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AIM

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SCOPE

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Design theories and methods for studio works,
Architectural design studio education,
Design principles for studio work,
Product design studios,
Interior design studios,
Urban design studios,
Landscape design studio,
Communication design studio,
Graphic design studio,
Media design studio,
Fashion design studio,
New trends in design studios,
Virtual design studios,
Design thinking,
Studio culture,
Studio teaching,
Innovative and creative works in design studios
Quality assessment in studio work,
Collaborative design studies in design studios,
Integrated design studio,
Design studio practice,
Design practice,
Design research,

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Editorial

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Editorial

This issue of the Journal of Design Studio covers fourteen research articles, one review article. Among the research articles, two are peer-reviewed papers presented at the İÇMEK 6th International Congress on Interior Architecture Education. I would like to extend my gratitude to Assoc. Prof. Dr. Derya Adıgüzel Özbek and Assoc. Prof. Dr. Armağan Seçil Melikoğlu Eke, who served as guest associate editors for the evaluation of these articles.

The first article in this issue, titled "Algorithmic Art Praxis: A Framework for Contextualized Programming Education" by Alp Tugan and Ayşe Hazar Köksal. This research utilizes a rigorously curated online database of algorithmic artworks as a primary source for content analysis and pedagogical investigation

The second research article, "Designing a Space for Documentary Filmmakers with Design Thinking Method," is written by Tuğba Arkan Demirörs, Ayşe Tüzün Güner and Selin Kılıç Dede. This paper discussed a design studio approach to put the student at the centre of the process by increasing the creativity and abstract thinking skills of students taking studio education by creating space for documentary film makers.

Chika Chudi – Duru authored the third research article, "Overview of Textile Arts/Design in Habitable Places: A Beauty to Behold in the Built Environment." this study highlights the new and innovative ways in which textiles have been showcased by textile artists, sculptors and some painters who have begun to dim the boundaries between textile design and other aspects of art

The next article, "Accessibility Analysis of Cafes and Restaurants for Disabled Individuals in Muratpasa, Konyaalti, Kepez, And Dosemealti Districts of Antalya Province" is written by Yaren Şekerci and Ayşan Ilgın Polat. This study examines the accessibility of cafes and restaurants in the Muratpaşa, Konyaaltı, Kepez, and Döşemealtı districts of Antalya for disabled individuals

Özge Ilık Saltık and Meltem Çetinel Ak authored the research article titled "Interior Design Education in the Context of Climate Change: A Systematic Assessment of Existing Capacity in Türkiye." The study aims to assess the existing capacity of interior design education in Türkiye in the context of climate change via a systematic assessment to determine the awareness levels of higher education institutes, including the actors of interior design scholars and interior design students, in Türkiye. The article based on paper presented İÇMEK Congress.

"An Investigation of How the Circular Economy's Upcycling, Repair, Reuse and Recycling Strategies Might Increase Resource Efficiency and Reduce Fabric Waste Generation in Nigeria " is the title of the article by Ngozi Kesiah Okeke. The aim of the paper is, reviewing existing practices on adoption of reuse, repair, upcycling and recycling of textile in Nigeria economy by using circular economy approaches.

The following research article in this issue is titled "Investigating the Impact of Effective Green Design Factors in the Formation of Green Hospitals" written by Razieh Rostami. This research aims to examine the topic and effective factors in the formation of green hospitals with a focus on quality and efficiency.

The article titled "Flipped Learning in Architecture: A Study on Student Comprehension and Performance in Materials and Building Construction Studios " is authored by Rabbia Tanveer Alam. This study investigates the implementation and impact of flipped learning in a Materials and Building Construction studio for third-year architecture students at the National College of Arts, Rawalpindi.

The article "A Review of Green Building Certification Systems through the Lens of Sustainable Architecture " written by Razieh Rostami, based on a descriptive and analytical method, relying on quantitative data and library research about the principles of sustainable buildings, followed by a review of various rating systems such as BREEAM, CASBEE, GBTool, U.S. Green Globes™, and LEED®.

The next article, authored by Yasemin Erdoğan Biter, is titled " Interior Design in the Age of Digital Addiction: The Role of Digital Detox Spaces." This study aims to examine the influence of minimalist and nature-based approaches in the design of digital detox spaces. The research addresses the causes of digital addiction and its detrimental effects on individuals, subsequently exploring how minimalist design principles, natural components, and sensory equilibrium can enhance the effectiveness of the digital detox process

“Value-Driven Concept: Achieving Architectural Innovation through Divergent and Convergent Thinking” by Mousa Ahmed Al-Haddad. The Article aims to introduce a structured educational framework specifically designed for architectural pedagogy, addressing significant methodological challenges in preserving philosophical and formal architectural concepts during the design process.

Farid Shahsavar is the author of the research article, "Integrating Sustainable Design, Smart Technologies, Certification in Green Hospital Architecture." This article presents a holistic approach to green hospital architecture that synthesizes sustainable design principles, energy-efficient smart technologies, green building certification systems, and seismic resilience strategies.

The research article based on the paper presented at İÇMEK Congress "AI-Guided Concept to Design Output: A Comparative Visual Analysis Based on SSIM, Histogram, and LBP in an Interior Architecture Studio " authored by Türkan Harmanbaşı. A comparative analysis was conducted between the AI-generated images and the final student designs using qualitative observations and quantitative image analysis methods: Structural Similarity Index (SSIM), Histogram Comparison, and Local Phase Descriptor (LPD). The evaluation focused on four key criteria: form, material, color, and spatial organization.

Hasan Taştan and Meryem Sevde Doğruer were the authors of the research article entitles “Developing Awareness about the Role of Cycling Infrastructure in Sustainability: Experiences from Architectural Design Studio.” The article searched cycling infrastructure in a higher education campus for sustainability in a design studio study.

The last research article is “An Innovative and Sustainable Design Approach in Contemporary Architectural Education: Parasitic Architecture” written by Fatma Kürüm Varolgüneş and Sedat Aras. This paper investigates parasitic architecture as an innovative and sustainable approach in contemporary architectural education.

Farid Shahsavar authored the review article, "Urban Design Frameworks: From Traditional Paradigms to Contemporary Landscape and Ecological Approaches" The study explores the evolution of urban design frameworks, tracing the shift from traditional models focused on spatial order and architectural form to contemporary approaches that prioritize ecological integration and sustainability.

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Algorithmic Art Praxis: A Framework for Contextualized Programming Education

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Abstract: The amalgamation of computational thinking (CT) with contextualized instruction provides a sturdy framework for enriching programming education, especially for novice learners in design-centric higher education programs, where visual and experiential learning modalities prevail. CT, recognized as a critical methodology for solving complex programming challenges, underpins the development of the Algorithmic Art Praxis (ALAP) Categories—a structured toolkit designed to bridge abstract computational concepts with tangible, art-based applications. This research utilizes a rigorously curated online database of algorithmic artworks as a primary source for content analysis and pedagogical investigation. Over 2,000 algorithmic artworks from secondary sources were subjected to a rigorous, iterative review process, narrowing the collection to 695 deeply analyzed samples that inform the database's foundational content. Through this analytical perspective, 18 distinct ALAP Categories were identified, each mirroring fundamental programming principles as exemplified in algorithmic art. These categories establish a structured taxonomy that harmonizes computational thinking activities with contextualized programming education, thereby providing a customized approach to addressing the distinct cognitive and creative requirements of design students. The ALAP toolkit, consisting of the 18 categories, a succinct reference guide, and the curated database, serves as a versatile resource for educators, researchers, and students. Through the integration of computational thinking with algorithmic art, it facilitates the cultivation of programming proficiency in visually oriented learners while promoting engagement through relevance and creativity. This framework underscores the potential of contextualized learning to transform abstract programming concepts into accessible, meaningful educational experiences.

Keywords: Computational thinking, Algorithmic art, Programming, Contextualized education, Problem-solving, Visual learning

1. Introduction

Computers have become an integral part of our daily lives across a range of disciplines, including engineering, architecture, design, visual arts and music, over the past two decades. In addition to proficiency in third-party software tools such as Word, Excel and Photoshop, the ability to read and write computer programs has emerged as a highly sought-after skill (Shein, 2014; Romero et al., 2017). While governments encourage individuals to gain computer literacy, large companies, managers, and employers have started to prefer employees with programming knowledge in their job applications, regardless of their actual requirements (Guzidal, 2009). All these developments have caused computing education to become a skill not only for

computer science (CS) majors but also for design students outside of this field.

Regrettably, programming courses have a lengthy track record of experiencing high dropout rates, failures, and inducing stress (Bryant et al., 2011). Research indicates various reasons for disengagement at programming courses independent from student majors. One of them is the prejudice against coding among students causes declining attendance to computing classes (Allwood, 1986; Winslow, 1996; Robins et al., 2003; Ring et al., 2008; Yardi & Bruckman, 2007). According to Yardi and Bruckman, younger generations perceive computer programming as tedious. Even if most teenagers use technology daily, using textual commands does not attract their interest. Although many modern programming language semantics are in English, students need help comprehend programming tools' linguistic grammar. Also, the abstract nature of programming languages compels novices on several concepts like variable types, loops, and conditional statements (Yadav et al., 2017; Robins et al., 2003; Brown & Wilson, 2018; Guo, 2017). Brown and Wilson (2018) claim that not all students have difficulty engaging with computing classes. While some novice students can effortlessly grasp the programming language syntax, some need help to handle the semantic concepts of programming language. Liao and Pope (2008) indicate that non-computer-major students are unwilling to deal only with numbers and semantic words on a white text window. Old-fashioned course materials cannot motivate students. Out-of-date computing exercises cannot help students build essential knowledge. The majority of studies advocate for educators to employ modern, high-level programming languages that generate visual output, including Processing, TouchDesigner, MAX, VVVV, and numerous others. Conversely, Hansen (2019) posits that the specific programming language employed in computing classes is inconsequential, provided that students are motivated by the relevance of the course content. As long as students are motivated by the relevancy of the course content, they internalize programming as a helpful aptitude for their vocational life (Lohiniva et al., 2021). It is therefore evident that enhancing the motivation and engagement of students represents a pivotal element within the context of programming classes. One potential solution to this issue is the implementation of a contextualized teaching approach. Previous research has demonstrated that teaching in context can positively influence student motivation (Bryant et al., 2011; Guzdial, 2006; Hansen, 2019). For students who are not majoring in computer science, contextualized courses can serve as an introductory gateway, enhancing the accessibility and relatability of the subject matter (Guzdial, 2010).

Computational thinking (CT) as a pedagogical approach has its roots in Seymour Papert's constructionist learning theory. It is considered to be an effective method for teaching programming tasks (Papert, 1980). CT has been proposed as a practical problem-solving approach, mainly through its emphasis on decomposition (Mollu, 2020). As a pedagogical approach has its roots in Seymour Papert's Constructionist learning theory (Papert, 1980). Papert's approach to constructionism highlights learning through active involvement and the creation of knowledge. This approach laid a solid theoretical groundwork for the principles and methods that later became linked with CT (Wing, 2008). Generally, CT has four main principles as a problem-solving method (Hansen, 2019). Decomposition entails separating objects, Pattern Recognition identifies recurring patterns, Abstraction involves representing the translation of collected ideas into computer domain, and finally, Algorithm Design interests arranging the order of the syntactic commands in the most optimal way related to identified programming tasks. The initial step is to deconstruct the intricate issues into smaller, more manageable components. By breaking them down into more manageable parts, it becomes possible to analyze and address each aspect effectively. Novices can handle the decomposition and pattern recognition steps using their natural language (Medeiros et al., 2019). However, effectively applying this principle requires overcoming a significant challenge because of

the tacit nature of computer programming. Tacit knowledge refers to the implicit understanding gained through experience and practice, which is often challenging to articulate and share explicitly (Polanyi & Sen, 2009). In programming practice, conveying the specific heuristics and strategies used to decompose complex problems makes it challenging to implement CT principles effectively, which poses a barrier to learners and practitioners. As a result, motivational issues arise, and students tend to drop classes or lose interest in the topic (Farah et al., 2020). Research indicates that beginner programmers demonstrate an intuitive grasp of step-by-step instructions in natural language, influencing their approach to programming tasks (Bonar & Soloway, 1983, 1985). While natural language aids in understanding computational concepts, it also presents challenges when used for coding (Good & Howland, 2017). Novices often require support translating their natural language understanding into formal programming languages, leading to misconceptions and bugs (Bonar & Soloway, 1985). Studies have shown that beginners can articulate required instructions in natural language narratives but need help converting these ideas into programming constructs (Souza et al., 2011). In light of these challenges, researchers have put forth design guidelines for novice programming environments that take into account the role of diverse notations, including natural language, in facilitating a range of programming activities (Good & Howland, 2017). Despite teaching in context increases student motivation and CT eases the process of analyzing and identifying the programming tasks, novices face off to a new layer of challenge. In the context of computer art, novices need to learn programming, and also complex algorithms used by artists. While CT lacks of customized tools, teaching in art context demands for complex programming paradigms (Medeiros et al., 2019). Repenning et al (2016) notes that there need to be tools for different contexts of Computational Thinking. Computational Thinking Tools are designed to educate users and promote computational thinking. It is imperative that they address not only the syntactic aspects of programming, but also the semantic and pragmatic elements, while providing support for the formulation of problems, the expression of solutions, and the execution and evaluation of solutions. This approach can facilitate computational thinking in various disciplines without introducing unnecessary complexity. These findings highlight the necessity of establishing a connection between novices' intuitive understanding and formal programming languages in the context of computational thinking and programming education. Following these implications, there needs to be additional materials in order to ease the process of knowledge translation. In that sense, we articulate the following research question: ***"How can we integrate programming fundamentals with Algorithmic Art to enhance computational thinking skills, such as pattern recognition, abstraction, and algorithm design that emphasize real-world applications for higher education?"*** To answer this question, the systematic review and content analysis of 2000 images representative Algorithmic works of art were performed. In light of our research findings, we have devised a framework and presented a case study that educators can employ in the context of contextualized programming classes. We created semiotically meaningful constructs by identifying and classifying common strategies used in algorithmic art. These constructs act as shared symbols and representations, facilitating communication and knowledge sharing about tacit knowledge related to CT application.

2. Methodology

The development of the Algorithmic Art Praxis study involves a thorough review of online secondary data sources, including online databases, art galleries, and research centers. We created an online database[1] using a third-party web application to organize all resources in one place and provide learning and practice material for other researchers, educators, and students. The data was systematically analyzed by collecting and categorizing the artworks based on their formal aspects, such as style, medium, and composition. The categorization system, referring to the programming practice, was developed using an iterative design

approach, which involved continuous refinement based on recorded samples related to the creative coding practices.

2.1. Data Collection

A comprehensive review was conducted of 2,220 secondary source images, from which 695 were selected for detailed analysis and recorded as entries in the database. Data was collected from reputable sources, including museum websites, digital art archives, and scholarly publications (Table 1). In selecting images for the online repository, consideration is given to the formal aspects of the artwork's visual composition. Provided that the final image is not solely a three-dimensional rendered or realistic image, it may be added to the collection for analysis.

The utilization of secondary data sources as a sample collection method is a crucial aspect of this research. The artworks' images and scanned photographs are collected from various sources, including gallery web pages, funded research collectives, published books, and magazines. When choosing a data source, it is of utmost importance to prioritize websites that are affiliated with official institutions,

Table 1: *List of secondary sources.*

Name	Content Type	URL
Atari Archives	Computational	www.atariarchives.org
Computer Art	Computational	dada.compart-bremen.de
DAM.org	Computational	dam.org
Digital Art Museum	Computational	digitalartmuseum.org
Guggenheim	Mixed	www.guggenheim.org
Internet Archive: Computers and Automation (1940-1980)	Mixed	www.archive.org
MOMA	Mixed	www.moma.org
MOMA San Francisco	Mixed	www.sfmoma.org
The MET Museum	Mixed	www.metmuseum.org
Monoskop	Mixed	monoskop.org
Rhizome	Mixed	rhizome.org
Scanlines: Computers & Art (1970-1980)	Mixed	scanlines.xyz
Spalter Digital	Mixed	spalterdigital.com
TATE	Mixed	www.tate.org.uk
The Art Story	Mixed	www.theartstory.org
TOPLAP	Mixed	toplap.org
Victoria & Albert Museum	Mixed	collections.vam.ac.uk
Whitney Museum of American Art	Mixed	whitney.org
WikiArt	Mixed	www.wikiart.org
ZKM	Mixed	zkm.de/en

communities, or other trustworthy sources. In pursuit of this objective, we have drawn upon the websites of distinguished institutions such as the Museum of Modern Art (MoMA) and the Guggenheim Museum, as well as those of esteemed researchers in the field, including DAM (Digital Art Museum), Spalter Digital, and Monoskop. For a comprehensive list of the research sources consulted, please refer to Table 1. The table features three columns, each containing relevant information in an organized manner as following;

- **Name:** Official name of the institution/collective/research center/museum.
- **Content Type**: The website's content can be classified into two principal categories: computational and mixed. Computational content encompasses technology-based artworks, including computer art, algorithmic art, and (new) media art. Mixed content, in contrast, incorporates both traditional and technology-based works of art.
- **URL:** Includes the website address of the relevant item.

Mixed type content sources involve a large repository of artists from diverse fields and artworks with variable mediums. The ones in the Table 1 like Victoria & Albert Museum website is not dedicated to works of computer art. However these sources collected vast amount of algorithmic art works as well. Rather than searching by artist names, keyword or tag based search method allows access all available works of art under the relevant keyword. The keywords used for searching the databases including mixed type are “Computer Art,” “Algorithmic Art,” “Generative Art,” and “(New) Media.”

The sources with “Computational” type like Anne and Michael Spalter Digital Art Collection, also known as Spalter Digital, is a prominent private collection of early computer art, renowned for its extensive scope and significance. It is home to over 1000 artwork images, making it one of the world's largest collections in the context of computer art, as per our research. While its primary focus lies in plotter drawings, the collection encompasses various other 2D media, including sculpture and 16mm film. It boasts major works and iconic pieces created by key artists in the field.

We utilized various secondary data sources in our research, including the Internet Archive[2] (IA), which offers a wide array of document sources covering diverse topics (Internet Archive, 2023). Our exploration of the IA website led to the discovery of documents related to early computer art, including one of the earliest open calls for computer art in the "Computers and Automation" magazine, which was published from the 1940s to the 1980s before assuming the name "Computers and People" in the 1970s (Berkeley, 1963; Franke, 1971; Macdonald, 1981). IA was an invaluable resource for accessing early works of algorithmic art and provided insight into early programming practices for creating algorithmic compositions from the 1950s to the 1970s. Our thorough review encompassed a total of 315 issues from the IA website, uncovering some of the earliest examples of computationally generated art. The complete archive is accessible on the IA webpage, and we meticulously reviewed each volume by examining pages and contents. Our review of the monthly issues involved two methods: The first method entailed searching for keywords such as "computer art," "computer-art," "algorithmic art," or "algorithmic-art." However, locating specific text within the scanned magazines proved challenging. The second method involved generating thumbnails of each page using a third-party application or IA's built-in PDF viewer, enabling us to more accurately and efficiently identify computer-generated artworks. This approach facilitated gathering more comprehensive information about the algorithmic artworks and their production methods.

2.2. Online Database System and Interface

In order to develop an accessible web application, we employed Notion[3], a note-taking application with a well-structured database infrastructure that perfectly aligns with our requirements. By utilizing Notion's relational database framework, we are able to

input and deploy data to the web swiftly and efficiently, thus saving valuable time and resources. Furthermore, its cloud-based system enables us to instantly upload new images, input data, and promptly publish the new content online.

The database consists of 695 entries we carefully selected from a pool of 2200 samples discussed in the preceding section. Each entry contains ten distinct properties that provide information about the entry. Table 1 illustrates the database infrastructure. The Medium and Classification parameters can accommodate multiple values based on information obtained from image sources. The Praxis parameter can also hold multiple values derived from contextual analysis of the artwork about programming principles. Except for the category names in the Praxis section, all the information has been utilized as indicated in the relevant sources. The naming convention for the category names in the Praxis section will be elucidated in the subsequent section.

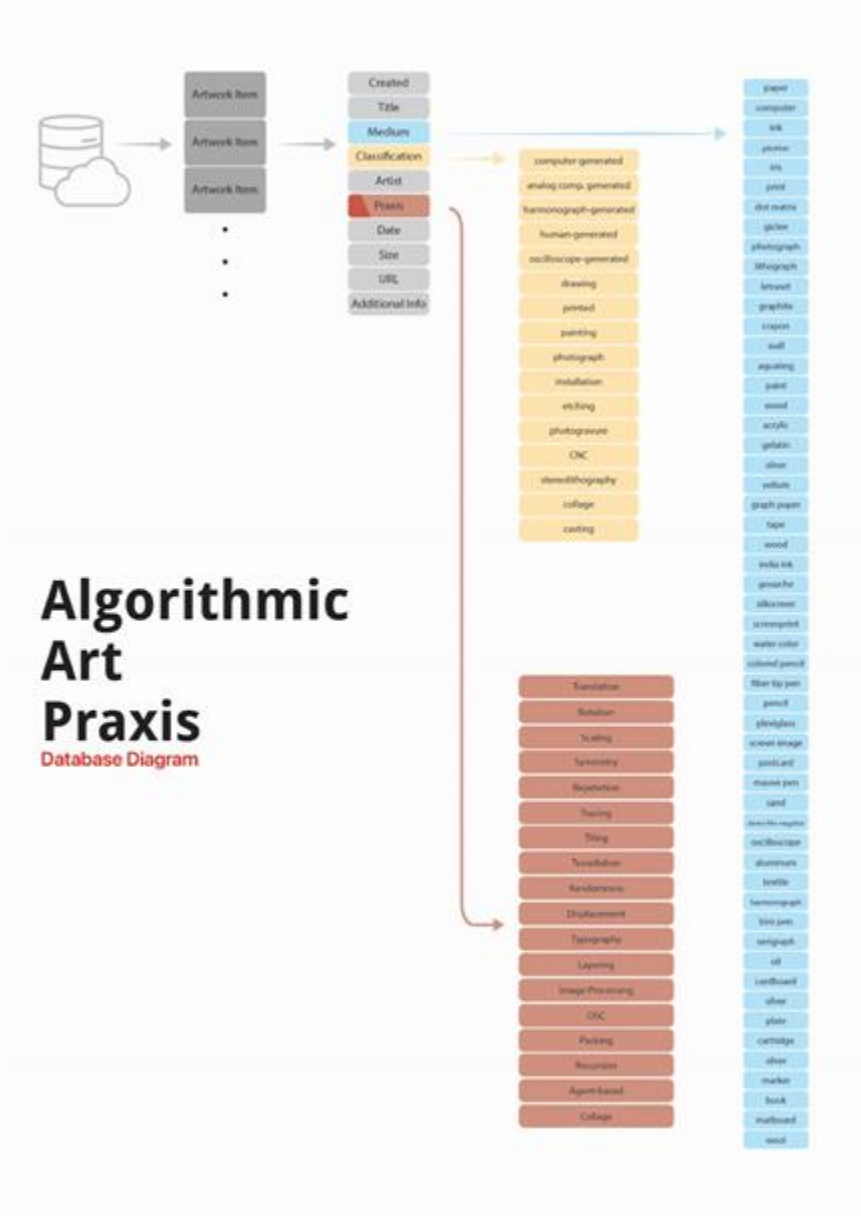

Figure 1: *Algorithmic Art Praxis Database Infrastructure*

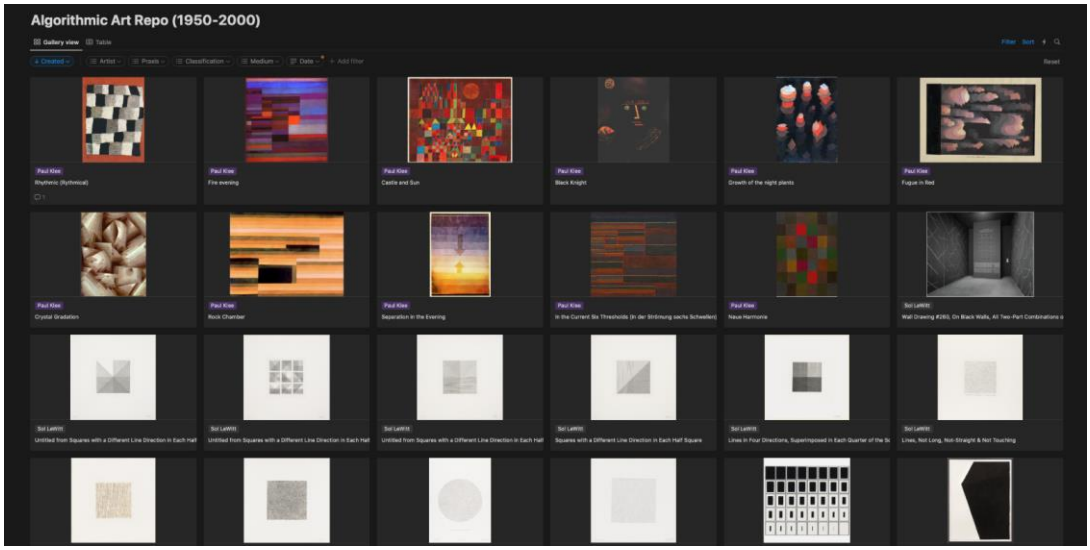

Figure 2: *ALAP Database Thumbnail View is online and accessible at* **https://tinyurl.com/alap-database**.

Each entry in the database consists of a singular image or multiple variations of the same artwork if the artist created them. The name of the artist and the artwork are displayed on each item in the gallery, as shown in Figure 3.

Users can access detailed information When they interact with an artwork displayed in the gallery (Figure 4). The gallery items share common parameters.

