% South Façade ~9.1% West Façade ~6.8%	 The surface area of the façade: ~ 511,5 m^2 Transparent surface area: ~ 46,6 m^2	 The surface area of the façade:~ 439,9 m^2 Transparent surface area: ~ 29,8 m^2
Transparency Ratios	South Façade (Mihrap)	West Façade

In Ataköy's study on the transparency rate in historical mosques, he determined the transparency rates of Kılıç Ali Paşa Mosque as 6% for the north façade, 19% for the east façade, 18% for the west and south façades and the average transparency rate of all façades as 15%. In the study, while the windows in the main walls were proportioned to the total surface area of the façades, the twenty-four windows in the dome drum were calculated to be equal to the façades by proportioning the dome surface area. In

addition, to determine the transparency ratios of the façades, the averages of the façade ratios were taken [5]. In addition, the surface areas of the elements of the covering system that make up the interior space in the façade drawings should also be included in the transparency ratio calculation. Looking at the façade drawings in Ataköy's study (Figure 1), it is seen that the half dome in the mihrab niche, the small domes on all four façades and the main walls of the right section on the east façade are not included in the transparency ratio calculation. This makes the building more transparent than it actually is. Since the arched windows on the entrance façade are not included in the ratio calculation, the north façade has a lower transparency ratio.

In this study, all the main walls forming the sanctuary and architectural elements such as dome, half dome, small dome, and squinch in the covering system were determined by thickly determining the boundaries on the façade drawings and the total surface areas of the façades were determined (Figure 2). In the inclusion of the windows in the covering system in the transparent surface areas of the façades, the twenty-four windows in the central dome were distributed to the façades as six each in a one-to-one ratio. The five windows of each of the two squinches in the two half domes were distributed as two windows each on the entrance and mihrab façades and three windows each on the side façades. In addition, to provide more accurate data in determining the transparency ratios of the façades, instead of taking the averages of the façade ratios, the total surface area on the four façades was proportioned to the total transparent surface area. Accordingly, the transparency ratios of the mosque were calculated as 7.6% on the north façade, 18.2% on the east façade, 15.8% on the south façade, 18.2% on the west façade and 15.4% on all façades.

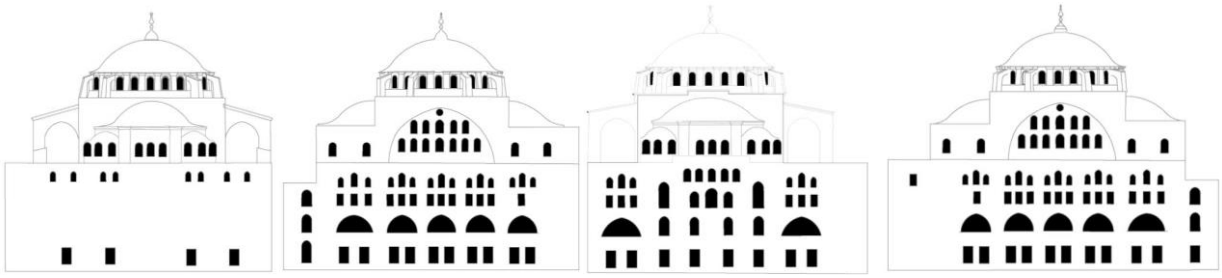


Figure 1. *Transparent surface areas determined on the north, east, south and west façades of Kılıç Ali Paşa Mosque in the study in Ataköy (Ataköy, 2018*)