Figure 3: *Gallery Item Close Up View*

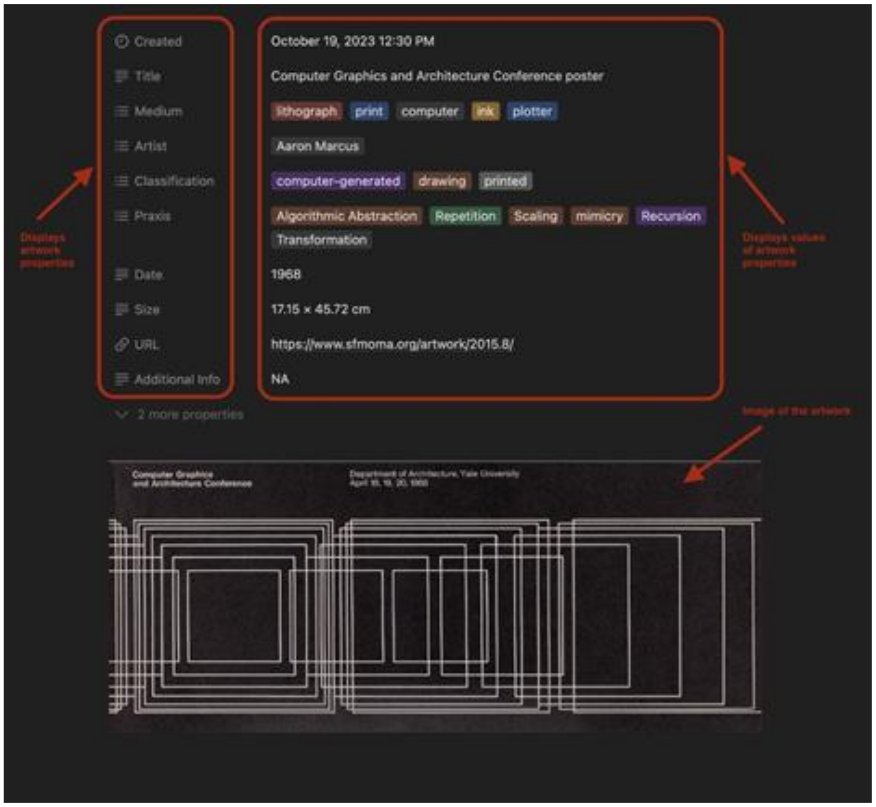

Figure 4: *Detail View of Clicked Artwork Item*

The following Table 2 lists the available sample (artwork) parameters, and their relevant descriptions related to Figure 4.

The database is designed to display a single image for each artwork item. However, the increase in the number of samples has led to an

Table 2: *Database Item Parameters and Descriptions*

Parameter	Description
Created	Database Item creation date.
Title	The artwork's official title.
Medium	The tangible supplies that were utilized to make the artwork.
Artist	The artist(s)'s name and last name.
Classification	Processes used to produce the artwork.
Praxis	Outlines the potential algorithmic practice categories that could be applied to produce the artwork.
Date	Artwork creation date.
Size	The original dimensions of the artwork (metric or inch units).
URL	The official source of the artwork.
Additional Info	Information regarding the technical hardware and methods used in creating the artwork.

issue with similar artworks. This similarity is due to algorithmic art techniques, such as randomness, weighted distribution of numbers, and stochastic decision processes (Bailey, 2018; Phon-Amnuaisuk & Panjapornpon, 2012). Artists who use computers and algorithms to create variations of the same artwork by tweaking parameters based on computational paradigms produce results that are formally similar but aesthetically different (Boden & Edmonds, 2009; Galanter, 2016). At times, artists may choose to exhibit all iterations, while other times they may not. The images in the database have been thoughtfully organized based on their formal resemblances. If a set of works was produced within an iterative approach, an artwork item in the database may include multiple images, as explicitly declared by the source or if it is obvious. For example, Aaron Marcus' Cybernetic Landscapes series (Figure 5). The main goal was to group similar artworks together, prioritizing this over arranging them according to their series. Nonetheless, all relevant details have been provided to aid fellow researchers in tracing the origins of the artwork, including information on whether it belongs to a series or not.

2.3. Analysis and Results

The development of the ALAP categories followed an iterative design process (Figure 6). This approach allowed for continuous refinement of the categorization system as new data was incorporated into the ALAP database presented in the previous section. The Praxis categories have been carefully crafted to align with the formal and compositional aspects of the artworks. Through a thorough review of over 695 algorithmic works of art samples from 1920 to 2000, 18 distinct category names have been identified.

The main inspiration for the category names is the fundamental ingredient of creating a visual representation, the vertex. In computer graphics, geometric forms are defined through points per pixel. A vertex represents a point in space determined by both x and y coordinates. We can position the vertex in a computer

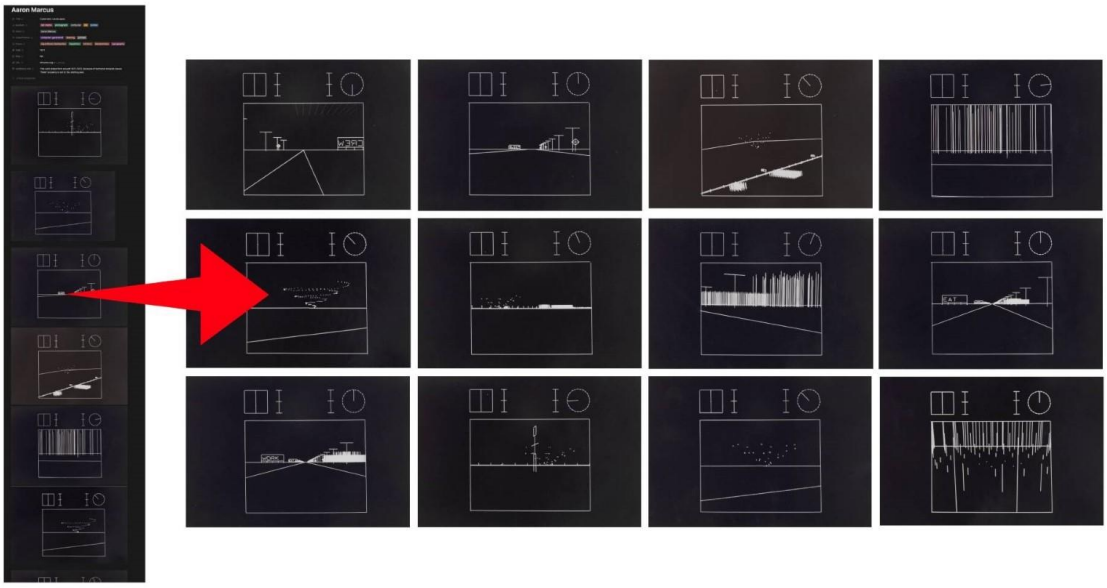

Figure 5: *Cybernetic Landscapes Series by Aaron Marcus*

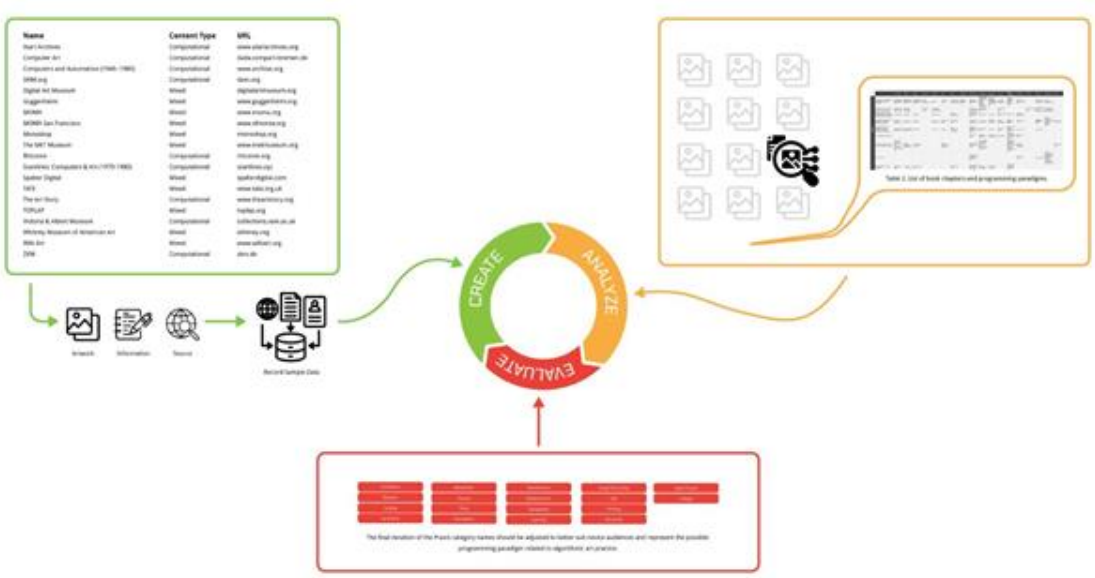

Figure 6: *Cybernetic Landscapes Series by Aaron Marcus*

window at any location. If we increase the number of vertices on the canvas, we can create more complex forms. A line comprises two vertices, while a triangle requires three, and a quadrilateral comprises four vertices, as shown in Figure 7. Whether a simple shape or a complex geometric form, the graphical element on the screen is the cause of vertices organization. By moving or rotating the vertices around a point, we can transform a geometric form into a leaf or increase the size of the leaf to fit our needs. In a basic sense, we can create any visual element using these three actions. We took these three properties for granted while determining the category names in the Praxis category. Thanks to programming language references and pre-coded examples, we compiled a list of function and algorithm names to serve as category names for representing a programming practice of the artworks.

We derived the category names using the list referenced from programming terms and algorithm names within creative coding frameworks depending on textual programming languages such as Processing (Reas & Fry, 2007; Shiffman, 2008; Terzidis, 2009; Pearson, 2011), P5JS (McCarthy et al., 2016), and openFrameworks (Noble, 2009; Perevalov & Tatarnikov, 2015). In our analysis, we meticulously document the formal aspects of elements in artwork images, focusing on the vertices of graphical elements. We thoroughly review the book chapters to identify relevant programming practices, and we organize each chapter with its respective page number under

Figure 7: *Vertices shape simple and complex polygons in computer graphics*

		Translation	Rotation	Scaling	Symmetry	Repetition	Trace	Tiling	Tessellation	Randomness	Displacement	Typography	Layering	Image Processing	Oscillation	Packing	Recursion	Agent-based	Collage
BOOKS	Algorithms for Visual Design Using The Processing Language	Implementing Transformations (76)	Implementing Transformations (76)	Implementing Transformations (76)	Cellular Automata (168)	Loops (8)	Line Traces (133)	Creating Grids of Shapes (80)	Voronoi Tessellation (154)	Order and Randomness (60)	The Structure of Shapes (63), Selecting Points, Segments, Shapes, or Groups (102)	Fonts and Images (20), Choice, Label, and TextField (98)	Grouping of Code (28)	Pointillist Images (48), Image Processing (109)	Sine and Cosine Curves (42)		Recursion (33), Fractals (162)	Cellular Automata (168)	
	Generative art: A Practical Guide Using Processing	Programmatic drawing (19)	Rotational drawing (66)		Exploration (180)	Looping (34), For loops (39)				Randomness and Noise (51)	Turning a circle into a spiral (67)		Drawing order (24)			Circle Packing (171)	Fractals (155), Infinite recursion (158)	Autonomy (127), Software agents (146)	
	Getting started with p5.js: Making Interaktive graphics in JavaScript and Processing	Translate (89)	Rotate (91)	Scale (96)		Repetition (46)		Rows and Columns (51)		Random (127), Roll the Dice (140)	Spirals (135)	Fonts (112)	Drawing Order (25)	Images (104)	Sine Wave Values (133)				
	Processing: A Programming Handbook for Visual Designers and Artists	Translate, Matrices (133)	Rotate (137)	Scale (137)		Repetition (61)	Lines, Curves (279)	Check boxes (444)		Decisions (51), Random (127)	Vertices (69)	Text (101), Typography 1 (111)	Lesson 3: Organization	Image Processing (355)	Trigonometry (117)		Parameters, Recursion (197)	Machine, Organism (291), Simulate 1 (461), Simulate 2 (477)	Collage (148)
	Learning Processing A Beginner's Guide to Programming Images, Animation, and Interaction	Translation and Rotation (227)	Translation and Rotation (227)	Scale (242)		Loops (81)	Trail (35)	Two Dimensional Arrays (220)		Random Numbers (203), Perlin Noise (207)	Vertex Shapes (223)	Text (305)	Organization (99)	Images (255), Image Manipulation (277)	Cosine (212)		Fractals (217)		
	openFrameworks Essentials									Perlin noise (108)	Geometric patterns (32)	Drawing curves and text (164)	Layers (68)	Drawing an image file (60), Mixing layers (65)	Simple LFO (106)				
	Mastering openFrameworks: Creative Coding Demystified	Coordinate system transformations (40), ofTranslate (187), Translate (261)	Rotating images (87), ofRotate (187)	ofScale (187), scale (261)			Offscreen Drawings (48), Trails (72)			ofRandom (29), Perlin Noise (321)	Control Points (39), Working with vertices (200), Deforming with shader (231)			Loading and Drawing an Image (84), Modifying (99), Image Processing (229), Filtering (256)	sine (34), Oscillating Plane (201)				Transparency (91)
	Nature of Code									Random Walks (1), Perlin Noise Basics (17)					Oscillation (101)		Fractals (355)	Particle Systems (143), Autonomous Agents (260), Cellular Automata (323), Neural Networks (444)	
	Cinder Creative Coding Cookbook	Translating (193)	Rotating (193)	Scaling (193)				Tile Renderer (94)		Vector graphics (90), Perlin Noise (236)	Aligning Particles (124)	Text Around Curve (174)		Using Image Processing Techniques (55)					

Figure 8: *Sources and book content relevant to the ALAP Categories*

the appropriate draft category name. Figure 8 displays the finalized category names, with book titles listed along the vertical axis and relevant topics associated with each category name listed along the top horizontal axis. Each cell within the table contains the corresponding book title and the page number in parentheses.

The iterative design process involves creating, testing, and refining a product/concept until it achieves the desired outcome. This process includes continuous comparisons, improvement, and adaptation to evolving needs. Creative coding frameworks like P5JS are primarily designed in high-level programming languages, resembling written human natural language in English. Consequently, for our research, the naming convention aims to mirror natural language as much as possible. We aim to keep Praxis category names comprehensible for novices without additional research into a programming practice. The process comprises three key phases: creation, analysis, and evaluation, illustrated in Figure 6.

1) **Creation**: Each image was added to the database as a sample, and its data was recorded based on the information obtained. Notably, no entry was made for the Praxis section during this stage.

2) **Analysis**: Once all the information collected from the source was entered into the database, the Praxis category was identified based on the formal and compositional features of the artwork, and its name was directly derived from the list of categories illustrated at Figure 8.

3) **Evaluation**: As the dataset grew, the Praxis categories underwent frequent review and refinement to accommodate the increasing number of new images. This led to further enhancements of the existing categories and, in some cases, the introduction of new ones to maintain precision and ensure an accurate representation of the data. For example, the initial version of "Transformation" was later changed to "Translate" to align with creative coding paradigms and programming languages. Eventually, "Translate" was refined to "Translation" to emphasize the practice rather than referencing a specific programming language syntax, as the Praxis category names need to be programming language agnostic. It was important to avoid confusion for beginners using different programming languages than Processing or P5JS, hence the adjustment from "Translate" to "Translation."

The iterative design process allowed the Praxis category system to evolve and adapt to the increasing data, fostering a robust and flexible framework for algorithmic art categorization to represent relevant programming practice. This evolution ensures that the system remains robust and up-to-date, ready to handle the

Figure 9: *Artworks showcase transformational behaviours.*

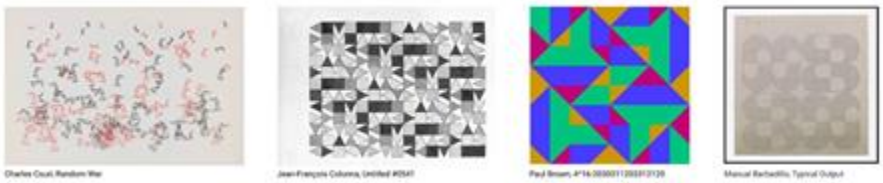

Figure 10: *Artworks showcase rotational behaviours*

complexities of algorithmic art categorization. We provide comprehensive explanations and a collection of sample artwork images from our online ALAP database for every category listed below. It should be noted that all reference images of artworks per category can be accessed in larger resolution via the online ALAP Database as well (https://tinyurl.com/alap-database). Also, there are video tutorials on how to use the interface of the database[4].

Translation: It refers to changing the x and y coordinates of the individual vertices separately or all together. Transformation is close to Displacement. The difference is that the vertex points gradually form from a primitive shape to another complex shape. "Return to Square" is an excellent example of this behaviour. The main property to define transformation can be viewed in (Return to Square) work. The use of translate function can be used (Figure 9).

Rotation: It represents the change in the orientation of objects on the canvas (Figure 10).

Scaling: It represents the change in the dimensions of objects on the canvas (Figure 11).

Symmetry: It depicts mirrored forms of representations. Sometimes, it is combined with other Praxis, and results in minor differences might occur (Figure 12).

Figure 11: *Artworks showcase dimensional behaviours*

Figure 12. *Artworks showcase symmetric behaviours*

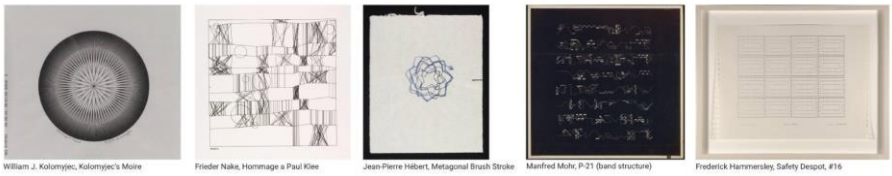

Figure 13: *Artworks showcase repetitive behaviours*

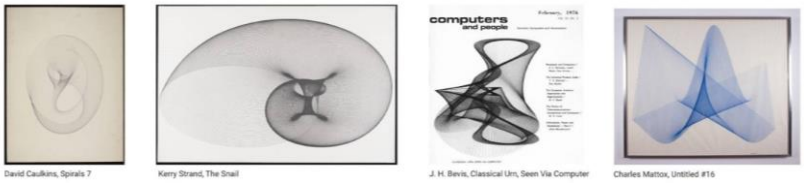

Figure 14*: Artworks showcase leaves of traces behaviours*

Repetition: It means repeating an action manually or computationally repeatedly in a limited amount of cycles to produce the visual form. Repetition is often used to create patterns, textures, and complex visual structures. Loops are a common way to implement repetition in computer programs. They allow a specific set of instructions to be repeated a certain number of times (Figure 13).

Trace: It occurs when the object's opacity decreases or increases through the canvas. The main difference between Tracing and Layering is the way they represent how the following or upcoming forms are structured. Tracing is a continuous set of repetitions, whereas layering is more like the style of color printing techniques applied in traditional printing press (Figure 14).

Tiling: Tiling is a way of creating a grid-based distribution on the canvas. Individual patterns in the grids do not have to be continuous or mixed with each other. Multiple objects or object groups can be positioned in a regular grid manner. Individual patterns in the grid can be different from each other (Figure 15).

Tessellation: The art of Tessellation is a one-of-a-kind computer-generated technique that produces visually appealing and seamless patterns by utilizing a variety of shapes. This artistic form has a lengthy history and can be observed in numerous creative and mathematical ventures (Torrence, 2021). Even though Tessellation and tiling both involve covering a surface with a pattern of flat shapes, these terms are different. Tessellation pertains specifically to the creation of patterns by fitting shapes together without gaps or overlaps. In

Figure 15*: Artworks showcase tiled behaviours*

***Figure 16**: Artworks showcase tessellated behaviours*

***Figure 17:** Artworks showcase random behaviours*

Tessellation, each tile must have a relational and formal connection in order to create a grid-based distribution. Tiling, on the other hand, is a more general term that refers to covering a surface with a pattern of flat shapes that may or may not meet the specific requirements of Tessellation. In short, every Tessellation involves Tiling, but not every Tiling can be considered a Tessellation (Figure 16).

Randomness: It represents stochastic decisions executed through a series of numbers by pre-defined programming tools. Similar to the notion of throwing a dice or tossing a coin in real life. There is a 1/6 possibility of getting six from dice and a 1/2 possibility with a coin to get head or tails. Sometimes artists get benefit from the random decisions (Figure 17).

Displacement: There must be a form that can be generated at least 3 points. It is the act of repetition by modifying the existing form. Displacement tells us the change of a specific vertex or vertices position. The formal changes must be observable, such as in Figure 18.

Typography: It means a typographic element used in the artwork, like fonts or graphics, that generates textual forms (Figure 19).

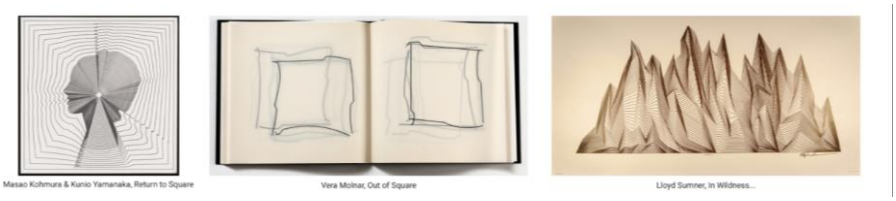

***Figure 18:** Examples of artworks exhibiting displacement behaviours*

***Figure 19:** Examples of artworks exhibiting typographic features*

Figure 20: *Examples of artworks that exhibit stratified behaviours*

Figure 21: *Examples of artworks that demonstrate processed image behaviours*

Layering: Layering refers to the procedural drawing order of the visual elements on the canvas. An explanatory example of layering can be Frieder Nake's work, which is a type of layering. During the periods of plotters, it was not possible to draw multi-color images. Another approach was to redraw iterations of the same idea on the same paper by switching the marker or pen (Figure 20).

Image Processing: In image processing category, usually, the image is preloaded into the computer buffer. The artist may use additional filters to this data and create something similar or a completely different image from the loaded data (Figure 21).

Oscillation (OSC): The concept of oscillation pertains to the recurring pattern of periodic phenomena, such as that of a sine wave. One can observe a repetition of neighbouring points in the visual representation; it could imply the utilization of trigonometric functions. The periodic pattern may consist of distinctive alterations with each cycle. It does not have to depict the reoccurrence of the same graphical object due to the nature of computer art programming practices and the artist's intuition (Figure 22).

Packing (Space-Filling): Packing involves fitting the objects into a limited space (a.k.a space-filling or packing algorithm). The rule is that objects must not interfere with each other (Figure 23).

Figure 22: *Examples of artworks that demonstrate forms of wave like behaviours*

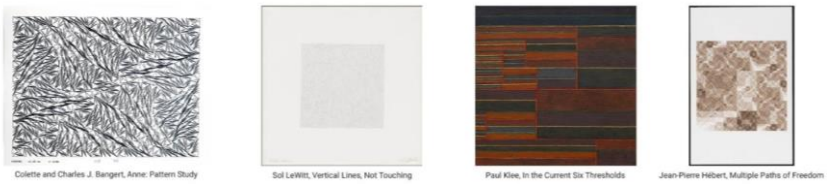

Figure 23: *Examples of artworks that Packing behaviours*

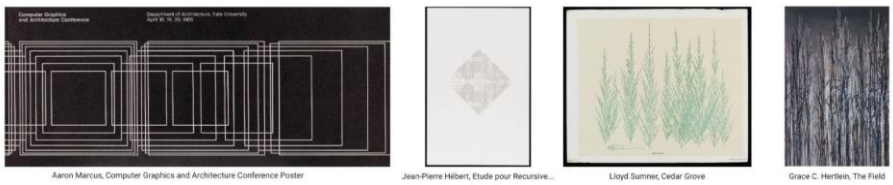

Figure 24: *Examples of artworks that demonstrate recursive behaviours*

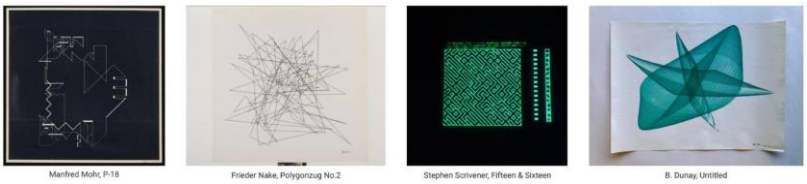

Figure 25: *Examples of artworks that demonstrate autonomous behaviours*

Figure 26: *Examples of artworks that demonstrate collage like behaviours*

Recursion: Recursion is a programming technique where a function calls itself to solve a problem. It can be used to create complex and organic forms in computer art. Recursion is different than repetition in terms of paradigmatic aspects in programming. For example, a repetition using a for loop draws five circles in a row, each with a slightly different x-coordinate. A recursive function draws a fractal pattern by repeatedly drawing circles and calling itself with a smaller size—for example, Georg Nees. In summary, repetitions via for loops are well-suited for simplicity, while recursion can create more complex and organic patterns in computer art (Figure 24).

Agent-based: The artist creates an algorithm, a mechanical device, or instructs human agents to produce the artwork by instructing the agents partly or entirely (Figure 25).

Collage: Collage praxis category is like the traditional collage methods in art. Variable techniques can be applied and combined in algorithmic art. Images can be cropped manually and then transferred to the computer, and using programming practices, they can be positioned on the canvas (Figure 26).

The ALAP database can serve as customized learning material for contextualized programming education. Instructors can utilize examples from the database to demonstrate relevant programming practices. Novices can explore the database to understand the connection between programming practices and visual compositions within Algorithmic Art. Prior to advancing to the next section, it is necessary to introduce a pair of helpful tool for learners: the ALAP Categories and Cheat Sheet (Figure 28). The final stage of our study involves organizing all the information into a manageable framework and incorporating illustrations for each category item. The resource is designed for two separate A4 size paper and can benefit both learners and educators during the analysis of algorithmically created visuals.

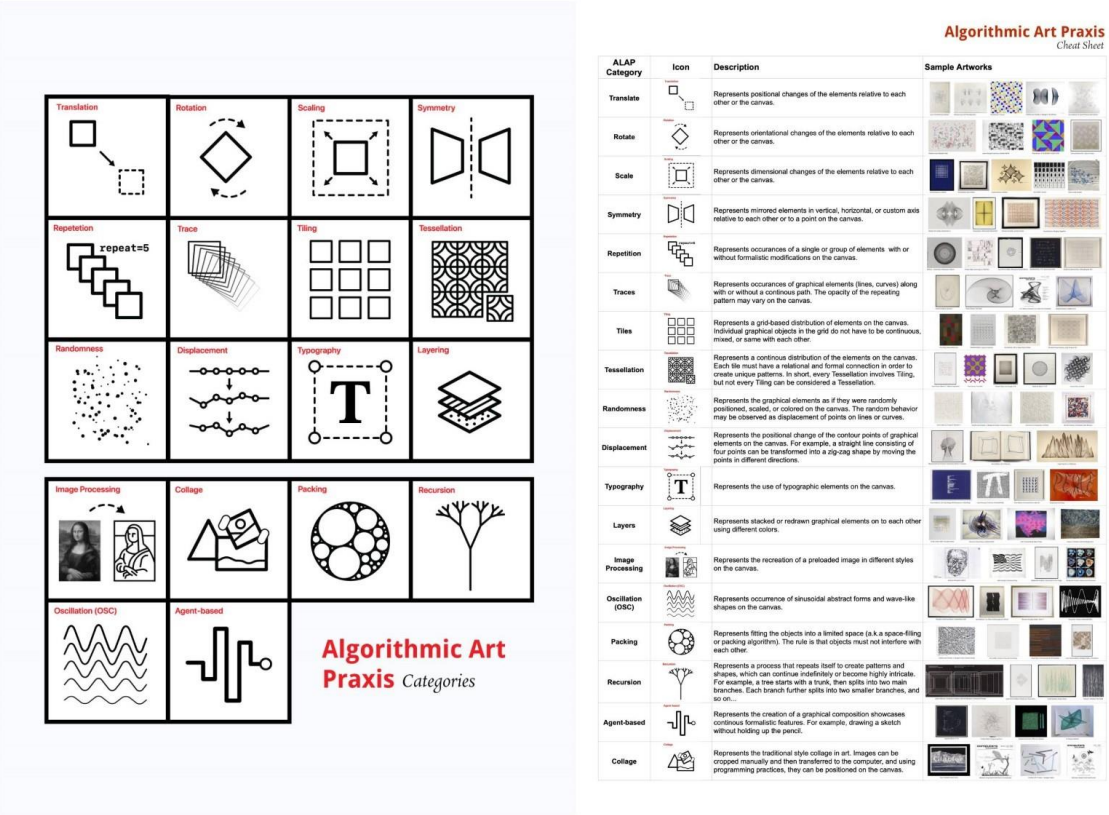

Figure 27: *ALAP Categories (left) and Cheat Sheet (right)*

As our primary audience consists of visually oriented learners, we have developed 18 distinct illustrations representing each category, along with a corresponding cheat sheet containing descriptions for each category. This resource aims to help beginners easily grasp the programming practice and patterns depicted in the artwork during their potential lectures. In addition to the online ALAP database, the printed versions of the categories and cheat sheet are intended to serve as tangible tools to facilitate the CT process during programming activities.

3. Case Study

In our case study, we will be utilizing the P5JS creative coding tool, which is based on the JavaScript programming language. However, individuals with intermediate or advanced programming skills can adapt and employ these concepts in other textual or visual programming languages. It is assumed that the students have a fundamental understanding of programming theory, including the concepts of variables, functions, and loops.

The case study will follow the following steps

1. Choosing an artwork from the online ALAP database.
2. Printing the ALAP Categories and Cheatsheet.
3. Applying Computational Thinking principles to analyze the artwork.
4. Using the ALAP Categories to address the programming tasks.

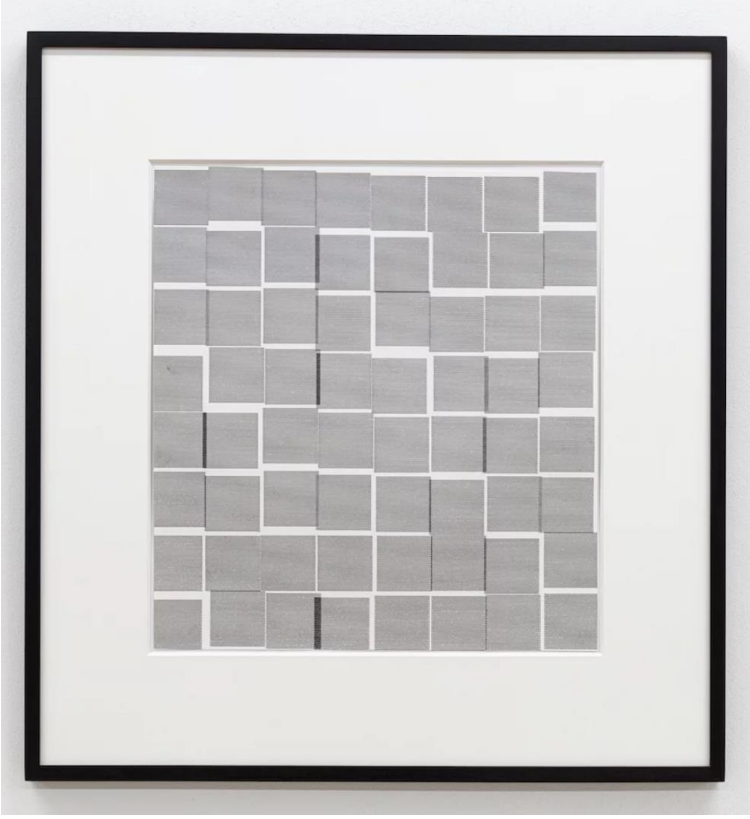

Figure 28. *Vera Molnar, Carrés (1991)*

For this case study, we have selected Vera Molnar's artwork "Carrés" (Figure 28).

By leveraging the principles of Computational Thinking (CT), we can systematically address the problem and devise a solution. Decomposition, Pattern Recognition, Abstraction, and Algorithmic Design principles of CT offer a structured approach to problem-solving and can provide guidance through the process of re-creating the selected algorithmic artwork using P5JS.

Decomposition is the process of breaking down a problem into smaller, more manageable parts. When creating Molnar's artwork, this step involves identifying the individual elements in the composition. During this phase, we concentrate on the formalistic features and observe the artwork's formal aspects without considering the programmatic part. For beginners, it's helpful to meticulously jot down every tiny physical feature they notice in the composition using their preferred medium, such as writing or illustrating on paper or a digital tablet. This approach allows us to focus on individual tasks one at a time, rather than attempting to figure out the entire computer program all at once. Figure 29 depicts our notes on the decomposition step.

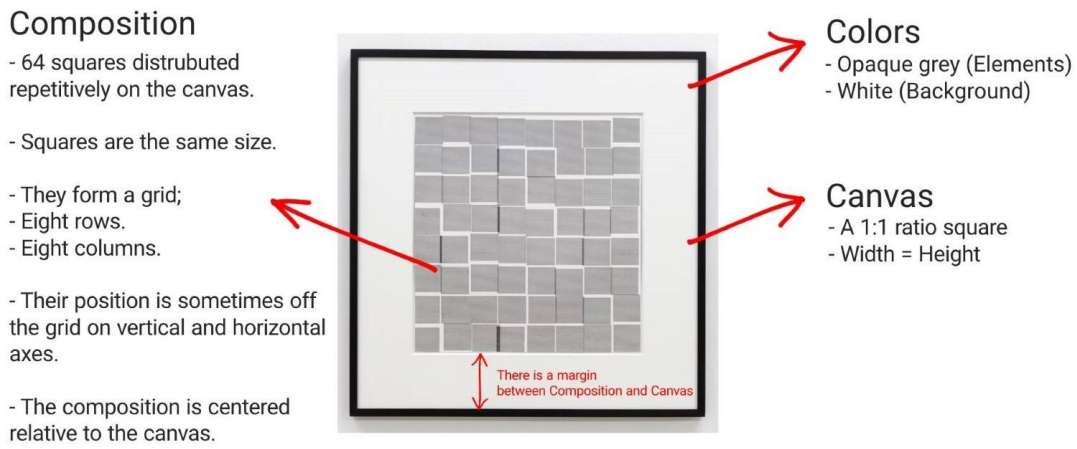

Figure 29: *Notes for Decomposition step*

In this step, we identify the correlations and relationships between different composition parts. For example, all elements in the artwork are copies of the same square. Therefore, we do not need to declare the size for each square individually. Instead, we can define a variable to hold the size of a square and instruct the computer program to use that same value for all squares. Another formalistic feature we can identify is the noticeable vertical distance between each row compared to the horizontal distance between squares. Even if the positions of the squares appear random, the vertical distance varies more than the horizontal distance.

Similarly, we can define another variable to store the color value of each square. The ALAP Categories sheet also acts as a bridge, allowing us to identify programming paradigms observed in the artwork (Figure 30). For instance, the objects appear to be distributed in a grid format resembling an 8x8 matrix, even if they seem randomly positioned on the canvas. We can categorize this as Tiling and start researching relevant sources related to the P5JS programming language. Upon observing the position of each square, we notice they are slightly off their exact position, displaced by a few pixels to the left, right, up, or down. This leads us to identify randomness as a part of the composition but with constraints, such as just a few pixels of variation.

Additionally, the margin between the composition and the frame depends on the size of the squares. The margin from the sides is two times larger than the size of a square. In this step, the possibilities are endless, and the discovery of patterns may vary according to the viewer's experience and level of familiarity with the compositional aspects of an artwork. It does not require specific talent but depends on how one looks at and perceives their environment. We mark down the Translation and Repetition categories because the squares are distributed on the canvas repeatedly. Lastly, we mark layering because the drawing order matters.

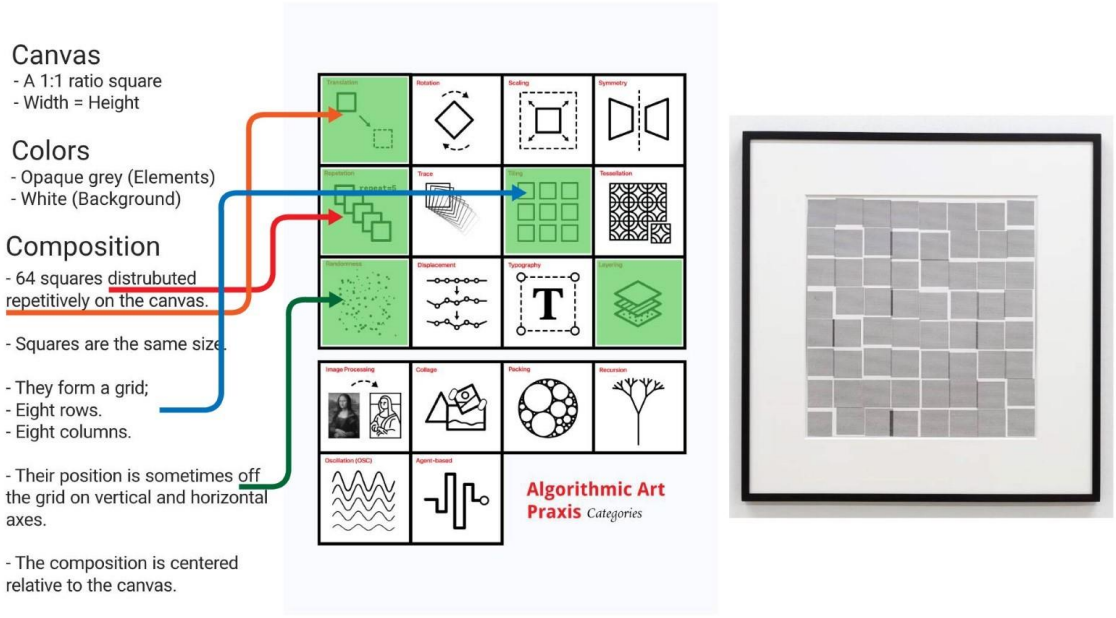

Figure 30: *Abstraction of Programming Practices Identified*

In the abstraction step, it's crucial to simplify complex concepts by concentrating on their essential features based on the capabilities of our computer and programming language, using the ALAP categories sheet as a guide. As shown in Figure 31, we can align the programming paradigms with our notes on the artwork. Instead of using natural language at this stage, we should express our findings in a declarative manner to ensure they are meaningful to the computer. During this phase, we can establish variable names such as "colorBg" for the background color and "colorSquares" for storing square color values. At this stage, we commence coding by declaring variables and assigning values. Figure 31 illustrates ten distinct variables extracted from our previous analysis. The abstraction stage resembles uncovering the meaning of a term in a particular language from a dictionary. The ALAP Categories sheet helps us search for relevant code snippets, online resources, and tutorials.

In the final step, we create a step-by-step procedure to develop the computer program. Figure 32 displays the code with comments indicating its function. Additionally, we organize the code snippets to present the relevant ALAP categories. To achieve Tilling, we employ nested for loops (lines 35,36). Within the inner loop, spanning lines 37 to 44, we initially compute x and y-axis values (lines

```
1   let columns = 8;      // total number of columns
2   let rows = 8;       // total number of rows
3   let squareSize = 50;  // size of each square
4
5   let startX;           // x position of to start drawing elements
6   let startY;           // y position of to start drawing elements
7   let margin;           // The margin of the drawing relative to the canvas sides
8   let canvasW;          // The total width of our canvas
9   let canvasH;          // The total height of our canvas
10
11  let colorBg = 'rgba(253, 254, 253, 1)'; // Red, Green, Blue, Alpha values
12  let colorSquares = 'rgba(10,10,10,0.4)';
13
```

Figure 31: *Variable declaration*

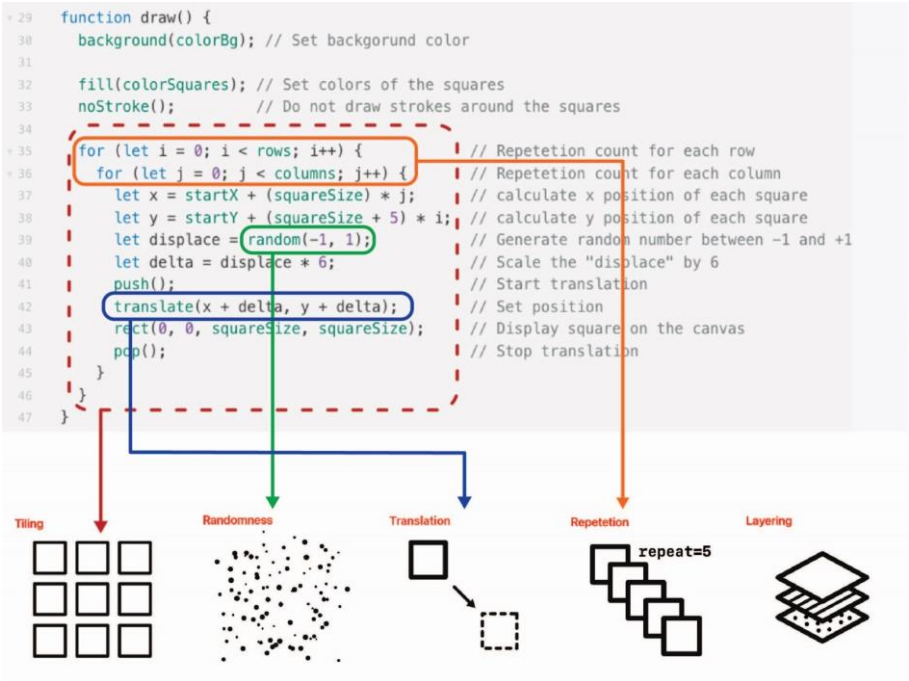

***Figure 32**: Algorithm Design*

37, 38) for each repetition to exhibit 64 squares on the canvas in a grid format. We introduce random displacement to each square by generating a random value within the range of -1 to +1 (line 39), which is then multiplied by six (line 40) to confine off-grid positions between -6 and +6. To position the squares, we utilize the translate function in each iteration (line 42) and incorporate the variable delta (line 40) to disperse the squares randomly.

The program utilizes random number generators to produce various iterations of the same concept without the need for manual editing. Figure 33 displays chosen outputs generated by the code. The progression of the artwork creation is visualized in a step-by-step manner, from left to right.

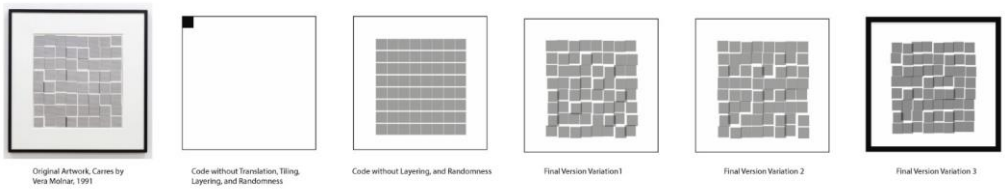

***Figure 33:** Result of the finalized program*

4. Conclusion

In this article, we propose the Algorithmic Art Praxis (ALAP) Framework as an output of our study, which was created through extensive research performed on secondary data resources, analyzing 2000 images and resulting in 695 entries to provide tools and learning material for computational thinking and contextualized programming education. While some entries have limited data, others provide detailed content. In conjunction with computer programming paradigms, the analysis has proposed 18 categories related to programming practices used in algorithmic art. The proposed framework consists of three main components that support contextualized programming education and serve as a tool for computational thinking and problem-solving methods. By proposing ALAP Categories, Cheat Sheet, and a public online database, we provide hands-on learning and teaching material that has the potential to grow and improve over time with the contribution of other researchers. The categories serve as semiotically defined constructs aimed at helping novices analyze artworks and bridge the gap between artistic expression and programming concepts.

The process of collating information from disparate sources to ascertain the most accurate data was challenging at times. In particular, gathering data from disparate and constrained sources proved to be a highly time-consuming endeavor. Although the present study is concerned with the formal aspects of created artworks, we have assumed the responsibility of providing the most accurate information about the artwork for the academic community. In addition to our framework, we aim to provide a unique resource material for teaching and learning programming, which we have previously argued is one of the missing tools for contextualized programming education. At the same time, our online database is intended to be a valuable resource for other researchers working on the topic in future studies who are looking for such information in one place rather than searching multiple web resources.

Following our research and analysis results, we demonstrated a case study on how others can integrate the ALAP framework as a helper tool with Computational Thinking principles in their creative coding classes. Our framework should be applied in introductory programming classes after the students are taught fundamental programming concepts. Then, using the ALAP categories, each Praxis category should be explained and demonstrated with various examples via our online ALAP database. During the lectures, students can also review the online database from their personal computers, and they can keep the ALAP categories and cheat sheet in printed format for in-class practices to benefit from the framework. Using these tools allows the learner to match similar formal behavior on the artwork with a relevant programming practice used in creative coding. So, the learner can research different sources or relevant book chapters using the keywords. For our case study, we suggest checking the P5JS forum[5], documentation[6], and the books (Table 2) related to P5JS for beginners and introductory programming classes.

By providing a structured approach that links visual elements to programming paradigms, ALAP offers valuable tools for researchers, educators, and students in digital art and computer science looking for concrete resource material and tools contextualized within Algorithmic works of art.

Finally, future research should focus on empirically testing the effectiveness of the ALAP framework in educational settings and exploring its potential applications in other domains where computational thinking intersects with creative practices.

Notes:

1. Online ALAP Database web site (https://tinyurl.com/AlgorithmicArtPraxis).
2. The Internet Archive is a non-profit organization that operates as a digital library for Internet sites and other cultural artifacts. Its aim is to provide universal access to all knowledge, offering free access to researchers, historians, scholars, individuals with print disabilities, and the general public. It functions like a traditional library, but in digital form, and is committed to preserving and providing access to the world's cultural heritage for future generations.
3. Notion web site (https://www.notion.so).
4. ALAP Online Database tutorial videos (https://www.youtube.com/watch?v=UWWDdKc2xko).

5. Processing Forum web site (https://discourse.processing.org/).
6. P5JS Documentation web site (https://p5js.org/reference/), examples (https://p5js.org/examples/) and tutorials (https://p5js.org/tutorials/).

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Ethics Committee Approval: N/A
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Designing a Space for Documentary Filmmakers with Design Thinking Method

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Abstract: Design education is based on the act of designing. Design education is based on the process, not the outcome. In this process-focused education, it is necessary to use methods that can generate creative and innovative solutions. Design thinking is one such method. This method is also used in spatial design, in addition to music, literature, science and education. In this study the design thinking method was used. This method aims to put the student at the centre of the process by increasing the creativity and abstract thinking skills of students taking studio education. The study was conducted with 10 students taking the studio course. The students were given the topic "Space Design for Documentary Filmmakers". The study was carried out in five stages over a period of 12 weeks: empathising, defining, generating ideas, developing prototypes and testing. The students' stage of development in the process was monitored through the resulting work. It was ensured that the students developed different perspectives throughout the process, without disengaging from the work. The importance of creating a concept for the design of space and the ability to think in three dimensions in accordance with the concept has been understood in design education. Based on this study, it is believed that the use of methods that enhance the creative thinking of those receiving design education will provide different perspectives and develop creative three-dimensional thinking.

Keywords: Design thinking, Interior architecture, Interior design, Documentary.

1. Introduction

The rapid changes in the social, cultural, economic and technological fields are affecting the thinking system and learning styles in our country as well as in the whole world. It is observed that the changes that occur due to this effect are also experienced in the field of education and design education, which aims to teach how to produce more identity and qualified design outputs. All these changes have put on the agenda how to reveal the creative thinking ability of individuals, which is one of the important issues in design education.

In the educational process where traditional learning/teaching methods are used in design education, it limits the creativity of individuals due to the lack of different perspectives at a sufficient level. As a result, not enough original designs are produced. Creativity, which is one of the most important elements of design education, has revealed both more original design ideas and a process in which the

individual discovers himself/herself, overcomes his/her limitations, breaks the usual assumptions and does not use rote techniques. For this reason, it has been observed that in the spaces where design education takes place, creative thinking emerges through the use of several different approaches and methods, and the resulting products are more qualified. The design-oriented thinking model, used as a method in design education, provides more creative results by providing different perspectives to students receiving design education.

In this study, students were asked to watch documentaries specific to their field of interest in order to introduce the subject for documentary filmmakers. The thematic and spatial characteristics of the documentaries watched were collectively discussed in the workshop environment. Through an online interview with the documentary filmmaker 'Mustafa Aslan', the students were informed about documentary filming and living spaces through the eyes of a documentary filmmaker. Then, by analysing this information, the students were asked to determine the type of documentary, the location where the documentary would be filmed and the number of people for the design concept. The students are expected to design a living space for documentary filmmakers using the design thinking method. Two small (300*600 cm) and one large (300*900 cm) containers were given to the students to create different shapes according to the concepts defined by the students. The students' creativity was analysed and guided for improvement through various readings on the resulting shapes and the spatial requirements determined according to their concepts. By interviewing a documentary filmmaker and using the design thinking method, the aim was to empathise with the students in designing a space and to identify threats and opportunities. The design-led research model used in the study was applied to interior design education and its impact on the originality and creativity of student projects was investigated. It is hoped that the findings of this study will enable students to stay on the project track throughout the 12-week course and produce original projects. It is also hoped that it will help design educators to monitor and improve students' project development process.

2. Design Education

The word design is of Latin origin and means 'to give form, to represent' (Eyüboğlu Erşen, 2018). Design is defined by TDK (Turkish Language Association) as 'the form and imagination visualised in the mind'. According to the philosophical approach of TDK, design is 'the copy of an object or event that is perceived beforehand and then concretised in the mind' (Yurtgün & Çınar, 2023). According to Hasol (1995), design is defined as the creation, design, draft, the written form of an object, the shaping of the object. According to Çınar and Çınar (2018), the shaping that is visualised in the brain with the first information is design. Tunalı (2021) defines design as a thought (idea) planned to solve a problem. A designer is a person who combines his/her skills with imagination and presents the object created in his/her mind as a product (Noraslı & Çınar, 2024). The designer's cultural background, genetic predispositions, knowledge, problem determination and problem solving skills are all transformed into creativity (Er Bıyıklı & Aksoy Gülen, 2018).

While design disciplines gain identity with the experiences that have multiplied from the past to the present, they are rapidly changing and developing today thanks to the design and production techniques that are specialised and personalised with the solutions they produce for the difficulties encountered (Sungur & Akçaova, 2024). Architectural design is not only about teaching the necessary skills and technical knowledge, but also about how an individual should work on a subject or problem and how to approach the subject or problem. Design education is necessary to enable individuals to think, define, associate, apply knowledge and work in a changing environment. In the design process, it is necessary to learn to wonder, imagine, observe, research and evaluate existing evidence in order to critically and creatively approach problems and find alternative solutions. The design process is fundamentally cognitive and involves

the idea of 'creativity'. It is the process of thinking creatively, producing new things, looking at objects or situations from a different perspective and acquiring skills, and this process can be acquired through design education (Besgen, 2015). Design education covers the act of designing and is shaped by the methods applied in this process (Yurtgün & Çınar, 2023). The aim here is to teach students how to design and how to reveal their own methods during design (Noraslı & Çınar, 2024). Design education is process-oriented rather than result-oriented (Aşkın, 2020). This process begins when design problems are encountered. During the process, the problem is transformed into a learning experience (Yurtgün & Çınar, 2023). Research on design education has explained that the creativity that emerges in the design process improves with the application of different experiential methods (Noraslı, 2023).

The element of creativity, expressed in all affective and intellectual activities, is a phenomenon that has been discussed for centuries. The concept of creativity is recognised as a phenomenon that many different disciplines such as philosophy, psychology, education, social sciences, fine arts and social sciences are trying to develop. The concept of creativity was only used as a phenomenon related to fine arts between the 15th and 19th centuries (Onur & Zorlu, 2017). At the beginning of the 21st century, scientific studies on the concept of creativity in the field of psychology began to be seen (Er Bıyıklı & Aksoy Gülen, 2018, p. 1275). Robinson (2003, pp. 84-86) defined the concept of creativity as the process of problem solving. Düzenli and Alpak (2016) defined creativity as the emergence of the new and unknown. Canaan (2003) defined creativity as an impulse. He emphasised that it means a strong driving force that challenges logic, an activity that gives designers an extraordinary sense of satisfaction and excitement, the origin of different ideas, products and designs, as well as the vision of seeing the world from a new perspective. According to Corbusier, creativity requires using all existing knowledge while being open to acquiring new knowledge, facts and experiments (Eyüboğlu Erşen, 2018). Efforts to develop creativity in design education, studies with different perspectives on creativity, and different opinions have been effective in the formation of differentiation in creativity theories.