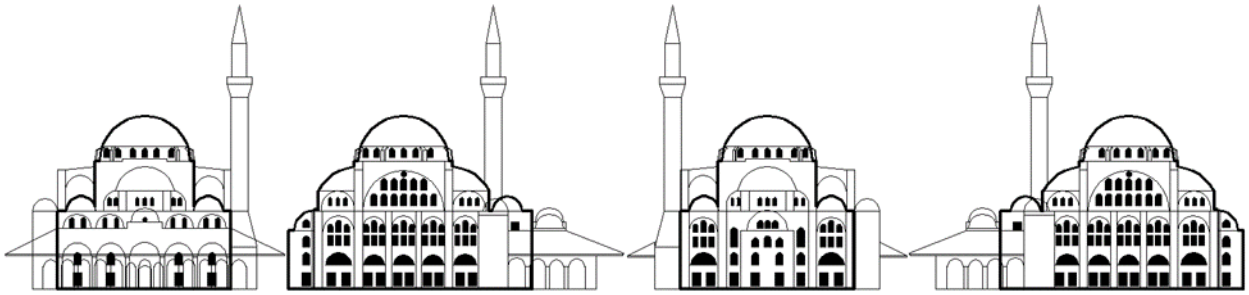


Figure 2. *Transparent surfaces and the boundaries forming the interior space determined on the north, east, south and west façades of the Kılıç Ali Paşa Mosque examined within the scope of the study*

When Table 3, which chronologically includes the buildings from Üsküdar Mihrimah Sultan Mosque to Rüstem Paşa Mosque, is examined, it is seen that the transparency rate of all façades of Üsküdar Mihrimah Sultan Mosque is approximately 7.9%, while this rate is approximately 9.9% in Şehzade Mosque. In Süleymaniye Mosque, this rate is approximately 10.3%, in Sinan Paşa Mosque 10.8%, in Kara Ahmet Paşa Mosque 10.4%, in Molla Çelebi Mosque 8.5%, and in Rüstem Paşa Mosque 14.5%. When Table 4, which chronologically includes the buildings from Edirnekapı Mihrimah Sultan Mosque to Nişancı Mehmet Paşa Mosque, is analyzed, it is seen that the transparency rate of all façades in Edirnekapı Mihrimah Sultan Mosque is approximately 17.4%. It is understood that Edirnekapı Mihrimah Sultan Mosque has the highest transparency rate among the other buildings examined within the scope of the study. This rate was calculated as 9.4% in Edirne Selimiye Mosque, 11.3% in Eski Valide Mosque,

12.1% in Kadırga Sokullu Mehmet Pasha Mosque, 14.8% in Zal Mahmut Pasha Mosque, 15.7% in Azapkapı Sokullu Mehmet Pasha Mosque, 16.2% in Kılıç Ali Pasha Mosque and 10.6% in Nişancı Mehmet Pasha Mosque.

When the graph (Figure 3), which chronologically ranks the transparency ratios of the buildings, is examined, it is observed that there is a proportional increase until Edirnekapı Mihrimah Sultan Mosque, while the transparency ratios of the buildings after this building change within a certain range. When we rank the Şehzade Mosque, Süleymaniye Mosque and Selimiye Mosque, which are the apprenticeship, journeyman and mastership of Mimar Sinan, according to the transparency ratio, Süleymaniye Mosque, Şehzade Mosque and Edirne Selimiye Mosque come from the highest to the lowest. When these three buildings are compared according to the number of windows, it is seen that Süleymaniye Mosque has the most windows and Edirne Selimiye Mosque has the least windows.

Bolak's [3] opinion that "the size and number of window openings increased in Şehzade, Süleymaniye and Selimiye mosques, which Sinan called his apprenticeship, journeyman and masterpiece" does not fit with these data. From this point of view, it is understood that this subjective discourse based on visual perception mentioned by Bolak does not comply with the objective and analytical results obtained in the study.

When Table 5 is analyzed according to the transparency ratio of the buildings, it is understood that the building with the highest transparency ratio by far is Edirnekapı Mihrimah Sultan Mosque. This mosque is followed by Azapkapı Sokullu Mehmet Pasha Mosque, Kılıç Ali Pasha Mosque, Zal Mahmut Pasha Mosque, Rüstem Pasha Mosque, Kadırga Sokullu Mehmet Pasha Mosque, Eski Valide Mosque, Sinan Pasha Mosque, Nişancı Mehmet Pasha Mosque, Süleymaniye Mosque, Kara Ahmet Pasha Mosque, Şehzade Mosque, Edirne Selimiye Mosque, Molla Çelebi Mosque and Üsküdar Mihrimah Sultan Mosque.

When the transparency rates of Edirnekapı Mihrimah Sultan Mosque, which has the highest transparency rate, on the entrance and mihrab façades are compared with other buildings, it is understood that it has the most transparent surface on these façades as well. Zal Mahmut Pasha Mosque has the highest transparency rate with 18.6% on the east and west façades, which are the side façades. This rate represents the highest transparency value compared to all other façades and façade averages.

When we compare the buildings in terms of façade planes, it is seen that the transparency rate on the west façade of Üsküdar Mihrimah Sultan Mosque, which has the lowest transparency rate, has the lowest rate compared to other buildings. It is understood that Molla Çelebi Mosque has the lowest transparency rate on the south façade, Kara Ahmed Paşa Mosque and Üsküdar Mihrimah Sultan Mosque on the east façade, and Süleymaniye Mosque on the north façade. Looking at these rates on all façades, it is seen that the north façade, which is the entrance façade of the Süleymaniye Mosque, has the lowest transparency rate with 5.2%.

When the buildings are compared according to the difference between the transparency ratios of the façades, it is observed that Kılıç Ali Paşa Mosque has the highest difference with a rate of 10.6%, while Rüstem Paşa Mosque and Selimiye Mosque have the least difference with a rate of 1.3%. Zal Mahmut Pasha Mosque, Süleymaniye Mosque, Sinan Pasha Mosque, Nişancı Mehmet Pasha Mosque, Azapkapı Sokullu Mehmet Pasha Mosque, Kara Ahmet Pasha Mosque, Kadırga Sokullu Mehmet Pasha Mosque, Şehzade Mosque, Edirnekapı Mihrimah Sultan Mosque, Molla Çelebi Mosque and Üsküdar Mihrimah Sultan Mosque follow these buildings, respectively. When we rank Şehzade Mosque, Süleymaniye Mosque and Selimiye Mosque, which are the most important works of Mimar Sinan, according to the difference in transparency ratios between the façades, Süleymaniye Mosque, Şehzade Mosque and Edirne Selimiye Mosque come from the highest to the lowest.

When the relationship between the transparency ratios of the fifteen buildings within the scope of the study and the central space is examined, a direct proportion between the development of the central space and the transparency ratios could not be determined. In the development of the concept of the central

space, with the increase in the number of pillars carrying the dome, the walls became independent in carrying the central dome, and thus the main walls acted as a curtain and allowed for the opening of many window openings. According to this situation, it is expected that the transparency rates of the buildings that contribute to the concept of central space will increase according to the architectural development. Looking at the graph in Figure 3, it is seen that there is no direct relationship between central space and transparency ratio. This is clearly understood by the fact that the eight-pillar Selimiye Mosque has one of the lowest transparency rates with 9.4%, while the four-pillar Edirnekapı Mihrimah Sultan Mosque has the highest transparency rate with 17.4%.

Although the Selimiye Mosque, Sinan's pinnacle work in the concept of central space, has a low transparency rate compared to other buildings, it is seen that it is among the buildings with the least difference in terms of transparency rates between the façades. According to this inference, it is thought that Sinan wanted to build a building in which the light is taken into the interior in a balanced way by leaving equal openings on all façades instead of constructing the building with the highest transparency ratio in the Selimiye Mosque, which he called his masterpiece. Accordingly, it is understood that Sinan had a different quest in the development of the central space and this should be addressed as the subject of another research.