Studies on the elements that reveal creativity and the factors that determine creativity have shown that there are different stages related to this subject. Wallas (1926) is one of the most prominent names in the first studies on the concept of creativity. According to Wallas (1926), there are four basic stages necessary for creativity. These are preparation, incubation, inspiration and verification. These stages have changed over time and more recently Harris (1959) defined these stages as six phases. These phases are: identification of need, gathering of information, effectiveness of thinking that processes this information, design of solutions, verification and implementation. In addition to approaches that evaluate the element of creativity according to a certain degree, there are also ideas that focus on certain components that make up creativity. According to Andreasen (2005), creativity has three components: individual, process and product. Firstly, creativity begins with the individual. Then, in creativity, which is a cognitive process, the individual investigates the problem or searches for a new idea and conceptualisation method by asking questions. When this process is completed, that is, when the existing problem is solved, the work with the answer is completed and a product emerges (Wallas, 1926; Harris, 1959; Andreasen, 2005, as cited in Er Bıyıklı & Aksoy Gülen, 2018).

The development of technology and science has revealed the need to use the phenomenon of creativity in design education over time. In this direction, great changes have taken place in design education and creativity has been effectively used in this process. With these changes, the understanding of education has been handled with a different method than the known method, and the information is not given directly to the students, but the students are taught how to access the information. In design education, creativity starts in the brain and is then observed in different dimensions. Therefore, in design education, a new process

takes place in which students take responsibility and combine new knowledge and skills with previously learned knowledge. In this process, many different design methods have been used with a student-centred educational approach (Noraslı, 2023). According to Onur and Zorlu (2018), creativity is a very important element in design education. For this reason, different approaches and methods are used to reveal and develop creativity in the studios where design education is carried out.

Some of these methods, which play an important role in the development of creative thinking in design education, are designed to develop sensory awareness. The main aim of these methods is to develop creativity. At the same time, they focus on reasoning through critical and relational thinking by following a path consisting of both cognitive and affective strategies. According to Bulhaz and Bulhaz (2019), the main aim of design education is to reveal and develop creativity. Various methods are used to reveal students' creativity, and these methods aim to develop students' creative thinking and acquire the ability to think in three dimensions and create forms. With a similar view, Garip and Garip (2012) highlighted the importance of methods to reveal creative thinking in design education.

2.1. Concept Formation in Design Education

Every design contains a main idea (concept). Design and concept can never be considered separately, design and design concept are considered as a whole. The design concept is the main idea of a phenomenon that abstracts the concepts in memory and transforms them into an object, and at the same time provides the shape of the design. Determining the design concept during the design process is the most important stage of this process (Bielefeld & El Khouli, 2010). A good design can be produced by transferring each stage of the identified concept to the design. In addition, many factors such as the designer's talent, professional development and design education contribute to the creation of a good design. The design concept, also called the conceptual theme, is an element that sometimes represents function, sometimes light, colour, texture, material or space. However, the design concept sometimes develops independently of the designer. This is a decision that is the responsibility of the designer. The design concept guides the designer to find the most appropriate solution where the designer gets stuck in the design process. If the designer encounters a problem in this process, he/she should not think independently of the concept and propose a solution. In this case, the concept provides the designer with possibilities for a solution (Eraslan Özdağ, 2018).

The architect or interior designer uses a number of methods and tools to develop the concept during the design process. Examples of these methods and tools include methods for expressing thoughts during the design process, and drawings and abstractions that allow the thoughts to become more concrete. The first of the methods used to develop the concept during design is 'brainstorming'. This helps to generate a large number of different ideas. Writing down the design ideas that come to mind during the design process is another way of finding a concept. Examining the area to be designed and analysing the environment contributes to the creation of the design concept. In addition, studying previously designed structures and seeing the architect's solutions for the structure increases the designer's ability to solve problems and helps to generate ideas. Another method of creating a concept is 'abstraction' in design. The abstraction method makes it easier to define the concept and increases the originality of the design. Sketching is an effective way to reveal the concept idea. At the end of all these methods and techniques, the design concept is determined. Subsequently, schematics, diagrams, mass models, modelling and animation are used to develop the concept and identify and develop the missing aspects of the design idea (Bielefeld & El Khouli, 2010).

Every element that influences and is influenced by the design process is called a value (Onat, 2006). All the elements highlighted by Onat (2006) as values in the architectural design process make up the concept. These elements, which Onat (2006) describes as values and which also have an important place in concept

formation, can be listed as subject-based values, architectural programme-based values, site/environmental-based values, investor/user-based values and designer-based values (Onat, 2006).

In the past, the concept was formed only in line with the general character of the building, independent of its location. Today, the concept has become abstract and is fed by context and content. The context here refers to the characteristics of the place, while the content is the design program and subject matter. In other words, while the concept was concerned with perfect geometry and perfect beauty in the past, today we can argue that it has changed by focusing on the problems in context and design and transforming these two elements into abstract ideas with the interpretation of the designer (Erman & Yılmaz, 2017, p. 103). According to Erman and Yılmaz (2017), the components of the concept are listed as problem, context and designer. The problem is generally defined as the subject and content of the project, functional requirements and conditions according to the design plan. The context includes natural and artificial environmental conditions, cultural and social conditions, as well as technological, economic and physical conditions. The designer component is the designer's experience, the designer's architectural style, knowledge, perception of the problem, perspective on problem solving and priorities, problem solving style are the qualities that the designer should have while creating the concept. The concept can also be formed by the designer's original thinking (Erman & Yılmaz, 2017).

Concept components usually drive the entire design process alone, and sometimes all concept components are included in the process. The interconnection of these components and the concept generation process model in architectural design is given in Figure 1. According to this model, problem and context elements are identified and concepts are developed. Concepts are elements that can be accessed by all designers without the need for interpretation. However, in order for the designer to create the concept by including his/her own interpretation, some determining elements are required. These elements are the designer's perception of the problem, the designer's style and the designer's experience. By interpreting the concepts with the designer's own views, each problem turns into original concepts with its own context. As the concept

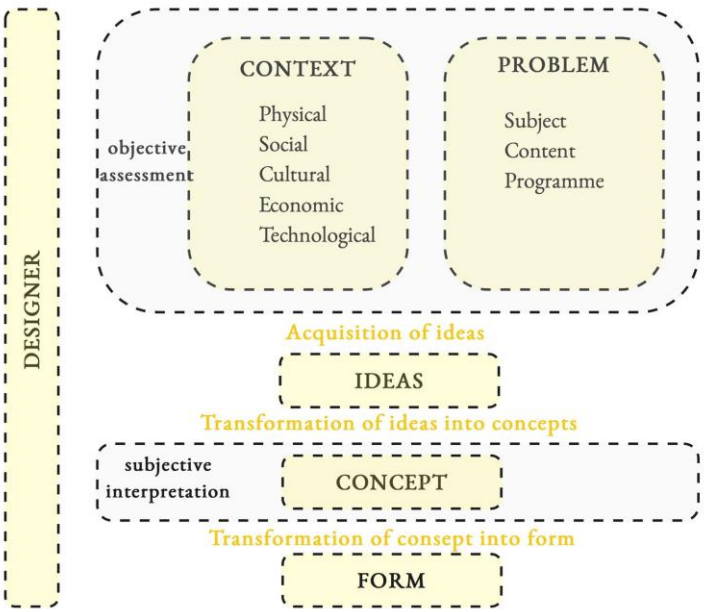


Figure 1: *Concept creation process model in architectural design* (Erman & Yılmaz, 2017).

transforms into form with the effect of the designer's interpretation, unique forms will be formed (Erman & Yılmaz, 2017).

All the above elements are very important for the creation of a concept in the design process in architectural education. The concept is a roadmap developed by the designer to find a solution to the design problem and is therefore included in the design process. The concept is not only part of the design discipline and architecture, but also appears in many different areas of everyday life. In this sense, the concept is seen as a phenomenon that makes the design unique and meaningful both in the field of architecture and design and in other different fields.

3. Design Thinking Method

The 21st century is a time of rapid advances in technology and science, and at the same time there is a need to develop students' abilities to respond to complex problems in education. These skills include collaboration, creativity, practical and analytical thinking. Students with independent thinking skills should not only be satisfied with content knowledge in order to find creative solutions to problems (Lipman, 2003). They should also be able to come up with original solutions to problems (Owen, 2007). Design thinking, which has an important place in the development of students' creativity, is used in many different studies as well as in education and training processes. Design thinking is a method that allows students to develop their critical thinking skills (Razzouk & Shute, 2012, pp. 340-342). The concept of design thinking, which was first discussed in 1987, has been widely used in studies since then (Owen, 2007; Brown, 2008; Ambrose & Harris, 2009). The interdisciplinary applicability of the design thinking method has received considerable attention (Dorst, 2010; Koh et al., 2015; Dolata & Schwabe, 2016; Liedtka, 2018; Noraslı & Çınar, 2024). It has been observed that design thinking is used with a multidisciplinary approach and different approaches at different levels of education from primary to postgraduate and in different fields (Pande & Bharathi, 2020; Rauth et al., 2010, pp. 2-3). This method provides creative solutions to the needs and expectations of the current period with a result-oriented approach to problem solving (Noraslı & Çınar, 2024). It also puts the theoretical structure of thinking into practice. For this reason, design thinking is described as an effective tool that contributes to the development of students who produce products and solve problems that arise in design productivity (Girgin, 2020). With design thinking, problems are approached in a solution-oriented way, using intuition and imagination to achieve the desired results. In this way, design thinking contributes to the development of traits such as creativity, patience and personality (Razzouk & Shute, 2012).

Design processes always consist of recurring cycles of construction and reflection. These cycles take place in many stages. They include sketching, daily discussions with colleagues, case meetings, prototyping and client reviews. Design Thinking education is related to these cycles from the very beginning. Learning and knowledge creation in design thinking education is based on highly iterative processes. These processes have been compared to learning concepts such as experiential learning theory (Rauth et al., 2010, pp. 2-3).

In order to teach design thinking, institutes called d.school (Hasso Plattner Design Institute) were established first at Stanford University in 2005 and then at Postam University in 2007 (Rauth et al., 2010). These institutes gave students the opportunity to develop their creativity and experience in order to change their image (Noraslı & Çınar, 2024). The institute aims to create innovators rather than any innovation. In order to achieve this goal, d.schools recruited a group of teaching experts from different disciplines (Rauth et al., 2010). One of the important principles of d.schools is that the institutes offer design thinking education especially for traditional disciplines that do not have design education, such as business, law, medicine, social sciences and humanities (Dunne & Martin, 2006; Plattner et al., 2009). In Turkey, Boğaziçi University's entrepreneurship centre Bright collaborated with Stanford University

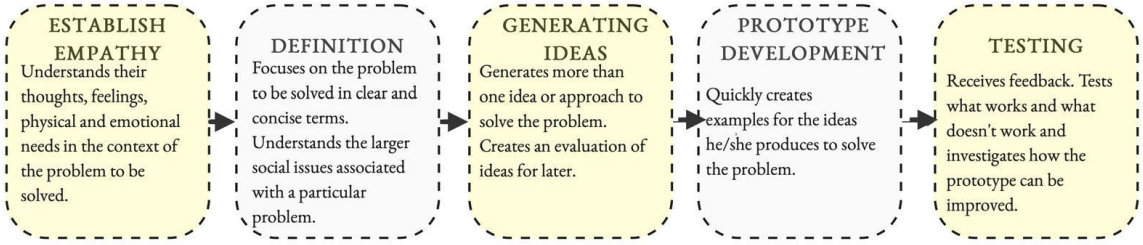


Figure 2: *D'school design thinking method* (Noraslı & Çınar, 2024).

d.school's University Innovation Fellows (UIF) programme in 2017. Through this collaboration, selected students from Boğaziçi University receive training in design thinking, creativity, innovation and business model development within the framework of UIF (University Innovation Fellowship Programme with Stanford d.school). Design thinking is a method that can be applied at different levels of education and in different fields. According to this method, design thinking consists of five basic steps, as shown in Figure 2. These steps are empathising, problem definition, idea, prototype and testing.

According to D'school, the design thinking model starts with problem identification. It then continues with the empathy phase. Empathy is gaining insight into the users and their needs. This stage is the understanding of a problem that needs to be solved through empathy. Empathy is very important for problem solving and a human-centred design process. Because it allows you to put aside your own thoughts about the problem you are trying to solve and get real ideas about the users' needs. At the same time, empathy helps us to understand the people we are designing for. The next stage is problem identification. This stage solves the identified problems, clarifies the situation and focuses on the design elements. Concrete and practical ideas are generated to solve the basic problem. In the idea generation phase, designers are ready to generate ideas. At this stage, designers brainstorm, sketch or physically perform something that enables the development of innovative solutions to generate new ideas. Another stage is the prototype stage. This is about finding the best possible solution to problems. It is the stage that involves building something that will answer questions when tested. By the end of the prototype phase, the design team will have a better idea of the product's limitations and the problems it faces. In the final stage, designers test the product using the best solutions identified in the prototype stage. This provides feedback on the prototypes. As a result, the design thinking process is complete with all its stages (The Interaction Design Foundation [IDF]. 5 Stages of the Design Thinking Process (Interaction Design Foundation., 2020; Cantwell, 2019; Council, 2021; Noraslı, 2023). It has been found that students who use the design thinking method are more enthusiastic and active in this process, they progress faster in the design process and their learning outcomes are clearer (Assaf, 2009). Choi and Kim (2017) suggested that teaching and learning strategies should emphasise analogical and metaphorical reasoning to stimulate design thinking skills in students. Rauth et al.'s (2010) study goes beyond the use of design thinking as a pedagogy and focuses on how design creativity can be activated through design education. Oxman (2004) presents a pedagogical framework for design learning and teaching called 'Think-Maps' for teaching design thinking in design education.

Lindberg et al. (2010) consider the design thinking method as a meta-disciplinary concept. They investigated the methods of developing collaboration with meta-disciplines, and concluded that designers can easily discover their own skills through the experiential learning process of design thinking. Wrigley and Straker (2017) investigated the impact of the design thinking method on the learning performance of students in 51 different courses

at 28 universities. As part of the study, Wrigley and Straker (2017) designed a project called 'Education Design Ladder'. This project was developed in 4 stages: product, project, business and professional. When the results obtained were analysed, it was found that design thinking is a very important method for identifying differences.

As a result, people have the skills needed for design. However, in order to have the ability to bring creative solutions to problems, the Design Thinking method should be used. In this context, it is clear that there is a direct relationship between design thinking and creativity. With the design-oriented thinking model, it is clearly understood that there is a noticeable increase in the potential of individuals to be creative day by day in design education.

4.Method

This study was conducted as part of the Interior Design Studio course taken by the first year students of the Department of Interior Architecture, Faculty of Fine Arts and Design, KTO Karatay University in the spring semester of 2023-2024. The methodology of the study was Design Thinking. In accordance with this method, the topic of "Living Space Design for Documentary Designers" was addressed. Two small (300cm*600cm) and one large (300cm*900cm) container plans were given to the students. The study was carried out with 10 students. The designs, created in accordance with the defined purpose and method, were carried out in a twelve-week process based on the stages of 'empathising, defining, generating ideas, developing prototypes and testing' that make up the Design Thinking method. The details of this process are shown in Figure 3.

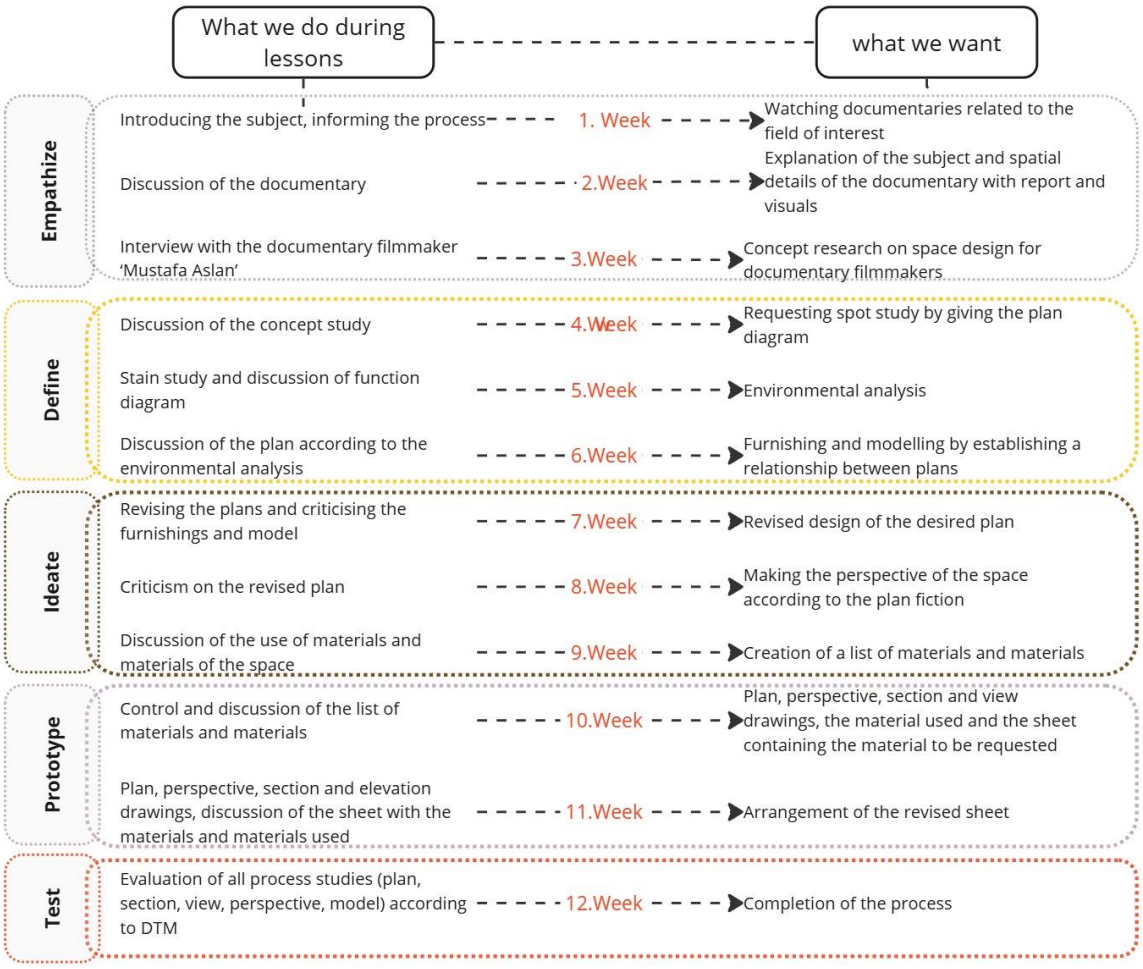


Figure 3: *Design process*

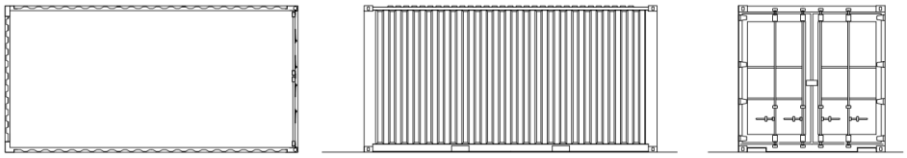


Figure 4: *Container drawings*

In this project, which was carried out according to the design-oriented thinking method, the fiction of bringing together the plans given to the students was formed by discussing them in the process. The plans, which consist of two small and one large container, consist of a total area of 81 m2. Drawings of the container are given in Figure 4.

5.Findings

This study was analysed according to the 'Design Thinking Method' stages of empathising, defining, generating ideas, developing prototypes and testing. The first stage, empathising, was processed in a three-week period.

5.1.Empathize

The first phase of the study was carried out over a period of three weeks. First, the students were introduced to the topic of designing a living space for documentary filmmakers. The students were asked to watch documentaries about their field of interest. According to the documentary they watched, the aim was to create spatial and fictional imagination. In the third week, as can be seen in Figure 5, an online meeting was held with Mustafa Aslan, who shot the documentary; the spatial needs of the documentary shooters, the effect of their location on the shooting area were discussed and an interview was conducted in the form of a mutual question and answer. According to the information obtained from the interview, they were asked to determine their own concepts for the next week.

Figure 5: *Interview with filmmaker*

5.2.Define

In line with the information obtained from the interview with Mustafa Aslan, the concept determined by the students according to the space design was discussed. Information such as the type of documentary, the number of people who will live in the container, the location where the documentary was filmed was created by the students. The created scenarios were discussed by the students and keywords were created and expressed with the word cloud method as shown in Figure 6. With the word cloud, the documentary types that will determine the concepts of the projects were collected and the data that will affect the design were defined. The documentary type, the number of people who will live in the container and the location where the documentary was filmed were used as a reference in determining the spatial needs of the user as a result of detailed research. The concept and the determined needs enabled the design of original functions and forms by providing the formation of the stain study and function scheme.

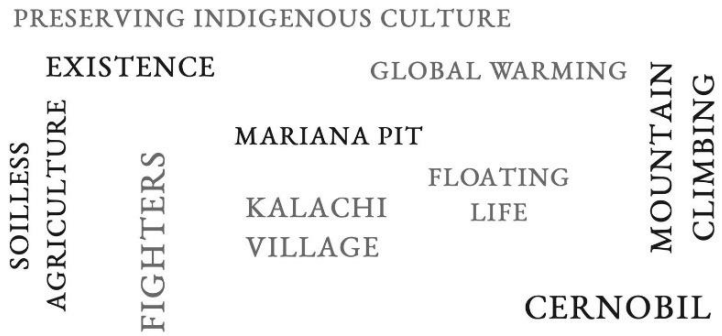
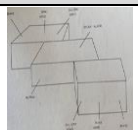
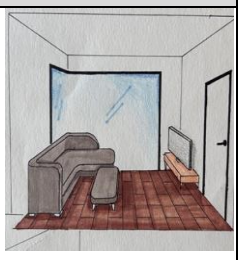
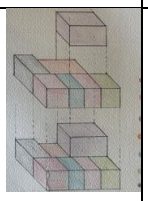


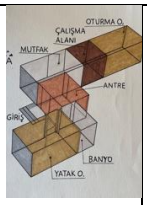
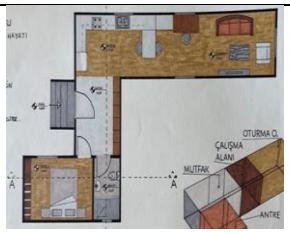
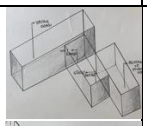
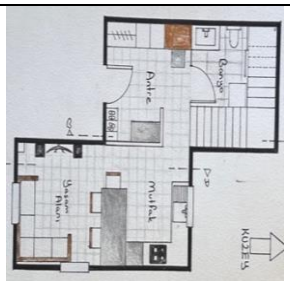
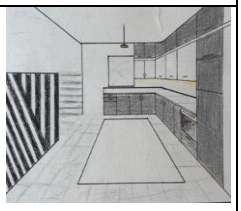
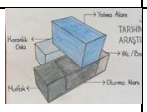
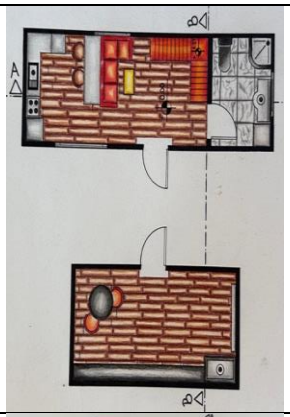
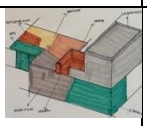
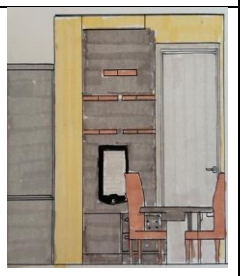
Figure 6: *Word cloud*

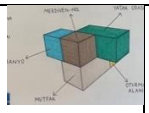
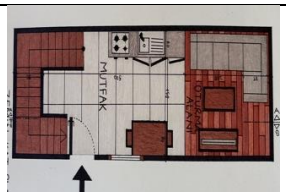
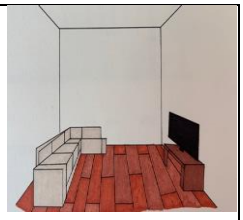
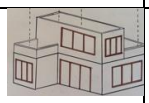
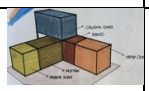
5.3.Ideate

After the empathising and defining stages, the design phase was started in line with the spatial needs. The plan diagram, form and model of the project were made by the students. Forms were determined in the model according to spatial needs and at this stage, all actions were carried out in the name of generating ideas. The keywords determined by the students had an impact on the interior design and the material use of the space in concrete or abstract terms. In this context, it was observed that spatial needs changed according to the type of documentary chosen by the students, the number of living people and the location where the documentary would be filmed. In this context, as seen in Table 1, the projects produced by the students differed from each other in terms of ideas and original designs emerged.

Table 1: *Concept, form, plan schemes and three dimensions of the projects*

	CONCEPT	FORM	PLANS	3D
PROJECT 1	**FLOATING LIFE** 2 people Australia **Aim:** Studying the Coral Reef			
PROJECT 2	**HYDROPONIC AGRICULTURE** 2 Person Laboratory **Aim:** The stages of soilless agriculture			

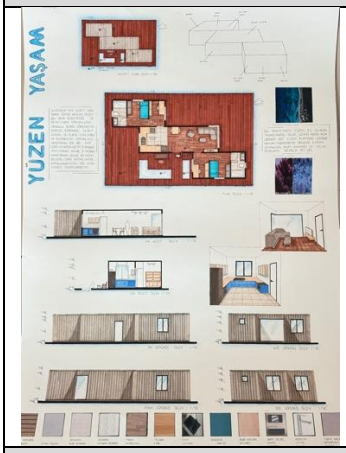
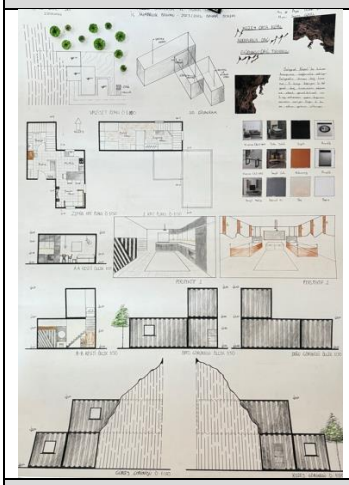
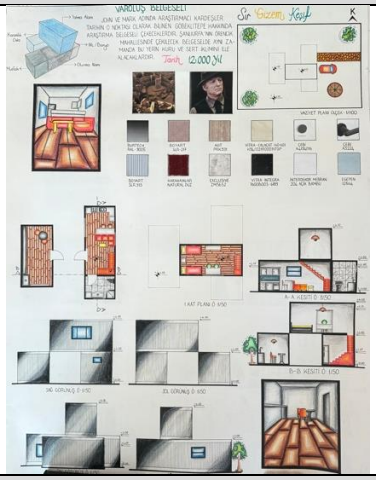
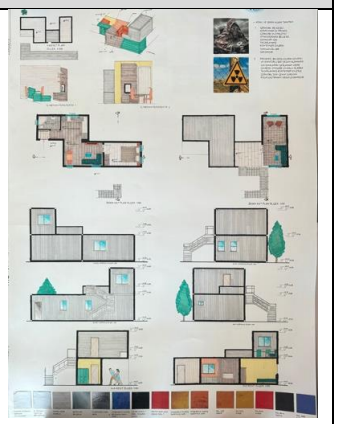
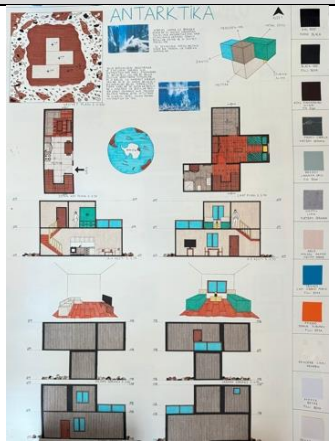
PROJECT 3	**FIGHTERS** 2 Person Russia **Aim:** To document the moments when fighters meet the audience			
PROJECT 4	**MOUNTAIN CLIMBER** 3 Person North Central Nepal **Aim:** Mountain climbing without equipment	 		
PROJECT 5	**EXISTENCE** 2 people Gobeklitepe **Aim:** To make a research documentary			
PROJECT 6	**CHERNOBYL** 2 Person Ukraine-Pripyat **City** **Aim:** To document the impact of a nuclear accident on the environment			
PROJECT 7	**MARIANA PIT** 2 Person Guam Island-Mariana Trench **Aim:** Investigation of the deepest known point on Earth			

PROJECT 8	**GLOBAL WARMING** Antarctica 2 Person **Aim:** To investigate climate change and see its effects			
PROJECT 9	**KALACHI VILLAGE** Kazakhstan-Armola Province 3 Person **Aim:** To investigate the village with sleeping sickness			
PROJECT 10	**PROTECTING INDIGENOUS CULTURE** Australia 2 Person **Aim:** To investigate the real life of the Austrian Aborigines			

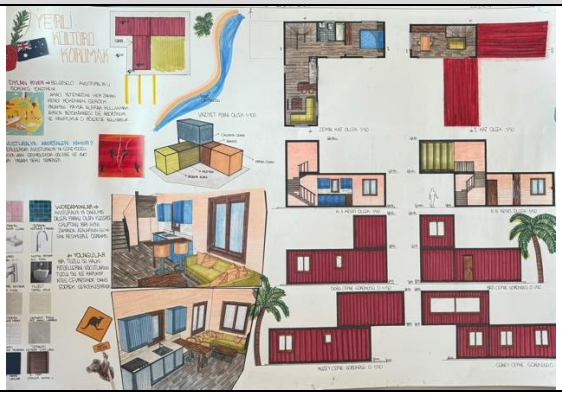
5.4.Prototype

The fourth phase, prototype development, comes after the idea generation phase. At this phase, the plans and other drawings made in the previous weeks represent the final state of the process. After the plan fiction was made depending on the concept, three-dimensional visuals formed the prototype of the design. Throughout the process, studio students searched for space design for documentary filmmakers, and with the concepts they developed, they also created materials and materials used in design. The students included all the data about the plan, section, view, three dimensions, concept, materials used in the space in the sheet. The sheets created by each student as a result of the process are given in Table 2. This section shows that studio students have different design ideas depending on the concept of the spaces designed for documentary filmers.

Table 2: *Concept design*

Project 1	Project 2	Project 3
		
Project 4	**Project 5**	**Project 6**
		
Project 7	**Project 8**	**Project 9**
		

Project 10



5.5.Test

Testing constitutes the last stage of the design thinking method. During the 12-week project process, the works of 10 students were evaluated. According to this evaluation, the interview with Mustafa Aslan about space design for documentary filmmakers constituted the 'empathising' stage of the study. At this stage, the students questioned the spatial requirements of a documentary filmer in the living space and decided how the design space should be with the information they learnt from the interview.

In the defining stage, the design thinking part of the plan fiction was formed. In the idea generation phase, three-dimensional visuals were made together with the plan and other drawings and the materials used in the design were included. In the prototype development phase, it was observed that the design suitable for the concept was supported with drawings and the final version was created on the sheet.
According to the results of these stages, the students' research into the environments in which the documentaries were filmed and the interview with Mustafa Aslan enabled them to analyse the information they had researched through empathy. This process influenced the idea generation stage of the project. It was observed that the stage of identifying the locations of the documentaries and the number of people involved in the project was made more concrete by identifying different types of documentaries. The keyword cloud created by identifying the students' concepts increased the quality of the project and allowed for a more original definition of spatial needs. The fact that each student determined the form according to the project concept and designed the interior accordingly was reflected in the materials used and design ideas, resulting in personalised designs.

6. Discussion and Conclusion

In interior architecture education, transforming the design from a conceptual stage to a quality prototype stands out as one of the biggest challenges. Traditional methods used in design education are often insufficient to cope with this challenge. When modern approaches are not used or the process is not managed with a specific methodology, problems such as conceptual clarity in the design process, loss of meaning and form in abstraction, and difficulties in two and three dimensional expression of concepts may arise. Such problems negatively affect the concretisation of ideas and the quality of the final products. In order for designs to be completed smoothly, it is of great importance to manage the process with scientifically based methods. Design thinking stands out as one of the most effective approaches in this process.

Five stages of the design thinking method were used in this study: empathising, defining, generating ideas, developing prototypes and testing. In the first stage, the students researched the documentary genre they were interested in and the places where these documentaries were filmed caught the students' attention. An interview with Mustafa Aslan, who shot the documentary, enabled the students to empathise

with the user of the space and formed the concept ideas for the project. In the second stage; the concept and the needs identified through the keywords created with the students' ideas enabled the design of original functions and forms by enabling the formation of a spot study and functional scheme. In the third stage; plans and three dimensions were created according to the defined concept. In the fourth stage; the final products were made with technical expressions in a specific discipline according to the concept. In the fifth stage, the qualities of the projects were analysed and tested.

It was observed that the designs produced as a result of this study were different from each other and developed in accordance with the concept determined at the beginning of the design process. Spatial requirements and materials used in interior designs varied according to the documentary type, location and the number of people using the space. Thus, it was ensured that original projects were produced. With the research method used, it was ensured that the students did not break away from the 12-week course process and designs with continuity emerged. The development of such techniques by applying methods similar to the design-oriented thinking model proven by scientific studies in design education improves project processes and quality. From this point of view, the use of design thinking method in design education is beneficial for educators and students who manage the process and its use is recommended.

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Overview of Textile Arts/Design in Habitable Places: A Beauty to Behold in the Built Environment

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Abstract: Textiles can be categorized into utilitarian and aesthetic. Utilitarian textiles are used for practical purposes. In contrast, aesthetic textiles focus on artistic expressions like textile installations for artistic and educational purposes in built environments. However, many people often overlook the use of textile installation art as decorative elements in their surroundings. Textile installations have come to pose some challenges to the conventional 2D textile design in that they are found in most art exhibitions and museums. Nevertheless, this has brought forth results in designs which are unexpected. In line with this, they are used to decorate the built environment. This paper is predicated on the fact that these installations have not been sufficiently practiced and paid attention to by artists and designers in Nigeria. Therefore, this study highlights the new and innovative ways in which textiles have been showcased by textile artists, sculptors and some painters who have begun to dim the boundaries between textile design and other aspects of art. It looks at the relationships between textiles and the environment, new technologies and techniques that artists are adapting to transform an environment aesthetically and instructively using textiles. It also looked at the shift of some textile artists/designers from concentrating on surface design to manipulation of form and structure of a fabric and how that manipulation can result in larger 3D designs which can be used to enhance the built environments. This is qualitative research. It employed the use of desk methodology. It utilized observations and photographs as research instruments. It found out that some Nigerian artists of various specializations now adapt textiles to their art works and it documented such works. This study concludes by suggesting that various ways in which textile art could be used as decorations in the built environment should be researched into, practiced, appreciated and encouraged in Nigeria to aid its sustainability.

Keywords: Textiles, Textile art, Embellishment, Built environment, Textile installations.

Introduction

The built environment encompasses human-made spaces designed for various activities. According to Roof and Oleru (2008), it includes everything from buildings and parks to neighbourhoods and cities, as well as the supporting infrastructure like water supply and energy networks. Macmillan Dictionary and Jackson (2003) define the built environment as all structures built by people, distinct from the natural environment, such as towns, houses, schools, and more. It could also refer to the human –made surroundings that provide the setting for human activity, from buildings, parks or green spaces to neighbourhoods and cities which include their supporting infrastructure, such as water supply or energy works. Burton (2011) emphasizes the crucial role of the built environment in the well-being of both children and adults, highlighting how

places like schools provide safe spaces for learning and other activities. Additionally, Jackson (2003) stresses the importance of houses as essential elements of the built environment, providing shelter and contributing to healthy living. These structures are constructed from various materials such as wood, bricks, and metals, and can be further enhanced through textile artworks. The parks usually have some trees that could also be enhanced using textile art. The built environment touches all aspects of people's lives for instance, buildings people live in, roads, bridges, and transportation system that takes people from one place to the other. The built environment serves practical, heritage, social, and aesthetic purposes, and it is important to recognize the aesthetic value that textile art/design can bring to these spaces. This study is of the view that the aesthetic and functional potential of textile art in the built environment has not been fully explored by artists, designers, and scholars. Therefore, there is a growing need to emphasize the aesthetic and functional contributions of textile art in the built environment to fully harness its potential, a process that is gaining attention in recent times. This is qualitative research. This study utilized desk methodology, and observations and photographs as research instruments. It recorded the textile arts utilized in the components of the built environment which are parks, buildings, roads, walk ways and others.

Literature Review

Textiles

Textiles consist of natural or synthetic fibers, which can be derived from animals (such as silk and wool), plants (including cotton, flax, and hemp), or synthetics like Kevlar, nylon, polyester, rayon, and spandex (Marjoly 1977 and Kadolph 1998). The term "textiles" encompasses a wide range of fiber-based materials, including fibers, yarns, filaments, threads, and various fabric types. While initially referring to woven fabrics, the term now covers various manufacturing methods, including knitting and non-woven techniques, to create textiles for diverse applications, from everyday clothing to specialized items like bulletproof jackets and spacesuits (Elsasser, 2005). Textiles are broadly categorized into consumer textiles, focusing on aesthetics and comfort, and technical textiles, prioritizing functional properties. Examples of technical textiles include geotextiles, industrial textiles, and medical textiles, while consumer textiles encompass clothing and furnishings. Each component of a textile product, including fiber, yarn, fabric, processing, and finishing, contributes to the final product and is selected based on its suitability for the intended use (Horrocks and Anand, 2016). Fibers, the smallest component of fabric, are spun into yarn and used to manufacture fabrics. Fibers can be transformed into fabric through techniques such as felting and bonding, or by manipulating yarns using various fabric manufacturing systems. Textile materials undergo processing and finishing to enhance their aesthetics, physical characteristics, and utility. Textile manufacturing, encompassing dyeing, printing, and embroidery, is considered one of the oldest industrial arts (Elsasser, 2005).

Embellishments and the built environments.

Embellishment refers to the addition of decorative details or ornamental features to enhance the visual appeal of something. Katz (2011) suggests that the adaptability of fabric is advantageous, as it can be utilized to embellish and enrich the structures where people live, work, play, and worship. The built environment encompasses the physical spaces created by humans for various activities, including living, working, and leisure pursuits, from individual buildings and parks to entire neighborhoods and cities. There is significant concern about the impact of the built environment on individuals, with studies showing that people can be positively or negatively influenced by their surroundings. Burton (2011) highlights the importance of enhancing urban parks and open spaces to provide opportunities for free play, interaction with nature, physical activities, and social engagement, particularly for children and tourists. Eichberger (2015) further emphasizes the need to enhance environmental features such as playgrounds and recreational facilities to encourage active living. According to Katz (2011), textiles are intimately intertwined with people's lives, from the moment of birth, when

newborns are swaddled in fabrics, to the end of life, when individuals are clothed. Bhatt (2014) describes the diverse roles that textiles play in daily life, from bedding and clothing to home decor such as curtains, rugs, and wall panels. Textiles have multiple functions and are deeply woven into the fabric of everyday life. However, this study specifically focuses on textile art and its utilization to embellish and enhance the built environment. Textile art, in the form of installations, wall panels, and hangings, has the transformative ability to enhance various built environments, including gardens, parks, hotels, churches, stadiums, houses, and shopping malls. For instance, a classroom can be transformed into a wedding reception hall through the use of fabric drapes, floral arrangements, and art installations. Textile installations in parks and open spaces often convey the artist's emotions and create a peaceful ambiance through colorful and creative art pieces.

Textile art as embellishments.

Textile embellishments in this context refers to the textile art or design works used to decorate the environments in form of installations, wall hangings and panels to make it more beautiful and attractive; so as to be more acceptable to people. Textile art encompasses some techniques. Gottesman, (2016) reports that, it has undergone a revitalization over the past century, in that textile artists have been able to push boundaries of what can be considered a textile, as well as how a textile can be considered an art. She further mentions that 1970s' in particular marked a new beginning in textile art history in that feminist artists like Judy Chicago and Miriam Schapiro embraced some textile techniques such as sewing and quilting and utilized them to produce textile art works. Others are Alighiero Boetti, Faith Ringgold, Judith Scott, Nick Cave, Alexandra Kehayoglou, Billie Zangewa, Pia Camil to mention but a few.

In most cases, in textile art, the unused fibres are used to create art pieces while in some cases the already made fabrics from the factory are used alongside with sculptural pieces to produce some textile art works for instance in most of Yinka Shonibares' art works. But before these fabrics can be employed in any textile art work, the surfaces have to be enhanced using one, two or more textile design techniques namely weaving, printing, dyeing, painting, fibre art, beadwork, embroidery, mirror work, quilting, knitting, stitching, applique, piping, trimmings, use of laces, pleating, crocheting, bonding, and other new techniques like laser cut textile installations. The textile arts produced can be painterly, functional, sculptural and conceptual. They are usually more than life size and not restricted to a square canvas mounted in strategic places.

Bhatt (2014) defines, surface designing as a superficial decoration on the fabric. There are innumerable varieties of decorations that enrich the surface of the fabric used for embellishing the built environment but their techniques vary. Some of them are discussed briefly by this study. For instance:

Dyeing: this is the method of colouring the fabric, yarn and fabric by dipping into the dye solution at estimated shade, concentration time and temperature. For better penetration of the dye solution, the dyeing process is extended beyond the specific time at predetermined temperature. In dyeing, there are various techniques which can be utilized for example discharge dyeing, tie-dyeing, ikat dyeing, tritik, batik and starch resist. In discharge dyeing, the discolouration of colour is achieved in selected areas of the dyed fabric with dischargeable agent and chemical. This is done by a technique known as bleaching. All dyes are not effectively bleached and sometimes are not safe to bleach. Therefore, appropriate bleaching or discharging agents which are safe and effective to produce excellent discharge effects should be selected, if this technique is chosen.

Tie-dyeing: This is a type of resist dyeing where water repellent strong twine, cord, string, plastic coated threads and wire are used as building materials to produce various variegated effect. The multi colour variegated effect of tie-dye is obtained by compressing and binding the cloth in various ways for example pleating, coiling and twisting, knotting,

spotting, marbling, tritik (stitching), clamping, folding and their combinations.

Ikat Dyeing: This refers to dyeing of yarn especially the warp yarns, to produce unique effects that are different from the well-defined designs printed on the fabric. The warp yarns or weft yarns are tied with resist materials as in tie-dye, when dyed, those covered or resisted areas do not absorb the dye, thus retain the ground colour. After dyeing the resist materials are removed before weaving. The product of this is characterized by fuzzy edges. When the weft or warp is tie-dyed it is called single Ikat but when both are tie-dyed it is called double Ikat.

Batik: This is an ancient craft, where wax, starch or resin act as resisting agent. In more complicated batik works, several layers or resist and dye with wax are applied which each layer of resist that protects the colour it covers. The special feature of a batik is its "crack" effect of wax which is done deliberately by squeezing and crumpling the wax applied on the fabric to crack and enable the dye to penetrate and produce a threadlike effect of fine veins on the dyed cloth.

Weaving: weaving involves the interlacing of the warp and weft threads, at right angles using a loom. There are off loom weaving which include tapestry and rug hooking. These products of the loom are utilized in producing textile embellishments.

Tapestry- is a form of textile arts,that involves often-meticulous process of weaving continuous and discontinuous threads of fabric to produce either pictorial or abstract designs. According to Gottesman (2016), the earliest tapestries date to 11th century in Germany and in most European centres while the commercial production of tapestries for nobility began in the 14th century and expanded afterwards. They are elaborate large patterns which are produced on the hand loom and much different from the machine made fabrics like jacquard. Tapestry art may be likened to a painting with yarn, showcasing an endless picture.

Printing: Printing is an art that makes use of different techniques to transfer the design to fabrics. This produces designs of numerous innovative ideas of thoughts and can be done using stencils, screen, photographic transfer, wooden blocks, rollers, transfers and so many others. In printing, the design may be imprinted with the aid of machines or hand made. The handmade prints are much more expensive than the machine made because they are more unique and artistic. Various methods of printing can be combined to produce a piece of printed fabric which can be used to produce art works for the built environment.

Hand painting: This is an ancient art that is done by free hand-painting of design. It involves the application of dye or pigment to textiles. The dyes are usually fast when it comes in contact with water. There are different types of paints which produces different effects; some are shiny and some produce embossed effects. In hand painting, some materials are used to achieve these effects namely ball paint fabric pen, 3D fabric polymer inks, felt-tipped markers crayons and designer's gouache.

Embroidery: it involves stitching pictures, scenes or other decorations on cloth or other materials using a needle and either thread or yarn. Batt (2014) mentions that, it utilizes two components; the base fabric and coloured thread for decoration. Hand embroidery depicts hand skill and machine embroidery requires dexterity and co-ordination of the eye and hand to transfer the design onto the cloth mechanically.

Applique: This is a decorative design made by stitching cut pieces or swatches of materials and other embellishments like beads and mirrors and applying them to the surface of a plain ground cloth for decoration.

Quilting: This techniques involves creating artistic and patterns from left over scraps of rich fabrics remains on a remarkably lightweight but durable fabric piece by stitching them over to the ground fabric. The patterns used in quilting consist of an entire cloth and known dimensions backed by padding and an underlining, with a

pattern formed by stitching through the layer of fabric and padding.

Patchwork: Unlike the applique, patchwork according to Naik & Wilson (2009), is not worked on a ground cloth, instead the small swatches are joined together side by side to form an overall pattern into totally a new piece. The designs or patterns are mostly geometric in shape, square, star, diamond and triangle.

Yarn bombing: McGovern (2014), defines this as a form of art that employs colourful displays of knitted or crocheted yarn or fibre to objects in the public environment rather than paint or chalk.

Textile artists and textile art installations in the built environment.

People have been practicing the art of creating with textiles for thousands of years. It started from a necessity to fill basic needs, different cultures around the world developed techniques of producing artistic, creative and beautiful cloth that has led to what is known as textile art. For millennium, according to Gottesman (2016), some textile artists and manufacturers have created fabrics for very specific purposes but more recently in 1960s, artists have created sculptures and installations from found, purchased or suitable fabrics, rejecting the weight or durability of traditional sculptural materials like stone and wood. For instance, Claes Oldenburg, Robert Morris, Yayoi Kusama and Joseph Beuys among others used felt and other consumer grade fabrics to create soft sculptures. Christo and Jeanne-Claude made use of millions of square feet of bright and shimmery textiles to drape entire buildings and geological formations so as to draw attention to them. Yinka Shonibare, a British-Nigerian artist(Sculptor), uses the colourful patterns of Dutch wax fabrics to highlight the role textiles played in the history of colonialism and global trade in recreation of historic European costumes. He is best known for his display of characters dressed in spectacular period costumes made from Dutch wax fabrics and some textile art installations, see Figure (13). Some textile artists like Judy Chicago(1939- till date) and Miriam Schapiro are feminist artists who in the 1970s,challenged the difference between textiles and fine arts by adapting some textile techniques that were traditionally labelled womens' crafts for example sewing and quilting to produce some textile installations that have made history. Gottesman (2016) indicates that Chicago's works include paintings, tapestries, and sculpture and mixed media installations. Her most celebrated work is, The Dinner Party (1974-19) **is** permanently displayed in Brooklyn museum, U.S.A., Sheila Hicks (1934- till date) (see figures 1 and 2) is a pioneer fiber artist, who has been able to showcase elements of painting and sculpture with her vibrant woven and textile works. She creates these works in different shapes and sizes in form of wall mountings that imitate the format of painting and suspended textile art pieces that hang from the ceiling to the floor like textured columns in sculpture.

Figure 1: *Shiela Hicks (2018). La Sentinelle de safran*
Source: http://www.dreamideamachine.com/?p=56936

Figure 2: *Shiela Hicks (1973). Title: Lianes nantaises,* Ligne de Vie, *installation view. Centre Pompidou, Philippe Migeat*
Source:
http://www.dreamideamachine.com/?p=56936

Figure 3: *Shiela Hicks (2014). Atterrissage. Title: Knotting, wrapping, folding, twisting and stacking wool, linen, cotton and more.*
Source: https://www.artbook.com/blog-sheila-hicks-atterissage.html

Anni Albers (1899-1994) was a textile artist who created some weavings to define pictorial textile art. Ever since the 1980s, textile arts and fibre arts have become more conceptual and developed new forms. Many artists were found to be experimenting with textile techniques, materials and concepts completely pushing the limits of the medium to another level. The re-born techniques for example are embroidery art, weaving, quilting, crocheting and many others. These, have been able to come up with something new other than challenging social and political issues like feminism, domesticity, women's and identity politics. These artists, utilized textiles and thread as painting and sculpting materials. According to Martinique (2017), contemporary textile art pieces today, explore different textile and fibre art techniques to provide a lot possibilities. She further gave some instances like; Ana Barboza- a Peruvian textile artist, utilizes wool and other yarns for embroidery to create landscapes. Her works imitate the flow of waves and grass. Mimi Jung- a Korean-American artist, creates constructions and woven wall pieces with yarns. Another is Nike Schroeder a Berlin based artist, who uses embroidery to create some striking illustrations that involve threads which emulate the appearance of dripping paint and she also explored the idealized beauty of the female form, Lin Tinamo a Chinese artist, created some textile installation works which incorporate materials and objects typically associated with women. Victoria Udondian a Nigerian artist (painter) but presently explores fabric collages and textile installations; and also Mary Izang a textile artist uses tapestry to explore the Plateau state landscapes as a research. All these artists with their works continue to showcase a heritage of different fabric arts which reinvent the medium in various ways.

Methodology

Functions of textile arts in the built environment.

There are many ways that the built environment can support health and wellbeing through the use of textile arts. Environments that promote stress reduction, physical movement, and social connection will support the basic human needs that encourage health and wellbeing. Textile Artists mostly incorporate the goal of health and wellbeing early in their designs phases so that each aspect of a project is informed and driven by the desire to support mental health and wellbeing. There are six levels of human needs in the built environment according to Bartuska, 2007.

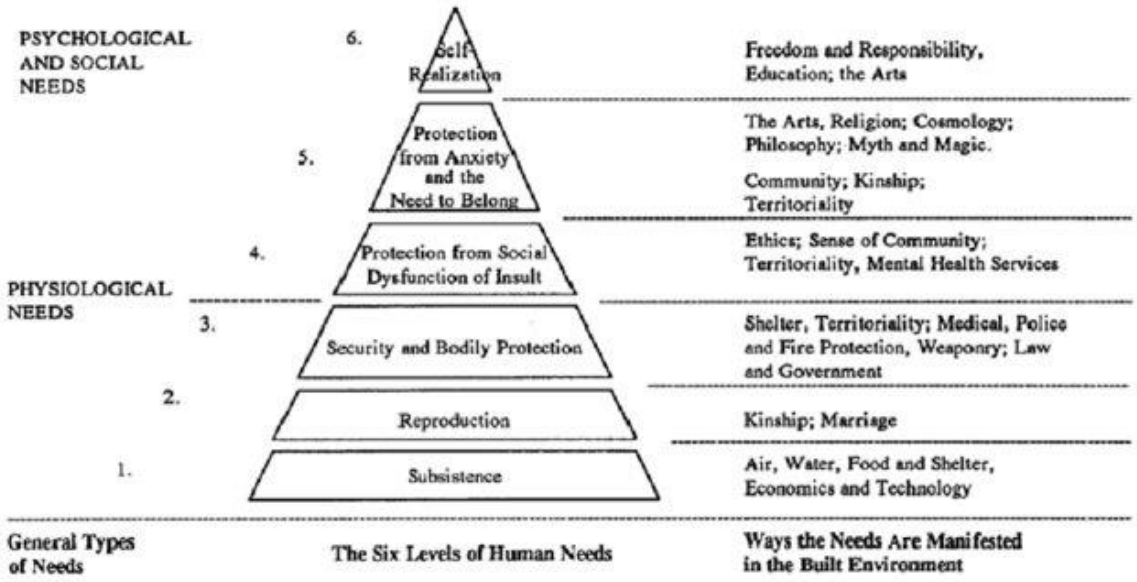

***Figure 4**: Human Needs and ways they are manifested in the built environment (Source: Bartuska Tom J, 2007)*

The fifth level type of need is protection from anxiety and the need to belong which are manifested in the arts, religion, cosmology, philosophy, myth and magic. Also in the community through kingship. Visual arts (textile arts) is the primary concern of this study. Textile arts could be installed externally or internally to enhance the built environment. They are often commissioned by developers, local authorities or other land owners, or may be procured by galleries, museums, arts organizations, and the Arts Council.