***Table 3**. Transparency rates were calculated based on the plans and façades of the mosques in the study (from Üsküdar Mihrimah Sultan Mosque to Rüstem Paşa Mosque)*

Plan of the Building	North Façade (Entrance)	East Façade	South Façade (Mihrap)	West Façade
1- Üsküdar Mihrimah Sultan Mosque Transparency Ratio of All Façades ~%7,9	Transparency Ratio ~%7,5	Transparency Ratio ~%8,2	Transparency Ratio ~% 8,9	Transparency Ratio ~%6,9
2- Şehzade Mosque Transparency Ratio of All Façades ~%9,9	Transparency Ratio ~%9,1	Transparency Ratio ~%9,8	Transparency Ratio ~%11,0	Transparency Ratio ~%9,8
3- Süleymaniye Mosque Transparency Ratio of All Façades ~%10,3	Transparency Ratio ~% 5,2	Transparency Ratio ~%12,9	Transparency Ratio ~%10,3	Transparency Ratio ~%12,9
4- Sinan Paşa Mosque Transparency Ratio of All Façades ~%10,8	Transparency Ratio ~%7,4	Transparency Ratio ~%11,3	Transparency Ratio ~%13,5	Transparency Ratio ~%11,3
5- Kara (Gazi) Ahmet Paşa Mosque Transparency Ratio of All Façades ~%10,4	Transparency Ratio ~%12,5	Transparency Ratio ~%8,2	Transparency Ratio ~%12,1	Transparency Ratio ~%8,2
6- Molla Çelebi Mosque Transparency Ratio of All Façades ~%8,5	Transparency Ratio ~%7,4	Transparency Ratio ~%9,1	Transparency Ratio ~%8,6	Transparency Ratio ~%9,1
7- Rüstem Paşa Mosque Transparency Ratio of All Façades ~%14,5	Transparency Ratio ~%14,2	Transparency Ratio ~%14,2	Transparency Ratio ~%15,5	Transparency Ratio ~%14,2 0 5 10 20 30 40m

Table 4. *Transparency rates were calculated from the plan and façades drawings of the mosques in the study (from Edirnekapı Mihrimah Sultan Mosque to Nişancı Mehmet Paşa Mosque)*

Plan of the Building	North Façade (Entrance)	East Façade	South Façade (Mihrap)	West Façade
8- Edirnekapı Mihrimah Sultan Mosque Transparency Ratio of All Façades ~%17,4	Transparency Ratio ~ %17,0	Transparency Ratio ~ %16,8	Transparency Ratio ~ %18,7	Transparency Ratio ~ %16,8
9- Edirne, Selimiye Mosque Transparency Ratio of All Façades ~%9,4	Transparency Ratio ~ %8,7	Transparency Ratio ~ %10,0	Transparency Ratio ~ %9,2	Transparency Ratio ~ %10,0
10- Üsküdar, Eski Valide Mosque Transparency Ratio of All Façades ~%11,3	Transparency Ratio ~ %9,7	Transparency Ratio ~ %10,6	Transparency Ratio ~ %13,5	Transparency Ratio ~ %10,6
11- Kadırga, Sokullu Mehmet Paşa Mosque Transparency Ratio of All Façades ~%12,1	Transparency Ratio ~ %11,0	Transparency Ratio ~ %11,6	Transparency Ratio ~ %13,0	Transparency Ratio ~ %11,6
12- Zal Mahmut Paşa Mosque Transparency Ratio of All Façades ~%14,8	Transparency Ratio ~ %9,1	Transparency Ratio ~ %18,6	Transparency Ratio ~ %13,8	Transparency Ratio ~ %18,6
13- Azapkapı, Sokullu Mehmet Paşa Mosque Transparency Ratio of All Façades ~%15,7	Transparency Ratio ~ %12,3	Transparency Ratio ~ %17,5	Transparency Ratio ~ %15,4	Transparency Ratio ~ %17,5
14- Kılıç Ali Paşa Mosque Transparency Ratio of All Façades ~%15,4	Transparency Ratio ~ %7,6	Transparency Ratio ~ %18,2	Transparency Ratio ~ %15,8	Transparency Ratio ~ %18,2
15- Nişancı Mehmet Paşa Mosque Transparency Ratio of All Façades ~%10,6	Transparency Ratio ~ %6,9	Transparency Ratio ~ %11,8	Transparency Ratio ~ %12,2	Transparency Ratio ~ %11,8