Through the utilization of African indigenous fabrics in the production of textile arts which are used for decorating the built environments, the cultural heritage is promoted and showcased. Since African fabrics are replete with symbolic motifs, a lot of messages are passed onto the onlooker in the environment in which the art piece is placed or mounted. For example the textile art installation of Chief Nike Davies-Okundaye (see Figure 5).

Bhatt (2014) affirms that a work of art express the imagination of artists in a non-grammatical way that are not linked to spoken or written language. Therefore, a textile art expresses the artists' ingenuity. Each textile art has a definite meaning which it reveals to the onlooker. By this expression, self-satisfaction of the artist is attained.

Textile art works have themes which are usually educative. They can be used to raise awareness for a large variety of causes. A number of art activities were aimed at raising awareness of autism, cancer, human-trafficking and a lot of other topics.

Textile art works are also therapeutics, for instance some of the textile art installations which are hung on the hospital, clinic, and pharmacy shops walls which are based on different aspects of health. It creates a process of healing through creative art works. While admiring those artworks by patients their minds are being distracted from their troubled health for quite some time.

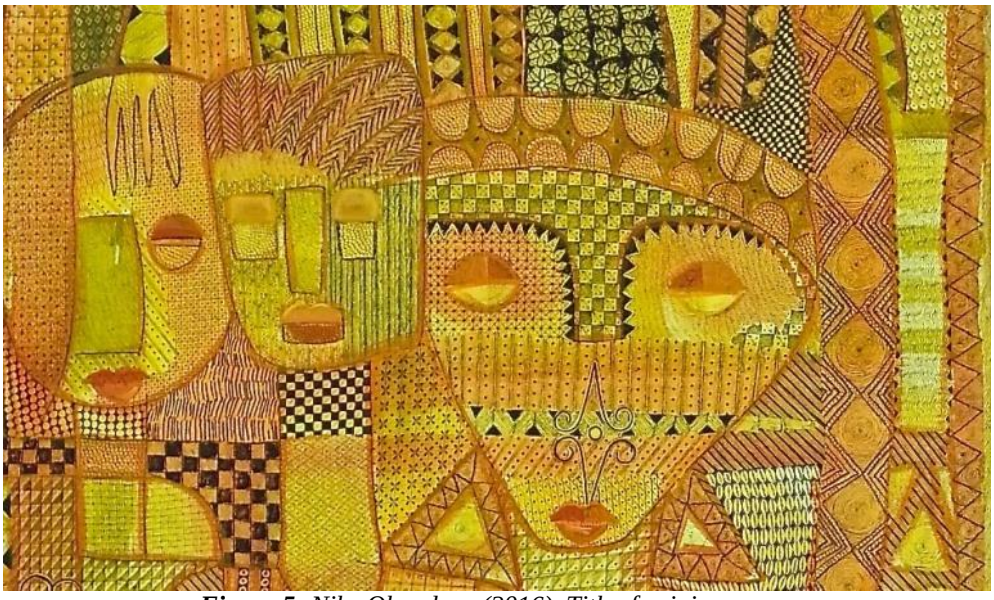

Figure 5*: Nike Okundaye (2016). Title: feminine power*
Source:
https://blogs.bl.uk/asian-and-african/2016/01/chief-nike-davies-okundaye-visits-the-british-librarys-west-africa-exhibition-.html

Textile art work installations are used in enhancing interiors, define space, absorb sound, and create specific character and atmosphere in the built environment. See Yinka Shonibares' Nelson ship in a bottle in Figure 14.

They could also be utilized as a form of propaganda in that they subtly manipulate the viewer into a particular emotional or psychological response towards a particular idea or object.

Through the utilization of left over fabrics in quitting and patchwork reduction of waste of left over materials is achieved. Instead of throwing them away into landfills or burning them, they are utilized to produce various textile arts which can be sold for economic purposes.

According to Katz (2011), a piece of fabric takes on symbolic value while creating sacred place. She further mentions that a fabric in a place of worship is relatable and flexible. It provides a decreased sense of alienation, disaffection, isolation and increased sense of closeness. It can transform the built environment, in that a room that serves as the spiritual home to one faith group on Saturday can be home to another on Sunday. A special fabric used to cover a table or a banner hung on the wall usually makes some differences.

Theoretical studies

Theory of Aesthetic Experience

To analyze this topic "Overview of Textile Arts/Design in Habitable Places: A Beauty to Behold in the Built Environment," several theories can be utilized.

Theory of Aesthetic Experience, propounded by John Dewey (1934 -), Dewey's philosophy emphasizes the importance of aesthetic experiences in everyday life. He argued that art should be integrated into the environment to elevate the human experience. In the context of textile arts, this theory can be applied to how textiles contribute to overall ambiance and beauty in habitable spaces.

Another theory is environmental Aesthetics, propounded by Alan H. Cowen (1982-). Environmental aesthetics explores the value of beauty in the environment. This theory can help assess how textile design affects the visual and sensory qualities of built environments, emphasizing that well-designed textiles can enhance both aesthetic appreciation and emotional responses.

The third is biophilic Design Theory, propounded by Stephen R. Kellert during early 2000s.This theory posits that humans have an inherent connection to nature, which should be reflected in design. Textiles that incorporate natural patterns, materials, and colors can create a harmonious balance between built environments and the natural world, enhancing well-being. These theories provide a comprehensive framework for assessing the impact of textile arts and design within the built environment, highlighting their aesthetic, cultural, and functional significance.

Some textile art installations

Biddulph town in Staffordshire in UK always utilize yarn bombing to decorate their environment during major celebrations every year. According to Lenton (2022), Biddulp town hall has again been 'yarn-bombed' over the weekend, and this time there are more lovely knitted creations than ever brightening up the town centre. The area around the town hall has been 'yarn bombed', this time as part of the Biddulph jubilee Festival, which has a wide range of all kinds of events happening in the town throughout July. This is a growing trend all over the country, yarn bombing involves covering objects or structures in public places with decorative knitted or crocheted material, as a form of street design or art. See figures 7-10 respectively.

***Figure 6**: Textile arts used as embellishments on fence.*
Source: https://biddulph.nub.news/news/local-news/gallery-biddulph-covered-in-knitted-creations-after-yarn-bombing-event-141302

***Figure 7**: Textile art as decorations in trees in the built environment. Source: https://eastmoline.librarycalendar.com/event/yarn-bombing-library*

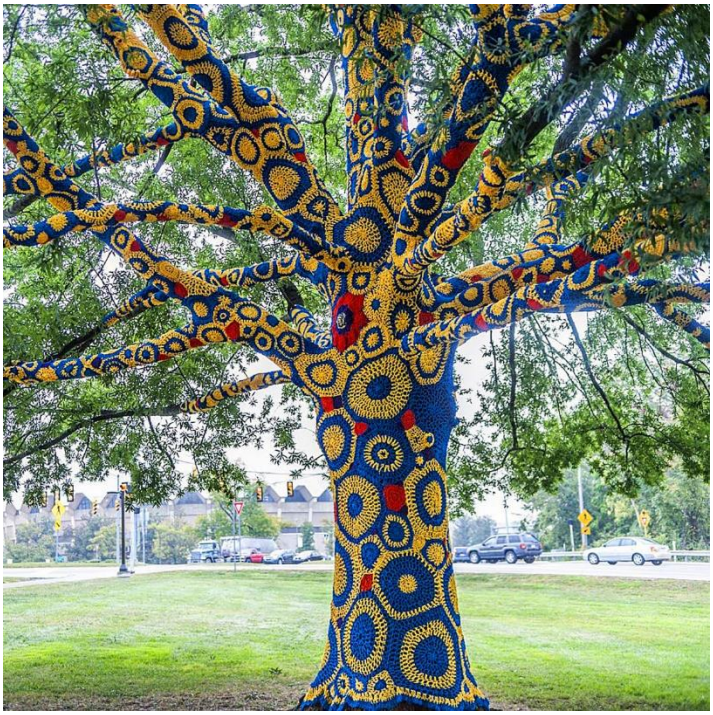

***Figure 8**: Textile art.*
Source: https://www.domestika.org/en/blog/6921-how-did-yarn-bombing-reach-your-city

Here in Figure 6, designs of crocheted colourful yarns were used to decorate this tree that has beautified the built environment.

Here the yarns were crocheted into different types of flowers attached to the barbed wire fence for decorations.

***Figure 9**: Textile art. Source: www.laivastrakuose.*

***Figure 10:** Textile art as aesthetics in a park. Source: Micoope*

Figure 11: *Textile artist Magda Sayeg transforms urban landscapes into her own playground by decorating everyday objects with colorful knit and crochet works.*
Source: https://www.google.com/search?q=yarn%20bombing&udm=2&uds=

Here, round wires were used to form some designs by crocheting some designs on them to beautify the built environment.

Findings

Contemporary African Textile art and Textile Installation artists

Textile art installations could be found in strategic places in the built environment, they could also be found in museums as permanent exhibitions and various temporary art exhibitions. They could be used for tourism purposes. Some examples of some textile art installations are placed in figures 9-14 respectively.

Victoria Udondian born in 1982 is a Nigerian artist that concentrates on Confronting notions of authenticity and cultural contamination she works with large-scale sculptural forms utilizing second-hand textiles as the primary material.... like used clothes, burlap, paper, plastic bags, shopping bags and textile recycling companies' product not minding that she trained as a painter. She has been able to synergize textiles and sculptural frames into her art from her exhibition 'We Face Forward; Art from West Africa Today" I'm Manchester, *Aso Ikele* was constructed in 3 parts like an Italian altarpiece. Working with donated second-hand clothes from the UK, it combined materials and narratives from various sources as well as having as a base, the traditionalism of her cultural cloths.

Figure 12: *Victoria Udondian (2012). Name of work: Aso-ikele. Media: used clothes from Manchester, used burlap from Nigeria. 231/4'*23'. South London Gallery.*
Source: https://www.contemporary-african-art.com/contemporary-textile-installation-artists.html

Figure 13: *Yinka Shonibare(2003) Scramble for Africa. Life size fibre glass maneqiunns14 chairs table, Dutch wax-printed fabrics. installation14figures, 14chairs, table 132 x 488 x 280 cm.The Pinnell Collection, Courtesy of the artist, Stephen Friedman Gallery (London), and James Cohan Gallery (New York). Commissioned by Museum for African Art, New York, for the exhibition Look Both Ways.*

Yinka Shonibare's born in 1962works explore cultural identity, colonialism and post-colonialism within the contemporary context of globalization. A hallmark of his art is the brightly coloured Ankara fabrics he uses. He is a sculptor but does not hesitate in carrying out explorations using the synergy of African wax printed fabrics and some other sculptural medium to produce some thought-provoking art pieces for the built environment.

Figure 14: *Yinka Shonibare:Nelson's Ship in a Bottle.*
Source:https://www.blackhistorymonth.org.uk/article/section/artists/yinka-shonibare-the-artist-celebrating-african-culture-and-identity/ national maritime museum

One of Shonibare's most famous works is "Nelson's Ship in a Bottle," a large-scale sculpture that was installed on the Fourth Plinth in Trafalgar Square in 2010. Yinka Shonibare's famous art work, "Ship In A Bottle", originally displayed for a couple of years on the fourth plinth in Trafalgar Square. After a new sculpture replaced it, this piece was moved to Greenwich to become part of the National Maritime Museum**.** The sculpture consists of a replica of Horatio Nelson's flagship, the HMS Victory, contained within a giant glass bottle. The sails of the ship are made from brightly coloured African wax prints, while the ship itself is made from fiberglass. The piece is a commentary on Britain's imperial past and its relationship with Africa, as well as a celebration of the diversity and complexity of contemporary British culture (Samuels, 2023).

Peju Alatise born in 1975 began her career with painting then branched out to be a multimedia artist using beads, cloth, resin and other materials in her works. By using fabrics, ceramics and metal she creates conceptual, 3-dimensional pieces that have an underlying theme highlighting the absence of women (see figure 15 and 16)- a theme that specifically

Figure 15: *Peju Alatise (nd). Wrapture- a story of cloth. Source**:** https://www.contemporary-african-art.com/contemporary-textile-installation-artists.html*

Figure 16: *Peju Alatise(nd). Orange goes to heaven. Source: https://www.contemporary-african-art.com/contemporary-textile-installation-artists.html*

Figure 17: *Nnenna Okore. (2017)*
Title of work: Osimili
Source:https://sculpturemagazine.art/nnenna-okore/ Nnenna Okore

resonates across Nigerian society after the disappearance of 100's of girls to the hand of Boko Haram ever since 2014.

Raised in a Muslim family Alatise originally faced opposition to her chosen career. A young Peju was shaped by her observations on the role of women in Nigerian society, increasingly questioning the status quo. Nowadays she addresses issues concerning her religion and other pertinant subjects like immigration and child brides also not neglecting the use of textiles in her art works.

Nnenna Okores born in 1975 works' are partly inspired by traditional women's hand woven fabrics in Africa though not a formerly trained textile artist. She is a painter but has blurred the demarcation between painting and textiles in her works. Presently, she held an exhibition with the title "Osimili." In the Igbo language of Nigeria, "Osimili," the title of Nnenna Okore's recent show, means a huge body of water. Her processes include weaving, sewing, rolling, twisting and dyeing - techniques garnered from watching women perform daily tasks in the visceral and tactile street markets of Nigeria. She uses wire to shape and join fabric forms, creating malleable and changeable sculptures with multiple parts that relate to the site of their installation. Her end products are truly masterful, intricate sculptural installations that are inspired by the textures, colors and landscapes of her local environment (Allen, 2018).

Textile installations have not been sufficiently practiced and paid attention to by artists and designers in Nigeria. This study found out that in many parts of the world, textile art was and still being utilized to beautify the built environment. Some artists have also began to employ the use of textiles in their art works to make various art statements and such art works are found in some strategic places abroad. Through the use of textile arts, the built environment can support health and wellbeing

Conclusion

The art of designing and creating textiles spans global cultures and represents one of the earliest human technologies. More recently, some artists have created sculptures and installations from fabrics instead of the usual medium like stone and wood. The shift of some textile artists from concentrating on surface design to manipulation of fibres and fabrics into some forms and structures to produce large 3D textile art works which are used to decorate the built environment have shown the versatility of textiles. Through the production of these textile art installations, fabric scraps are utilized thereby, reducing any form of waste; for

instance in quilting and patchwork. Therefore, different types of textiles should be utilized quite often to produce art works that can be used to enhance the built environments as this has proven that textiles can yield very interesting results.

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Accessibility Analysis of Cafes and Restaurants for Disabled Individuals in Muratpaşa, Konyaaltı, Kepez, and Döşemealtı Districts of Antalya Province

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Abstract: This study examines the accessibility of cafes and restaurants in the Muratpaşa, Konyaaltı, Kepez, and Döşemealtı districts of Antalya for disabled individuals. The study analyzes the current status of design elements for visually and physically impaired individuals and assesses the compliance of these spaces with accessibility standards. The findings indicate that most of the spaces lack critical adjustments such as tactile surfaces for visually impaired individuals and basic accessibility elements like ramps and restrooms for disabled individuals.

This study highlights the importance of implementing universal design principles and emphasizes that interior architectural projects should be included in municipal permit processes. Designs need to be human-centered and inclusive to support full participation of disabled individuals in society. Ensuring accessibility in the physical environment will not only improve individuals' quality of life but also play a critical role in social awareness and social integration.

Keywords: Accessibility, Interior architecture, Antalya, Disabled, Access.

1. Introduction

Throughout life, humans face a variety of physical and mental conditions. From birth, individuals possess limited physical and cognitive abilities and lack many fundamental skills. During childhood, particularly between the ages of 5 and 6, basic physical skills are acquired; however, anthropometric dimensions remain a limiting factor for many activities in this period. Upon reaching adulthood, individuals exhibit anthropometric diversity such as height, sitting height, shoulder, and hip width; reach and movement capabilities such as arm, leg, and hand reach distances; detailed extremity measurements such as hand and foot length; and postural and movement diversity such as height, sitting height, shoulder, and hip width; reach and movement capabilities such as arm, leg, and hand reach distances; detailed extremity measurements such as hand and foot length; and postural and movement diversity such as knee, elbow, and eye level height. Additionally, differences based on age, gender, and ethnic groups are among the key factors influencing anthropometric diversity (Pheasant, 2003). With aging, physical and cognitive

functions decline, making it increasingly difficult to perform certain tasks.

Even individuals born without any disabilities are at risk of developing temporary or permanent disabilities over their lifetime. At a minimum, they encounter at least one of the conditions described above, ranging from infancy to old age.

Today, the increase in average life expectancy further underscores these challenges. According to the World Health Organization (WHO), the global average life expectancy rose from 66.8 years in 2000 to 73.4 years in 2019 (WHO, 2023). This rising life expectancy demonstrates that physical and mental adaptation issues are inevitable at certain stages of life and highlights the importance of environmental and social adjustments in improving the quality of life.

Longer and more complex lifespans raise the likelihood of disability. According to the WHO, approximately 16% of the global population, or 1.3 billion people, live with some form of disability, a phenomenon that becomes more pronounced with aging populations (WHO, 2023). In Turkey, 2021 data indicates that 6.9% of the population aged 3 and above (4,876,000 individuals) have at least one kind of disability; this figure stands at 5.9% for men and 7.9% for women (Ministry of Family and Social Services, 2021).

The aging population is another factor contributing to the increase in disability rates. The WHO estimates that the proportion of the global population aged 60 and over will rise from 12% in 2015 to 22% by 2050, with this age group expected to grow from 1 billion in 2020 to 1.4 billion by 2030 (WHO, 2022). In Turkey, the population aged 65 and above increased from 6,895,385 in 2017 to 8,451,669 in 2022, marking a 22.6% rise (Turkish Statistical Institute, 2023). These demographic shifts necessitate a broader perspective and more comprehensive solutions to address disability-related issues.

Disability should not be perceived merely as a result of an individual's physical or mental conditions. Instead, it should be understood as a consequence of social and environmental factors that hinder an individual's full participation in society. In this context, the International Classification of Functioning, Disability, and Health (ICF) frames disability and functioning as outcomes of the interaction between an individual's health conditions (such as diseases, disorders, and injuries) and contextual factors. External and environmental factors, including social attitudes, architectural characteristics, legal and social structures, climate, and geography, play a significant role in shaping these outcomes (WHO, 2002).

The United Nations Convention on the Rights of Persons with Disabilities United Nations (2006), ratified by the Republic of Turkey in 2008, outlines key principles aimed at securing the rights of individuals with disabilities. These principles include:

- Respect for inherent dignity, individual autonomy, and freedom to make one's own choices,
- Non-discrimination,
- Full and effective participation in society,
- Respect for differences and acceptance of persons with disabilities as part of human diversity,
- Equality of opportunity,
- Accessibility,
- Gender equality,
- Respect for the evolving capacities of children with disabilities and their right to preserve their identities

These principles provide a universal framework for supporting the full inclusion of individuals with disabilities and removing social barriers.

In conclusion, addressing disability requires a holistic approach that considers not only individual physical or mental limitations but also the environmental and social factors influencing their participation in society. Accessibility and public awareness initiatives are critical for developing sustainable solutions and improving the quality of life for individuals with disabilities.

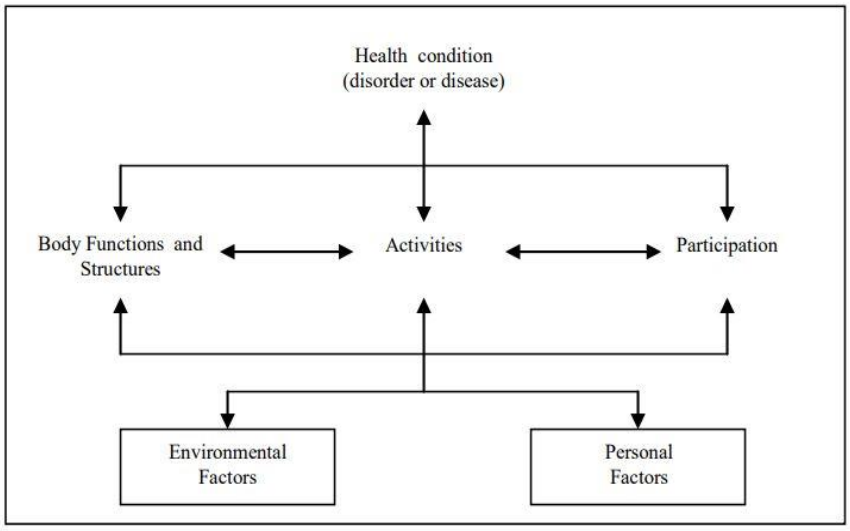


Figure 1: *International Classification of Functioning, Disability, and Health (ICF) Model (WHO, 2002)*

Environmental factors refer to the physical, social, and attitudinal environments in which individuals live and sustain their lives (WHO, 2002). These factors are evaluated using negative and positive scales to determine the degree of barriers or facilitators encountered by individuals and encompass the following elements:

- Products and Technology,
- Natural Environment and Human-Induced Environmental Changes,
- Support and Relationships,
- Attitudes,
- Services, Systems, and Policies

In this regard, disability is not merely a matter related to an individual's health condition but is intricately linked to the environmental and social conditions in which the individual resides. This relationship underscores the necessity for efforts to address disability and enhance individuals' participation in societal life, extending beyond healthcare services to encompass environmental and social adjustments.

Efforts to combat disability and improve functionality must adopt a multidisciplinary perspective that includes not only healthcare services but also environmental modifications and social policies. One of the most significant factors affecting the social lives of individuals with disabilities is the physical environment. Physical barriers encountered in daily life negatively impact social participation and limit societal integration. Inaccessible or physically restrictive spaces hinder the mobility of individuals with disabilities and constrain their social interactions.

Scientific studies have shown that active participation in community-based leisure and recreational activities has positive effects on the health and well-being of individuals with disabilities (Perry et. al., 2021). In this regard, the design of accessible public spaces and the creation of environments that foster a sense of inclusion and value for individuals are of paramount importance. Accessible designs that enable all individuals to actively participate in their communities serve as critical components for strengthening social equity and promoting societal solidarity (Wilkinson, 2023).

Ensuring accessibility in the built environment for everyone requires a thoughtful and comprehensive design process, as well as compliance with legal regulations that govern the construction and monitoring process. In

Turkey, submitting architectural, structural, electrical, mechanical, and fire safety plans to municipalities for approval is a legal requirement when constructing a building. These plans must comply with municipal zoning regulations, and revisions may be requested until compliance is achieved. However, interior architectural plans are not included in the project packages submitted during this process. The long-standing legal efforts by the Turkish Chamber of Interior Architects to have interior architecture recognized as a specialized discipline were concluded with a decision by the Council of State's 6th Chamber. The court annulled the phrase "architect or," legally affirming that interior design projects must be prepared by interior architects specialized in this field (TMMOB, 2021). Consequently, the preparation of interior architectural plans by interior architects is now recognized, even for smaller-scale projects, a practice previously limited to large-scale projects.

If a building is designed with a specific function in mind from the outset and no changes are planned for the interiors, this may not pose a risk to human health and safety. However, in most cases, the architectural plans submitted to municipalities depict commercial spaces as empty shells. Once construction is complete, the design of these interiors depends on the preferences of the owner or tenant, who initiates the interior design process to open a business.

Interior design is a multidisciplinary process requiring a user-centered approach. One of the primary challenges in architecture is designing buildings for general use without a specific user in mind. In contrast, the interior design process begins with identifying the user and proceeds by addressing their specific needs, preferences, and profile. However, some individuals, to reduce costs, choose to "decorate" their spaces through application firms rather than seeking professional interior design services even though these companies are operated by individuals without formal education in interior architecture. This approach highlights a gap in the inclusion of interior architectural services in project approval processes.

Interior architectural services are not limited to aesthetic arrangements but involve expertise in technical aspects such as structural systems, fire safety, and accessibility, all of which are critical for human-centric design. For this reason, incorporating interior architectural plans into building approval processes is essential to prepare user-oriented interior design projects and to eliminate the need for renovation afterwards.

Incidents such as the February 6, 2023 Kahramanmaraş earthquake (TRT Haber, 2023) and the October 30, 2020 İzmir earthquake (Anadolu Agency. 2021) have revealed that significant losses of life and property can result from interventions made to enhance the functionality of spaces that compromise the structural integrity of buildings. Similarly, a fire on April 2, 2024, in Istanbul's Beşiktaş district during the renovation of a venue that claimed the lives of 29 workers exemplifies the consequences of not requiring approval for interior architectural plans, leading to insufficient occupational health and safety measures (BBC Türkçe, 2024).

This study addresses accessibility issues and emphasizes their importance, as every individual faces a risk of encountering temporary or permanent disability at some point in their lives. Examples of temporary disabilities include aging, pregnancy, stroller use, or fractures in the arms or legs, while permanent disabilities include conditions such as blindness or physical impairments. Individuals with disabilities face various challenges in participating in education, social life, and employment, underscoring the critical importance of accessibility for social equality and quality of life.

From an anthropological perspective, daily activities such as dining and coffee drinking are not only means of meeting biological needs but also serve as significant social activities that strengthen bonds and contribute to cultural identity (Cipriano-Crespo et. al., 2023). However, for individuals with disabilities, these social activities are often fraught with difficulties, primarily due to environments that fail to make them feel comfortable.

Society's supportive and understanding attitudes towards individuals with disabilities can enable their more active participation in

social life. This approach allows individuals with disabilities to discover their potential and contribute to society. Additionally, providing the necessary support and assistance can make their daily lives easier and more comfortable.

Nonetheless, individuals with disabilities may be perceived differently due to their eating habits or limited access to spaces and services, leading to exclusion from dining out activities. This exclusion can result in social isolation and, ultimately, feelings of loneliness. These challenges range from physical barriers such as inaccessible interiors and transportation issues to societal discrimination (Cipriano-Crespo et. al., 2023). To prevent such isolation and ensure greater social interaction for individuals with disabilities, creating accessible and inclusive social spaces is of utmost importance.

The lack of accessible environments is a fundamental issue limiting the social participation of individuals with disabilities. This issue also affects those who wish to spend time with individuals with disabilities but face challenges due to the limited availability of suitable environments. Thus, incorporating interior architectural plans into municipal approval processes and ensuring that new spaces meet minimum accessibility criteria are essential as current architectural projects often include such arrangements superficially, highlighting the need for in-depth planning.

Such measures can help individuals with disabilities feel comfortable and actively participate in social life, ultimately enhancing individual quality of life and promoting societal welfare and solidarity.

This study aims to encourage academic research in this field and contribute to the standardization of interior architectural projects. It seeks to examine accessibility issues through the principles of human-centered and universal design. In this context, the accessibility status of cafes and restaurants in Antalya's four major central districts—Muratpaşa, Konyaaltı, Kepez, and Döşemealtı—will be analyzed. These evaluations aim to provide recommendations to facilitate the lives of individuals with disabilities and raise societal awareness.

1.1. Universal Design

The term "Universal Design" was first introduced in 1985 by architect Ronald L. Mace. It is defined as the design of products, environments, programs, and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. However, the inclusion of assistive devices for specific groups with disabilities is not excluded from the concept of universal design (United Nations, 2006), universal design is also referred to by terms such as "design for accessibility," "design for all," and "inclusive design." Despite ethical principles and terminological differences, this design approach represents a universal perspective that transcends national and regional boundaries (Mitrasinovic, M., 2008).
Ronald L. Mace, a disabled architect, emphasized that universal design principles should apply not only to public spaces but also to private spaces, such as housing. Mace and his colleagues published various articles on universal design principles for housing (Mace, 1998); (Trachtman et. al., 1999) and systematically established these principles (Story et. al. 1998). These principles, which remain valid today, provide a framework aimed at making design more accessible and usable for everyone. Principles of Universal Design (Story et. al. 1998):

- Equitable Use: Design should be useful and marketable to people with diverse abilities.
- Flexibility in Use: Design should accommodate a wide range of individual preferences and abilities.
- Simple and Intuitive Use: The design should be easy to understand, regardless of the user’s experience, knowledge, or language skills.
- Perceptible Information: The design should effectively communicate necessary information to the user, regardless of environmental conditions or sensory abilities.
- Tolerance for Error: Design should minimize hazards and the adverse consequences of accidental actions.
- Low Physical Effort: The design should be usable efficiently and comfortably with minimal fatigue.
- Size and Space for Approach and Use:

> The design should provide appropriate size and space for approach, reach, and use, regardless of the user's body size, posture, or mobility.

These principles not only aim to make physical environments accessible but also serve as a foundation for promoting social equality and inclusivity.

Studies have revealed that the challenges faced by individuals with disabilities are evident both in public spaces and society at large. These challenges range from physical barriers, such as inaccessible interiors and transportation, to social barriers perpetuating discrimination. Research (Chia-Hsin, C., 2020); (Gay, 2022); (Peterson, H. 2021); (Kent, 2021); (Lee, 2023); (Gürlek, 2024) detailed the accessibility issues experienced by individuals with disabilities and highlighted the inadequacy of existing practices, policies, and regulations in addressing their needs. Even when regulations exist, their inconsistent or insufficient implementation often compounds these issues. These systemic deficiencies hinder the full participation of individuals with disabilities in daily life and underscore a broader societal failure to meet their needs effectively. Enhancing the participation of individuals with disabilities in social life and making physical environments more accessible in line with universal design principles are thus of critical importance.

Efforts to address accessibility issues must also extend to the discipline of interior architecture, where regulatory frameworks and standards play a vital role. In Turkey, the inclusion of interior architectural projects in municipal approval processes is crucial for both individual and societal well-being. Such regulations not only contribute to ensuring safety standards and ethical practices in interior architecture but also promote sustainability and creativity in the design process, enhancing accessibility for all. Effective oversight of these practices is also essential for maintaining high professional standards. Proper supervision ensures that the aesthetic value and functionality of spaces are preserved while preventing improper practices. This approach not only enhances individuals' quality of life but also strengthens the societal contribution of interior architecture and fosters the creation of more inclusive environments.

1.2. Problem Statement

Accessibility challenges that limit the social participation of individuals with disabilities stem from inadequacies in the physical and spatial environment. This study seeks to answer the question: **To what extent do cafes and restaurants in Antalya's Muratpaşa, Konyaaltı, Kepez, and Döşemealtı districts meet the accessibility needs of individuals with disabilities?** Identifying these shortcomings and developing solutions is critical for enhancing individuals' quality of life and supporting their participation in social life.

1.3. Objectives of the Study

This research aims to examine the accessibility levels of cafes and restaurants in Antalya's four major districts—Muratpaşa, Konyaaltı, Kepez, and Döşemealtı—highlighting the physical barriers faced by individuals with disabilities. Additionally, it seeks to raise awareness of the application of universal design principles in spatial design and develop recommendations for interior architecture practices in this context.

1.4. Hypotheses

- Most cafes and restaurants in Antalya fail to meet the minimum accessibility standards for visually and physically impaired individuals.
- Adopting universal design principles will improve the accessibility of these spaces and support social integration.
-Including interior architectural projects in municipal approval processes will contribute to solving spatial accessibility issues.

1.5. Scope of the Study

This study covers 49 cafes and restaurants located in Antalya's districts of Muratpaşa, Konyaaltı, Kepez, and Döşemealtı. The research evaluates five basic accessibility criteria: tactile surfaces for the visually impaired, ramps for individuals with physical disabilities, wide entry doors, circulation areas, and accessible restrooms. The aim is to analyze the current state of these spaces and provide recommendations.

1.6. Methodology

The study evaluated cafes and restaurants in various districts of Antalya based on five accessibility criteria. Observations were supported by photographs and compiled into reports. The collected data were used to analyze the accessibility levels of the spaces and to develop recommendations. The five criteria selected for establishing the conceptual framework of the study-venue, tactile surface on the floor, ramp at the entrance, door width, circulation areas, and accessible WC-are based on universal design principles aimed at enhancing spatial accessibility in interior design for individuals with disabilities. According to Steinfeld and Maisel (2012), universal design involves creating environments that are equal and usable by all people, regardless of age, ability, or status. For example, tactile surfaces on the floor are essential for visually impaired individuals to safely navigate and orient themselves in spaces. According to the World Health Organization (2011), tactile indicators are a primary means for individuals with visual impairments to find their way in unfamiliar environments. Ramps at entrances are another crucial criterion, as they facilitate access for wheelchair users when present. This criterion is also critical for barrier-free and accessible design (Preiser, 2010). According to the Americans with Disabilities Act (ADA, 1990) and TS 9111 (Turkish Standards Institute (2011), door width is an important factor, as it ensures that individuals with limited mobility can easily enter and exit spaces. Circulation areas, as highlighted by Goralzik et. al. (2024), must be wide enough to accommodate individuals with varying mobility needs. Accessible WCs, which meet both functional and privacy requirements, are a standard feature of universally designed environments (Mace, 1998). In this context, five different criteria have been determined for use in the study.

The five main criteria for evaluation included:

- Tactile Surfaces
- Entrance Ramps
- Wide Entry Doors
- Circulation Areas
- Accessible Restrooms

A total of 49 cafes and restaurants were analyzed, distributed as follows: 18 in Muratpaşa, 18 in Konyaaltı, 10 in Kepez, and 3 in Döşemealtı (Figure 2).

Muratpaşa and Konyaaltı are central and developed districts with higher socio-economic status, a dense urban pattern, and a concentration of commercial, residential, and mixed-use spaces. These factors contribute to a greater number of examined samples.

Kepez represents a developing district with a more diverse socio-economic structure. While urban expansion and new housing projects are increasing.

Döşemealtı on the other hand, is characterized by lower population density, suburban or rural settlement patterns, and fewer commercial or

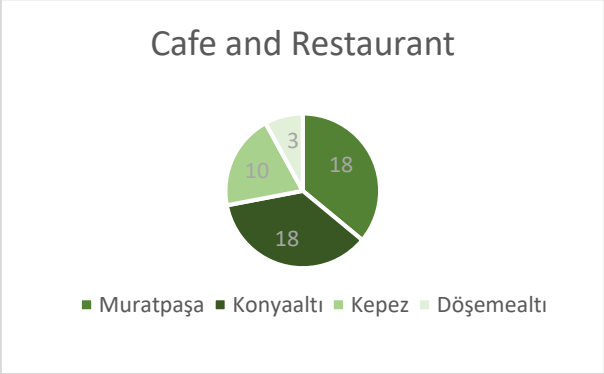


Figure 2: *Distribution of Analyzed Cafes and Restaurants by Districts*

residential spaces that require interior design modifications. As a result, the number of examined samples in this district is significantly lower.

No restrictions were placed on the selection of establishments, allowing for a broad analysis across Antalya. To ensure diversity, participants were encouraged to choose from chain establishments, luxury restaurants, newly opened cafes, and popular venues. This approach enabled the evaluation of accessibility across different types and standards of spaces.

In this process, a comprehensive dataset has been compiled to analyze the accessibility conditions of cafes and restaurants in various districts of Antalya for individuals with disabilities. This dataset not only highlights the current state of these spaces but also identifies areas that require improvements in terms of accessibility.

The methodology of this study aims to provide critical insights into the accessibility conditions of establishments in different districts of Antalya. Furthermore, this research holds significant value in raising societal awareness about interior design and accessibility while contributing to the discipline of interior architecture.

The findings of this study serve as a foundation for developing recommendations to improve accessibility standards. By addressing both the physical and societal aspects of accessibility, the research seeks to foster a more inclusive and user-centered approach in interior architectural practices.

2. Findings and Evaluation

2.1. Muratpaşa District

The evaluation of 18 cafes and restaurants in the Muratpaşa district of Antalya (Tables 1-2) revealed that none of these establishments had designs suitable for visually impaired individuals. It was determined that tactile surfaces, which are mandatory for visually impaired users, were absent from the floors of these venues, and there were no alternative design elements to compensate for this deficiency.

In terms of accessibility standards for individuals with physical disabilities and wheelchair users, it was found that three of the 18 establishments did not require ramps due to being on the same level as the ground. Among the remaining 15 establishments, only five had ramps that met the necessary standards. In one establishment, the ramp was rendered unusable due to an excessively steep slope, while in another, despite having an appropriately sloped ramp, the placement of decorative lighting elements at the end of the ramp made it impossible for users with disabilities to access the venue (Tables 1-2).

Regarding the width of main entrance doors, 15 establishments met accessibility standards which is at least 90 cm opening. According to international guidelines such as the Americans with Disabilities Act (ADA) and the TS TS 9111 (Turkish Standards Institute (2011) making this criterion the most successful among those evaluated.

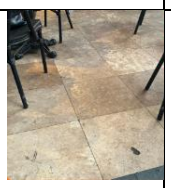
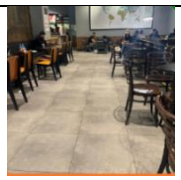
In terms of interior circulation space, only seven establishments were found to provide sufficient space (Tables 1-2). However, considering more specific criteria, such as wheelchair access to seating arrangements, access to the cashier, and whether the transaction surfaces at the cashier were at an appropriate height, it is anticipated that this number would significantly decrease. The limitations of this method include the inability to fully assess all environmental and design factors that affect wheelchair accessibility, as well as the challenge of comprehensively analyzing real-life user experiences beyond standard measurements. Additionally, factors such as surface materials, maintenance conditions, and user feedback may not be fully incorporated into the study's scope, which could lead to an incomplete or insufficient evaluation of accessibility.

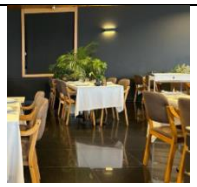
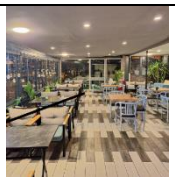
As for accessible restrooms, only two establishments were found to offer this feature (Tables 1-2). One of these was a cafe located within a shopping mall, where the accessible restroom was situated in the general area of the mall rather than within the cafe itself. The other establishment was a long-standing restaurant known for its brand image and architectural identity, which has maintained its original design while incorporating accessible features.

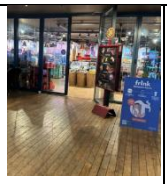
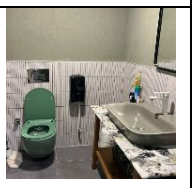
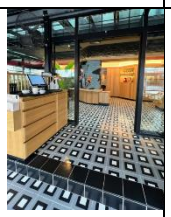
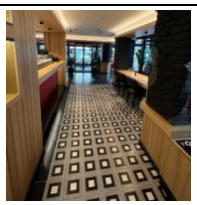
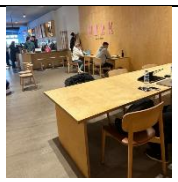
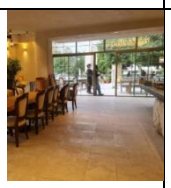
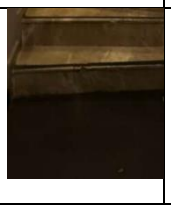
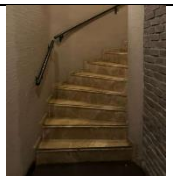
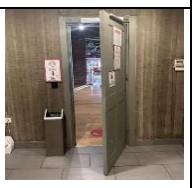
Table 1: *Spatial Accessibility Analysis of Cafes and Restaurants in Antalya's Muratpaşa District*

Venue	Tactile Surface on Floor	Ramp at Entrance	Door Width	Circulation Areas	Accessible WC
1	No	Not necessary	Sufficient	Narrow	Yes (Shared in Mall)
2	No	No	Sufficient	Sufficient	No
3	No	Yes but not suitable	Sufficient	Narrow and there are obstacles	No
4	No	Yes	Sufficient	Narrow	No
5	No	Yes	Sufficient	Narrow	No
6	No	Yes	Sufficient	Wide	Yes
7	No	Not necessary	Sufficient	Sufficient	No
8	No	Yes	Sufficient	Sufficient	Yes but locked
9	No	Not necessary	Narrow	There are obstacles	No
10	No	No	Sufficient	There are narrow corridors and stair	No
11	No	Yes	Sufficient	Sufficient	No
12	No	No	Sufficient	Narrow	No
13	No	No	Narrow	Narrow	No
14	No	No	Sufficient	Sufficient but there is level difference inside the venue	No
15	No	No	Sufficient	Sufficient	No
16	No	Yes	Sufficient	Sufficient	No
17	No	No	Narrow	Sufficient	No
18	No	Yes but not suitable	Sufficient	Narrow	No

Table 2: *Spatial Accessibility Analysis of Cafes and Restaurants in Antalya's Muratpaşa District*

Venue	Tactile Surface on Floor	Ramp at Entrance	Door Width	Circulation Areas	Accessible WC
1					
2					
3					x

4					x
5					
6					
7					x
8					
9					
10					
11					

12					
13					
14					
15					
16					
17					
18					

The venues analyzed in the Muratpaşa district highlight the critical importance of implementing necessary adjustments in spaces to enable individuals with disabilities to sustain their daily lives and integrate into society. These adjustments not only improve accessibility but also contribute to the creation of an inclusive urban environment where individuals with disabilities can participate in social, cultural, and economic activities without barriers. Ensuring that public and private spaces are designed with universal design principles enhances their quality of life and strengthens their sense of belonging within society.

2.2. Konyaaltı District

The analysis of 18 cafes and restaurants in Antalya's Konyaaltı district revealed significant deficiencies in providing services for visually impaired individuals (Tables 3-4). None of the evaluated venues featured tactile surfaces on their floors, which are critical for visually impaired users, and no alternative design solutions were implemented to address this gap. In terms of accessibility for individuals with physical disabilities and wheelchair users, it was found that five of the 18 establishments were at the same level as the pedestrian walkway and therefore did not require additional stairs or ramps. Among the remaining 13 establishments, 10 were equipped with appropriate entrance ramps, one had a ramp that was unusable due to its steep slope, and two lacked ramps despite their necessity (Tables 3-4). These results indicate that the establishments in Konyaaltı performed better than those in Muratpaşa with respect to entrance ramps. However, it was observed that elements beyond the scope of this study, such as the material used for garden paths—especially stone surfaces—were unsuitable for wheelchair use.

The analysis revealed that 16 of the venues had main entrance doors of adequate width to allow access for individuals with disabilities (Tables 3-4). Similar to the findings in Muratpaşa, this criterion was the best-performing among those evaluated. However, it was noted that the operation of two of these doors was challenging. Regarding the width of interior circulation areas, nine establishments were found to provide sufficient space.

These findings suggest that while the venues in Konyaaltı showed better compliance with certain accessibility standards, they generally fell short of fully meeting the required criteria. Addressing these accessibility shortcomings is a priority to ensure easier access for individuals with disabilities to these establishments.

Among the 18 cafes and restaurants examined in Konyaaltı, only five had accessible restrooms for individuals with disabilities. Of these, one restroom was locked, and another was located not within the cafe itself but within the complex where the cafe was situated. These findings indicate that the establishments demonstrated the lowest performance in meeting the accessibility criteria related to restrooms for individuals with physical disabilities.

One of the primary reasons for the relatively better accessibility in Konyaaltı compared to Muratpaşa is the presence of complexes housing cafes and restaurants. Municipal-led projects, such as the Antalya Coastline Project along the Konyaaltı shoreline, have ensured the construction of venues adhering to certain standards and enabled the inclusion of establishments accessible at ground level without elevation differences. Additionally, free restrooms and restrooms designed for individuals with disabilities, provided by the municipality in this area, are important elements supporting accessibility.

Another significant factor is the construction of luxury living complexes in Konyaaltı by real estate developers. These complexes, which include commercial spaces on lower floors and residences on upper floors, integrate necessary design elements such as ramps during the project planning phase, ensuring accessibility without leaving it to the discretion of individual shop owners or designers. This approach has contributed to the superior accessibility of venues in Konyaaltı compared to those in Muratpaşa.

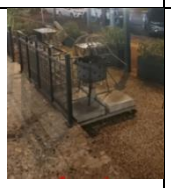
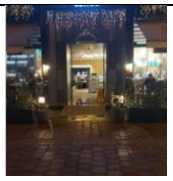
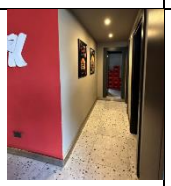
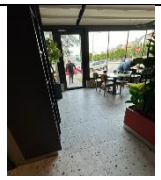
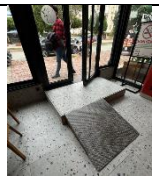
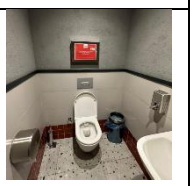
Despite these positive external factors, it was found that the needs of visually impaired individuals were not adequately considered in the design processes, and measures for individuals with physical disabilities remained insufficient in venues outside of municipal projects or residential complexes. This highlights the extent to which these venues are distant from principles of accessibility and inclusivity, and it underscores the persistence of barriers that prevent individuals with disabilities from fully participating in social life.

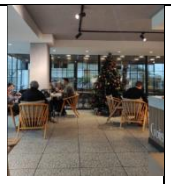
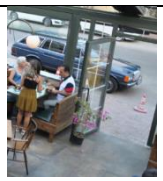
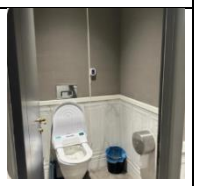
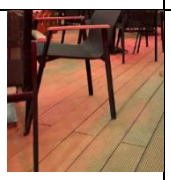
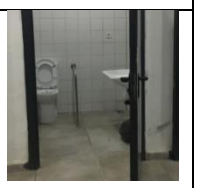
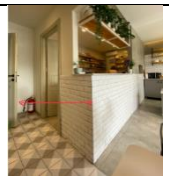
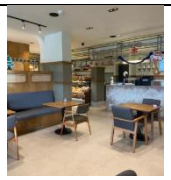
In this context, the principles of accessibility and inclusivity must be adopted as fundamental approaches in all design processes, rather than being limited to specific projects.

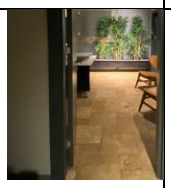
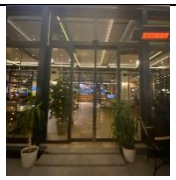
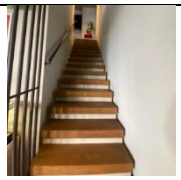
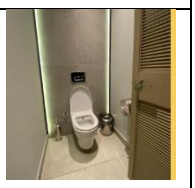
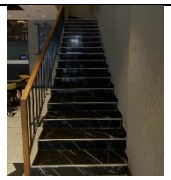
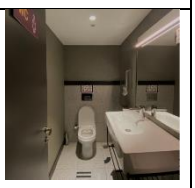
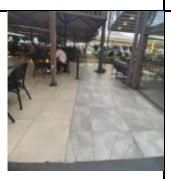
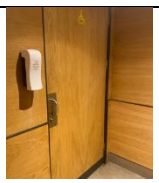
Table 3: *Spatial Accessibility Analysis of Cafes and Restaurants in Antalya's Konyaaltı District*

Venue	Tactile Surface on Floor	Ramp at Entrance	Door Width	Circulation Areas	Accessible WC
1	No	Yes	Sufficient	Sufficient	No
2	No	Yes	Sufficient but difficult to open	Sufficient	No
3	No	Not necessary	Sufficient	Sufficient	No
4	No	Not necessary	Sufficient	Sufficient	No
5	No	Yes but steep	Sufficient	Sufficient	Yes
6	No	Yes	Sufficient	Sufficient	No
7	No	No	Narrow	Narrow	No
8	No	Yes	Sufficient	Narrow	No
9	No	Not necessary	Narrow	Hard	No
10	No	Not necessary	Sufficient but difficult to open	Narrow	Yes but not belongs to the cafe
11	No	Yok	Sufficient	Sufficient	No
12	No	Yes	Sufficient	Narrow	No
13	No	Yes	Sufficient	Sufficient	No
14	No	Yes	Sufficient	Sufficient	No
15	No	Yes	Sufficient	Sufficient	Yes
16	No	Yes	Sufficient	Sufficient	Yes
17	No	Yes	Sufficient	Narrow	No
18	No	Not necessary	Sufficient	Narrow	Yes but locked

Table 4: *Photographs of Cafes and Restaurants in Antalya's Konyaaltı District*

Venue	Tactile Surface on Floor	Ramp at Entrance	Door Width	Circulation Areas	Accessible WC
1					
2					
3					
4					x

5						
6					x	
7					x	
8						
9					x	
10						
11						
12						

13					
14					
15					
16					
17					
18					

2.3. Kepez District

The analysis of 18 cafes and restaurants in Antalya's Konyaaltı district revealed significant deficiencies in providing services for visually impaired individuals (Tables 3-4). None of the evaluated venues featured tactile surfaces on their floors, which are critical for visually impaired users, and no alternative design solutions were implemented to address this gap. Although Antalya's Kepez district has a quieter location compared to Muratpaşa and Konyaaltı, it offers a variety of dining and entertainment venues, thanks to the presence of student neighborhoods housing Akdeniz University students. The accessibility features of the nine cafes and restaurants examined in this study revealed that these venues do not provide adequate services for visually impaired individuals (Tables 5-6). The findings showed that none of the venues had tactile surfaces necessary for visually impaired users, nor were there any alternative design elements to compensate for this deficiency.

In terms of accessibility for individuals with physical disabilities and wheelchair users, it was determined that two of the venues were at the same level as the pedestrian walkway, eliminating the need for stairs or ramps. Five venues were found to have ramps suitable for disabled access, while two lacked the necessary ramps altogether (Tables 5-6). Compared to

Table 5: *Spatial Accessibility Analysis of Cafes and Restaurants in Antalya's Kepez District*

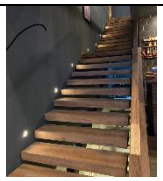
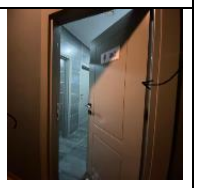
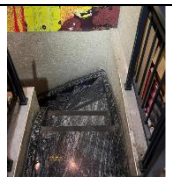
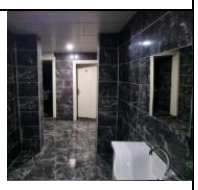
Venue	Tactile Surface on Floor	Ramp at Entrance	Door Width	Circulation Areas	Accessible WC
1	No	Not necessary	Sufficient	Sufficient	No
2	No	Not necessary	Sufficient	Sufficient	No
3	No	No	Sufficient	Narrow	No
4	No	Yes	Sufficient	Narrow	No
5	No	No	Sufficient	Narrow	No
6	No	Yes	Sufficient	Sufficient	No
7	No	Yes	Sufficient	Sufficient	No
8	No	Yes	Sufficient	Sufficient	No
9	No	Yes	Sufficient	Narrow	No

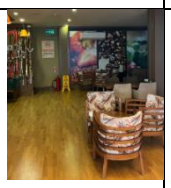
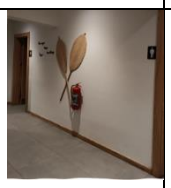
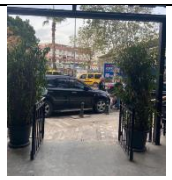
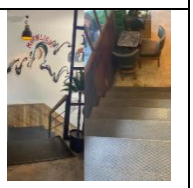
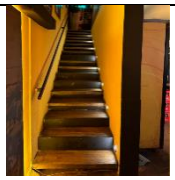
Muratpaşa and Konyaaltı, cafes and restaurants in Kepez presented a more positive picture in terms of the entrance ramp criterion.

All of the examined venues in Kepez had main entrance doors of adequate width for individuals with disabilities, making Kepez more successful in this criterion compared to the other two districts. However, when evaluating the adequacy of interior circulation areas, only five venues were found to provide sufficient space for individuals with disabilities. Considering more detailed criteria, such as access to seating arrangements with a wheelchair, accessibility to the cashier, and the appropriate height of transaction surfaces, this number is expected to decrease.