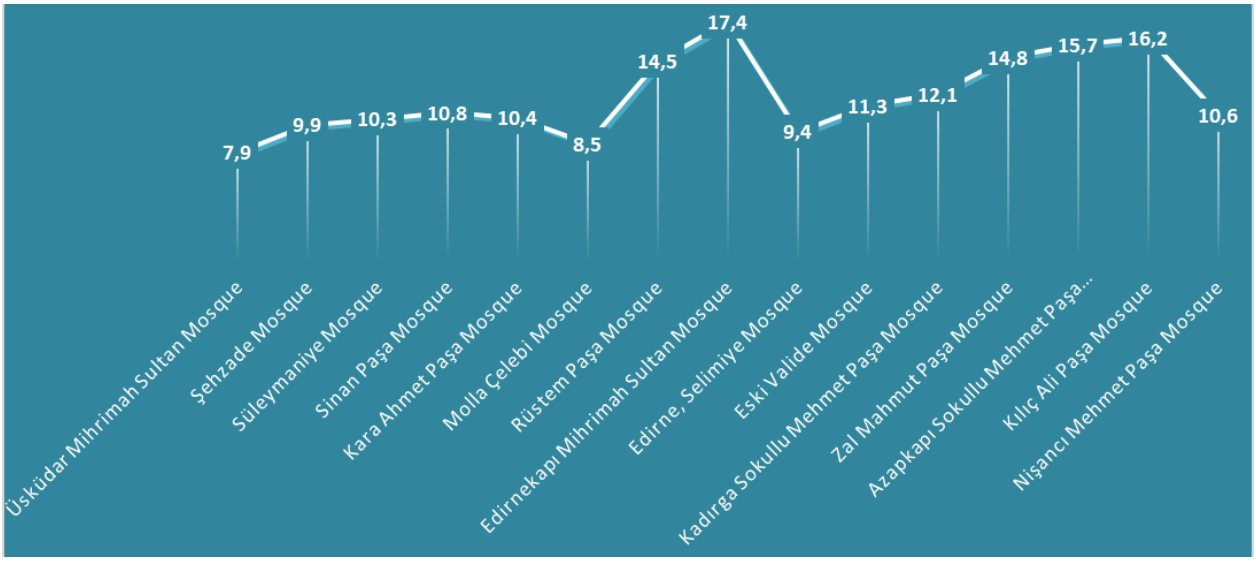


Figure 3. *Chronological change graph of transparency rates of the mosques included in the study*

Table 5*. Ranking of the mosques in the study according to their transparency rates*

Transparency Ratios	Name of Building	Date of Construction	Transparency Ratios (Glass Surface Ratio %)					
			North Façade (Entrance)	East Façade	South Façade (Mihrap	West Façade	All Façades	Difference Between Façades
↑	Edirnekapı Mihrimah Sultan Mosque	1562-1565	**17**	16,8	**18,7**	16,8	**17,4**	1,9
	Azapkapı Sokullu Mehmet Paşa Mosque	1577-1578	12,3	17,5	15,4	17,5	15,7	5,2
	Kılıç Ali Paşa Mosque	1580	7,6	18,2	15,8	18,2	15,4	**10,6**
	Zal Mahmut Paşa Mosque	1577	9,1	**18,6**	13,8	**18,6**	14,8	9,5
	Rüstem Paşa Mosque	1562-1564	14,2	14,2	15,5	14,2	14,5	1,3
	Kadırga Sokullu Mehmet Paşa Mosque	1572	11	11,6	13	11,6	12,1	2
	Eski Valide Mosque	1570-9, 1583	9,7	10,6	13,5	10,6	11,3	3,8
	Sinan Paşa Mosque	1553-1556	7,4	11,3	13,5	11,3	10,8	6,1
	Nişancı Mehmet Paşa Mosque	1584-88	6,9	11,8	12,2	11,8	10,6	5,3
	Kara Ahmet Paşa Mosque	1554-1558	12,5	8,2	12,1	8,2	10,4	4,3
	Süleymaniye Mosque	1550-1557	5,2	12,9	10,3	12,9	10,3	7,7
	Şehzade Mosque	1543-1548	9,1	9,8	11	9,8	9,9	1,9
	Selimiye Mosque	1568-1574	8,7	10	9,2	10	9,4	1,3
	Molla Çelebi Mosque	1561-1562	7,4	9,1	8,6	9,1	8,5	1,7
	Üsküdar Mihrimah Sultan Mosque	1540-1548	7,5	8,2	8,9	6,9	7,9	1,4

4. CONCLUSION

In this review, which discusses fifteen mosques of Mimar Sinan with central plan schemes in Istanbul and Edirne, the contribution of the transparency ratios of the buildings to the central space is analyzed. In the first stage of the study, the general characteristics of the selected fifteen buildings of Mimar Sinan are examined through their plans, sections and façade drawings. Secondly, the approximate transparency ratios are calculated by proportioning the surface areas of the windows to the total façade area, in terms of the façade drawings of the buildings. Graphs (Figure 3) and tables (Tables 2-5) are made to analyze the contribution of these ratios to the central space.

If Tables 3 and 4, which show the transparency ratios of the selected mosques are examined, it is seen that each mosque has a different transparency ratio and these ratios vary according to the different façades of the buildings. When Figure 3, which graphically shows the change in the transparency ratios of the mosques, is examined, it is seen that there is no significant increase or decrease in the transparency ratios of the buildings due to chronology.

Considering Table 5, which ranks the buildings in the study according to their transparency ratios, it is seen that Edirnekapı Mihrimah Sultan Mosque has the highest transparency ratio and Üsküdar Mihrimah Sultan Mosque has the lowest transparency ratio according to all façades. On the north façade, Edirnekapı Mihrimah Sultan Mosque has the highest transparency rate and Süleymaniye Mosque has the lowest; on

the east and west façades, Zal Mahmut Paşa Mosque has the highest transparency rate and Üsküdar Mihrimah Sultan Mosque has the lowest; on the south façade, Edirnekapı Mihrimah Sultan Mosque has the highest transparency rate and Molla Çelebi Mosque has the lowest. When the change in transparency ratio between the façades is analyzed, it is observed that Kılıç Ali Paşa Mosque has the highest difference and Selimiye Mosque has the lowest, as shown in the table.

With the construction of six-pillar and eight-pillar mosques, the walls widely lost their role in supporting the central dome, and thus they allowed the opening of more windows on the façades. It is understood that Mimar Sinan's efforts to create the ideal unitary and collective space reached its climax with the Selimiye Mosque, considering the point that Classical Ottoman architecture had reached in terms of the structure system. Looking at the mosques he built in the following period, it is seen that variations of various schemes that existed before the Selimiye Mosque and its predecessors were used.

According to the hypothesis of the study, it is expected that the transparency rates of the buildings that contribute to the concept of central space will increase according to the architectural development. However, when the data obtained is examined, it is seen that the transparency ratios do not increase in parallel with the development of space and a direct relationship cannot be established between these ratios and the concept of central space.

When we examine the Şehzade, Süleymaniye and Selimiye Mosques, according to their transparency ratios and the difference between these ratios, Süleymaniye Mosque, Şehzade Mosque and Selimiye Mosque are ranked from high to low. It is seen that the Selimiye Mosque is one of the buildings with both the lowest transparency ratio and the smallest difference in transparency ratio between the façades. Accordingly, instead of obtaining the maximum number of façade openings with this building, he kept the openings on the façades close to equal and created a central space.

According to the results of the study, despite the subjective evaluations of the researchers, a direct relationship between the transparency ratio and the development of the central space in Mimar Sinan's mosques with a central plan scheme could not be determined. In particular, the eight-pillar Selimiye Mosque is known to be of great importance in terms of the development of the central space, although its transparency ratio was found to be lower than the others. This situation reveals that Sinan had different pursuits in the development of the central space and that the relationship between the transparency ratio and its contribution to the central space should be examined with different parameters.

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