None of the nine cafes/restaurants examined had accessible restrooms, indicating the weakest performance of Kepez venues in addressing the basic needs of individuals with disabilities. This finding clearly highlights the need for more comprehensive regulations and improvements in accessibility.

Table 6: *Photographs of Cafes and Restaurants in Antalya's Kepez District*

Venue	Tactile Surface on Floor	Ramp at Entrance	Door Width	Circulation Areas	Accessible WC
1					
2					
3					
4					

5					
6					
7					
8					
9					

2.4. Döşemealtı District

Located further from Antalya's central districts, Döşemealtı has shown significant development in the variety of cafes and restaurants in recent years. However, the evaluation of the three cafes and restaurants analyzed in this study (Tables 7-8) revealed that these venues are not suitable for visually impaired individuals. It was determined that tactile surfaces, necessary for guiding visually impaired users, were absent from the floors of the examined venues, and no alternative design solutions were implemented to address this deficiency.

In terms of accessibility for individuals with physical disabilities and wheelchair users, the analysis found that one of the three venues had an appropriate ramp at the entrance. In another venue, although a ramp was present, it failed to serve its purpose due to the absence of a flat

Table 7: *Spatial Accessibility Analysis of Cafes and Restaurants in Antalya's Döşemealtı District*

Venue	Tactile Surface on Floor	Ramp at Entrance	Door Width	Circulation Areas	Accessible WC
1	No	No	Sufficient	Sufficient	No
2	No	Yes	Sufficient	Sufficient	No
3	No	Yes but is unusable; there is no flat landing area, such as a platform.	Sufficient	Narrow	No

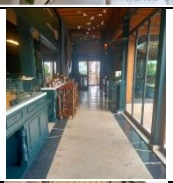
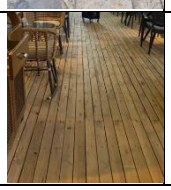
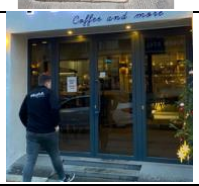
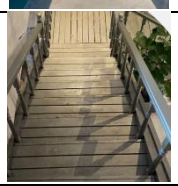
landing at the end, causing collisions with the entrance door. The third venue lacked a ramp altogether. Regarding the width of entrance doors, all three establishments were found to have main entrance doors that met accessibility standards for individuals with disabilities (Tables 7-8).

In the evaluation of interior circulation areas, two venues were found to provide sufficient circulation space for individuals with disabilities. However, when more detailed criteria—such as access to seating arrangements with a wheelchair, accessibility to the cashier, and the appropriateness of cashier height for wheelchair users—are considered, this number is expected to decrease.

The assessment of accessible restrooms revealed that none of the three venues had an accessible toilet. This indicates significant shortcomings in Döşemealtı venues' ability to meet the basic needs of individuals with disabilities. Despite the region's development, the accessibility deficiencies in Döşemealtı venues highlight a lack of full compliance with universal design principles.

A comparative analysis of the districts examined in this study reveals notable differences in accessibility features across Muratpaşa, Konyaaltı, Kepez, and Döşemealtı districts. While Konyaaltı demonstrated relatively better performance in terms of entrance ramps, the overall accessibility of public spaces remains insufficient, particularly for individuals with visual impairments. The absence of tactile surfaces and inadequate restroom facilities were common issues across all districts. Additionally, the study highlighted the impact of external factors such as municipal planning and private development projects in shaping accessibility levels. Despite some improvements in newer constructions, the lack of standardized regulations and enforcement continues to hinder full inclusivity in public spaces. These findings underline the need for a more comprehensive approach to accessibility, integrating universal design principles into both new and existing establishments to ensure equitable access for all individuals. In this regard, the role of interior architectural project planning becomes crucial, as accessibility is not solely dependent on structural elements but also on the functional organization of interior spaces.

Table 8: *Photographs of Cafes and Restaurants in Antalya's Döşemealtı District*

Venue	Tactile Surface on Floor	Ramp at Entrance	Door Width	Circulation Areas	Accessible WC
1					x
2					
3					

3. Conclusion and Discussion

Social activities hold a significant place for every group in society, and activities such as dining out or having coffee allow individuals to strengthen their social bonds and develop understanding among different groups. Cafes and restaurants are not merely spaces for eating and drinking; they serve as venues where people come together to build social relationships, experience diverse cultures, and engage with various lifestyles. These spaces play a critical role in broadening perspectives and fostering an understanding of differences. Additionally, such activities help individuals relieve stress and momentarily escape the challenges of daily life.

Enhancing the participation of individuals with disabilities in these social activities is not limited to the physical accessibility of spaces. Venues designed for individuals with disabilities must not only be physically accessible but also meet their practical needs. For example, providing tactile surfaces, suitable ramps, wide entry doors, and accessible restrooms ensures that individuals with disabilities can easily access these spaces. However, this alone is not sufficient; it is equally important for staff in these establishments to be trained in communication and support for individuals with disabilities and to adopt a service approach free from bias. Such measures play a pivotal role in making spaces truly inclusive and disability-friendly.

Universal design principles require accessibility and inclusivity to be fundamental goals in space design. Spaces designed in accordance with these principles not only ease the lives of individuals with disabilities but also raise societal awareness and reinforce social equity. Particularly within the discipline of interior architecture, applying these principles not only enhances the quality of life but also promotes sustainability and creativity, ensuring that spaces are accessible to all.

In this regard, incorporating interior architectural projects into municipal approval processes and developing relevant regulations in Turkey are of great importance. A robust legal and regulatory framework ensures that interior architectural practices comply with safety standards and ethical requirements while facilitating the creation of accessible spaces for all segments of society. Effectively monitoring these regulations is essential to maintaining high professional standards and designing spaces that encourage the full participation of individuals with disabilities in social life.

Beyond developing relevant regulations and conventional accessibility measures, solutions such as the use of high-contrast flooring materials to aid visually impaired individuals, adjustable-height service counters for wheelchair users, and sensory guidance systems incorporating auditory and tactile surfaces could be discussed. Additionally, smart technology applications, such as automated doors and app-based navigation assistance, could be highlighted as innovative approaches to improving accessibility.

In conclusion, making cafes and restaurants accessible is not only about ensuring physical compatibility but also about fostering social connections among different groups in society. A society where every individual can come together at the same table to share stories without barriers or hesitation lays the foundation for a more inclusive future. Achieving this goal requires contributions from professionals and all segments of society, which will significantly help break down prejudices about disability and recognize diversity as an integral part of society.

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Interior Design Education in the Context of Climate Change: A Systematic Assessment of Existing Capacity in Türkiye

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Abstract: The increase in the global mean temperature leads to the climate change events we experience today. To limit global warming at +1.5-2°C, actors of the built environment -who are responsible for 40% of the greenhouse gas emissions in the atmosphere- along with their institutions and authorities, should act. However, recent studies indicate that the awareness level of actors from the interior design field on their role in climate action is lower than that of other built environment-related disciplines. Nevertheless, higher education institutions that are dealing with complex, abstract concepts such as climate change itself, more often than other educational institutions, are thought to have a significant role in this awareness issue since awareness can be boosted by knowledge and learning. Yet, the nexus of design education and climate change in Türkiye has not been well-studied. However, assessing the existing capacity of individuals, institutions, and entities can provide guidance to cope with the impacts of climate change.

Therefore, this study aims to assess the existing capacity of interior design education in Türkiye in the context of climate change via a systematic assessment to determine the awareness levels of higher education institutes, including the actors of interior design scholars and interior design students, in Türkiye. To achieve that, it employs a 3-phased assessment in the curriculums of (1) undergraduate programs, (2) graduate programs of interior design departments, and (3) theses which are conducted on the topic in Türkiye. Statistical results were interpreted under two main subjects: climate change-focused and climate change-related. While the significantly low results of focused ones addressed an educational gap in the curriculums, promising numbers of climate change-related courses and theses indicate an ongoing process that can be boosted by increasing the awareness levels of the educational actors.

Keywords: Interior design, Education, Climate change, Assessment, Capacity.

1.Introduction

1.1. Climate Change and Climate Action

The definition of the term *climate* has changed from the long-term average of weather events to the integration of biogeophysical systems that are significantly vulnerable to human intervention (Dryzek, 2021). Even though the alterations in the climate have been an ongoing process throughout the Earth's history, the climate change we experience today is referred to as an anthropogenic process (Shepherd et al.,

2022). The observed increase in the global mean temperature, and related weather and climate extremes (such as droughts, heavy precipitation, storm surges, heatwaves, etc.) are strongly attributed to the results of human actions that cause a dramatic increase in the greenhouse gas (GHG) emissions in the atmosphere (IPCC, 1995, 2008, 2014; IPCC & WMO, 1992; Watson & UNEP, 2003).

Discussions on climate change (CC) are mostly focused on two major actions: mitigation and adaptation (Smit & Pilifosova, 2003; UNFCCC, 2016). In the definitions of the Intergovernmental Panel on Climate Change (IPCC), mitigation refers to actions that are taken to reduce GHG emissions or enhance their sinks in the atmosphere, whereas adaptation refers to adjustments to existing or expected climate to reduce the harm and cope with the impacts (IPCC, 2012, 2019). It is known that mitigation measures have been the most prominent type of action among national governments and international advisory bodies so far (Otto & Fabian, 2023). However, since we passed the critical thresholds in our carbon budget to limit global warming at 1°C or 1.5°C (IPCC, 2023), giving adaptation actions the weight they require has become inevitable (Bassett & Fogelman, 2013) to prevent further losses (Otto & Fabian, 2023).

In this context, "loss" refers to the irreversible negative impacts of CC on tangible entities and/or intangible practices despite the efforts of mitigation and adaptation (Simpson et al., 2024). To avoid that, adaptation actions are needed to be transformational (Leichenko & O'Brien, 2024; Marshall et al., 2012) which indicates that actions should address the whole system, or even more than one system, at a fundamental level, to cope with the impacts in the long run (IPCC, 2019). Therefore, the capacity of a system to achieve these goals has become a key concept in both literature and practice.

Adaptive capacity refers to the potential of a system, a community, or a region to adapt (IPCC, 2012; Smit & Pilifosova, 2003; Smit & Wandel, 2006; Turner et al., 2003). Hence, it can be affected by various determinants (natural capital, physical capital, financial capital, social capital, human capital, psycho-social factors, etc. (Mortreux & Barnett, 2017)) in various scales (such as individual, household, institution, nation, etc. (Adger & Vincent, 2005; Smit & Wandel, 2006)). Building or improving adaptive capacity requires various actors (Mortreux & Barnett, 2017). Nevertheless, the awareness status of actors, as well as the targeted community, is significantly vital to a system to increase its adaptive capacity.

1.2. Issue of Awareness

Individuals have to adapt to the new climatic conditions since there is no way to return the climate to what it used to be (Bassett & Fogelman, 2013; Gifford et al., 2011; Grafakos et al., 2018; IPCC, 2023). However, even though our brains are capable of adapting to changing environmental conditions such as CC, the adaptation does not occur naturally in this context (Duhaime, 2022; Gifford et al., 2011). It requires a trigger at the cognitive level, which can be achieved by increasing awareness or knowledge. In other words, people can *learn* to adapt, but how?

Diduck (2010) defines five concepts of learning concerning social units: individual, action group, organizational, network, and societal. Every concept of learning includes its predecessor in its definition, yet, expands it with more connections. Therefore, achieving societal learning, which refers to alterations in the core societal institutions in response to social-environmental changes, requires individual learning, a highly sociocultural process that affects one's knowledge, skills, beliefs, or behaviors due to the related experience (Diduck, 2010). This indicates that taking action against the impacts of CC starts with individual awareness and motivations, which then trigger groups, organizations, networks, and consequently, the society itself (Diduck, 2010; Gifford et al., 2011; Rogers, 1983). One should acknowledge the problem to change his/her behavior. Yet it is not an easy task to achieve since the observable impacts of CC spread over time and can be attributed to other natural causes, which leads to an

underestimation of the risk (Gifford et al., 2011). At this point, studies have proven that the level of education is related to adaptive capacity and, thus, the awareness level of the population. Even in the absence of personal experience with CC-related disasters, people with higher education levels are shown to have more awareness due to their ability to understand more abstract concepts (Lutz & Muttarak, 2017).

1.3. Role of Interior Designers and Interior Design Education in Climate Change

Without a doubt, understanding the abstract concepts is a vital part of the design education and practice in general. The roots of the interior design discipline within the design field can be found in the USA, where the first practices and institutionalized education activities can be found at the beginning of the 20th century (Usta et al., 2022). In Türkiye, however, the foundation of *Sanayi-i Nefise Mektebi* (which is now called Mimar Sinan Fine Arts University) in 1925 can be seen as a starting point (Kaptan, 1998).

The relationship between climate change and interior design can be addressed via the very definition of the practice: it is referred to as a professional practice that aims to create interiors that protect and respond to human needs in a creative, sustainable, technical, and functional way (IIDA, n.d.). Furthermore, a more recent and discussed definition of the discipline was made by CIDA as 'The specialized discipline for creating spaces and experiences that allow people, the community, and the planet to thrive' (CIDA, 2021). Referring to the social and environmental contexts of interior design in this definition is a vital aspect since interior designers have the responsibility of protecting the physical, mental, and emotional well-being of the users of the space (CIDQ, 2019) as well as preserve the environment and planet (CIDA, 2021) through their design *actions*.

The mentioned actions can take various forms in both professional practice and education. For practice, it addresses a significant percentage of overall construction actions since interior design changes more frequently than the buildings themselves. Nevertheless, these alterations are made according to consumers' preferences with very few thoughts of their socio-environmental impacts (Cole & Hamilton, 2024). Yet, renovations that are sensitive to their carbon footprints in historic buildings could boost sustainable management in cities and provide better indoor living conditions for their users (Hassan & Xie, 2020; Troi, 2011). Sustainable, and therefore CC sensitive, interiors can be achieved via material selections, energy and water efficiency decisions, employment of natural elements to provide interior environmental quality, etc. (Adıgüzel Özbek, 2015; Cole & Hamilton, 2024). Research points out that professionals in built environment-related fields are stating their lack of skill and experience, even though they accept the fact that CC is a significant issue to cope with (Hurlimann et al., 2023). Hence, this addressed knowledge gap connects the practice with education or with the gaps in the learning outputs of the interior design education processes (Hurlimann et al., 2024).

As Lutz and Muttarak (2017) state "Good institutions do not fall from heaven", they emerge from self-empowered societies. Universities, as institutions of higher education, should embrace the reality of CC and take on the task of raising awareness in their communities (Alves et al., 2018; Hergert et al., 2010; Santos et al., 2016; Wachholz et al., 2014). The awareness mentioned here should not be understood just as the awareness of CC itself, but also as *what one can do*, in this case, *what an interior designer can do* to cope with its impacts. In addition to individual efforts, universities can offer group, organizational, and even network learning opportunities to their students, which can affect their individual beliefs, values, and awareness (Diduck, 2010).

In the case of Türkiye, universities with interior design departments offer similar programs due to the accreditation processes called 'Bologna', which aims for common qualifications across various universities (Usta et al., 2022). In this framework, interior design education consists of core and elective courses that support the

workshop-studio-based design courses that are at the very heart of the profession. Even though elective courses on more recent topics are added to the academic program, the very structure of it has not changed significantly in the last hundred years, yet, the order of the world has so (Boelen cited in Adıgüzel Özbek, 2020). However, although architecture and interior design students get similar education in terms of the curriculum structure, as Alves et al. (2018) point out in their study that includes the students from both departments, architecture students are relatively more aware of the CC impacts, the built environment's share in carbon footprint, and their role in climate action

Just as every other discipline in the environmental and social sciences, the architecture and design field has much to offer to contribute to climate action. In terms of the Sustainable Development Goals (SDGs) of the United Nations, *climate action* refers to actions that are required to be taken immediately to cope with the impacts of CC (*THE 17 GOALS | Sustainable Development*, 2015). However, while the carbon footprint of the buildings has been a topic of debate for several years, both in the education and practice of interior architecture, designers and educators appear to be unaware of the responsibilities of their share (Alves et al., 2018; "Why Interior Designers Must Fight Climate Change," n.d.). Therefore, this study aims to investigate the existing awareness level of interior design education in the context of CC as a starting point, and contribute to further capacity studies in Türkiye. To achieve this, we employed a systematic assessment process in the scientific publications, curriculums, and theses of interior design departments in Türkiye, which are thought to be the indicators of the existing capacity.

2.Methodology

At the beginning of the study, the systematic literature review (SLR) was employed as the data collection methodology since it provides comprehensiveness, objectiveness, non-biased, and high-quality results compared to literature reviews (Petticrew & Roberts, 2006). Firstly, Scopus was chosen as the database. To achieve an integrated and inclusive search on the topic, the search string was designed to include variations of key terms and searched in titles, abstracts, and keywords:
(interior*) AND (educat*) AND ("climate chang*") AND (Türkiye OR Turkiye OR Turkey)

Due to the various titles of interior design departments in Türkiye, the term "design" was not included in the search string to be more inclusive. However, no result was found in the nexus of interior (design) education, climate change, and Türkiye. The same quarry ring was then searched in the Web of Science (WoS) database, yet again, no result was found. Therefore, the systematic literature review is adopted as a systematic assessment and extended to include the curriculums of the universities that offer interior design education (Figure 1).

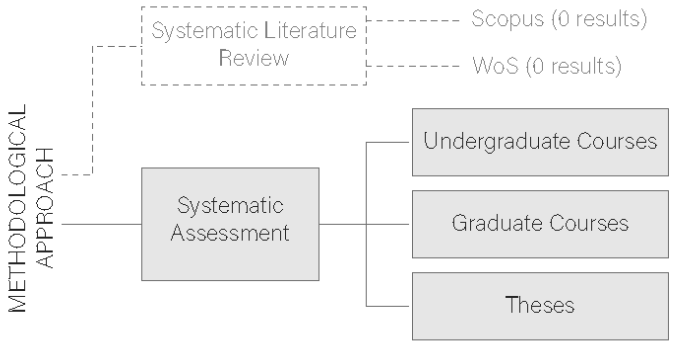

Figure 1: *Methodological approach of the study*

3.1.1st Phase: Undergraduate Courses

In the first phase, undergraduate-level interior design programs in the universities both in the Republic of Türkiye and the Turkish Republic of Northern Cyprus (TRNC) are listed. According to data in *Yök Atlas*[1] (2024), there are 85 undergraduate interior design programs in a total of 82 universities (75 in Türkiye and 7 in TRNC). 41 is named *Interior Architecture*, while 43 is named *Interior Architecture and Environmental Design* (*İç Mimarlık Programı Bulunan Tüm Üniversiteler | YÖK Lisans Atlası*, 2024; *İç Mimarlık ve Çevre Tasarımı Programı Bulunan Tüm Üniversiteler | YÖK Lisans Atlası*, 2024).

In the examination of the curriculums to determine whether any CC-focused course is offered, it is aimed to be more inclusive. Therefore, to collect more data on the subject, which was significantly limited due to the lack of scientific publications, and depict a broader image of interior design education, all types of courses, including core, departmental electives, and university electives, are taken into consideration during the process. The examination of the curriculums was conducted in August 2024 with the most recent course content documents that were available on the departments' web pages at the time.

To determine CC-focused courses, key terms of "climate change", "global warming", "climate crisis", and "environmental crisis" are searched in the titles and the descriptions of the course content documents. 5 courses are determined to be CC-focused. Then, the weekly schedules and learning outcomes of these 5 courses are examined with only the inclusion of "climate change" and "climate crisis" to confirm whether the main focus of the course is on CC. As a result, 4 courses are determined to be CC-focused.

Consistent with the results of SLR, significantly limited numbers of CC-focused courses called for a requirement of a second examination in the curriculums to determine whether any CC-related course is offered. This time, the keywords of "mitigation", "adaptation", "resilience", "disaster", "sustainability", "ecology", "conservation", "re-cycle", and "re-use" as promoting sub-concepts of CC (especially in the context of the built environment), are searched in the titles and the descriptions of the course content documents. 249 courses are determined to be CC-related. However, due to the broad meanings of the selected keywords, the courses that contain "earthquake" or "emergency" in their titles or descriptions are excluded which resulting in 239 CC-related courses. Since this second examination is conducted to determine CC-related courses instead of focused ones, another round of examination with inclusion-exclusion criteria in weekly schedules and learning outcomes is not conducted. Nevertheless, both of them are scanned to note the main and sub-focuses (Figure 2) of the courses to interpret the network of key concepts, which is thought to indicate the existing capacity.

[1] *YÖK: Yüksek Öğrenim Kurumu* (General Directorate of Higher Education)

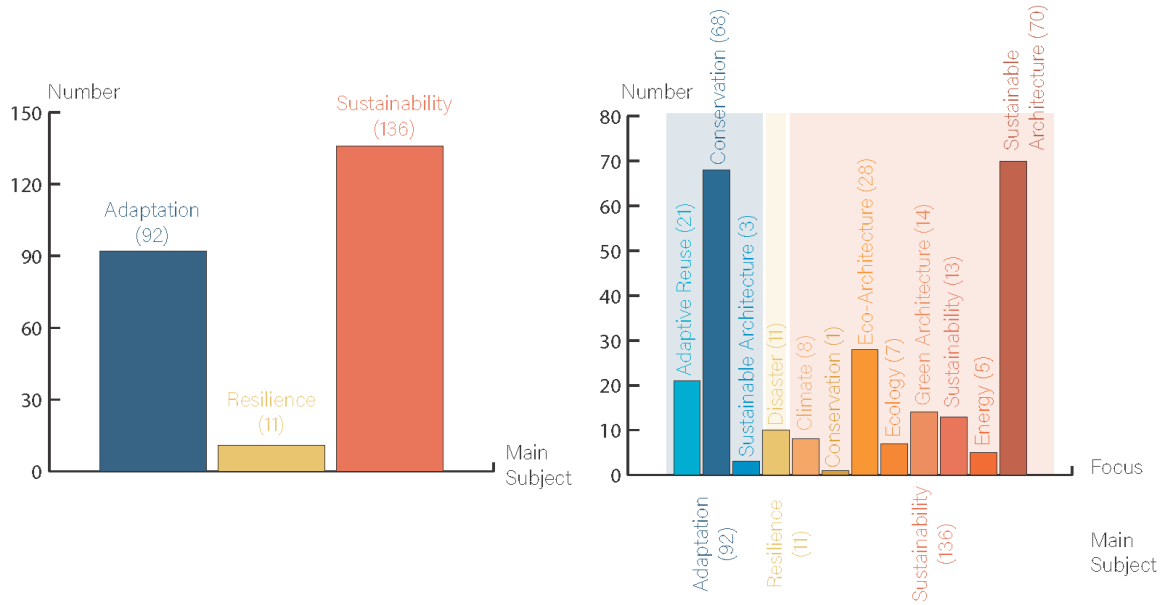

Figure 2: *The distribution of the main subjects and focuses of the CC-related undergraduate courses*

At this point, it is important to emphasize the significance of the learning outcomes and their reflections on the content and schedule of the course. Due to the global accreditation process of interior design departments, certain learning objectives and outcomes must be included in the curriculums to achieve accreditation. Upon reviewing CIDA`s accreditation documents, it is evident that environmental sustainability is one of the main themes that interior design education should cover. Moreover, while standard 16 (regulations and guidelines) refers to the sustainability of interior design, standard 4 (global context) directly addresses climate change in the guidance section, along with other key concepts such as design for resiliency and natural disasters (CIDA, 2024b). Contrarily, in the parallel document of TAPLAK (design and planning accrediting association), only *'uluslararasi baglam'* (global context) pertains to a CC-related topic, which is 'ecology' (TAPLAK, 2024). Unlike CIDA`s document, there is no mention of sustainability or climate change. While this highlights the differences between national and global perspectives on the topic, it should also be noted that the curriculums of the departments in Turkiye take into account both national and international accreditation documents. Therefore, it is not accurate to attribute the low number of CC-focused courses solely to the national accreditation process. However, it can be seen as supportive evidence of the lack of awareness among educational actors in Türkiye.

3.2. 2nd phase: Graduate Courses

As it was stated, this study aims to be inclusive, therefore, in the second phase of the research, the same procedure is applied to the graduate-level courses of interior design departments. Among the 75 universities in Türkiye[2]: 33 master's, 9 Doctor of Philosophy (Ph.D.), and 4 Doctor of Arts (D.A.), in a total of 46 graduate programs are determined. The total offered courses are counted as 2348 in these 46 programs. However, when the duplications [3]are removed (since one course can be offered both

[2] TRNC universities are not included due to the lack of information on the universities' websites on graduate programs and their exclusion in the *Yök Tez* database.

[3] If the same course is offered both in the master's and PhD programs of the same university, it was counted only once.

in master's and Ph.D. programs of the same university), 2323 courses[4] remain.

In parallel with the 1st phase, to determine CC-focused courses, key terms of "climate change", "global warming", "climate crisis", and "environmental crisis" are searched in the titles and the descriptions of the course content documents. Nevertheless, 0 courses are determined to be CC-focused. Then, another round of examination is conducted with the keywords of "mitigation", "adaptation", "resilience", "disaster", "sustainability", "ecology", "conservation", "re-cycle", and "re-use": 54 courses are determined in this process. Again, the courses that contain "earthquake" or "emergency" in their titles or descriptions are excluded, which resulted in 53 CC-related courses (Figure 3).

When the main and sub-focuses of CC-related courses are examined, they are observed to be in parallel with the undergraduate CC-related courses. Therefore, the hypothesis of "*these categorizations are the indicators of the nexus of interior design education in Türkiye and climate change*" is formed.

3.3. 3rd phase: Graduate Theses

To validate the parallel findings and therefore the hypothesis, another phase is thought to be required. In the total of 46 interior design graduate programs in Türkiye, 1922 theses[5] are determined to be conducted until August 2024 (Figure 3). To calculate this number, the advanced search tool in the official theses database of YÖK (*Yök Tez*) (*Ulusal Tez Merkezi | Tarama Ekranları*, n.d.) is used.

Firstly, the search string is structured based on the "Interior Design and Decoration" subject tag as:

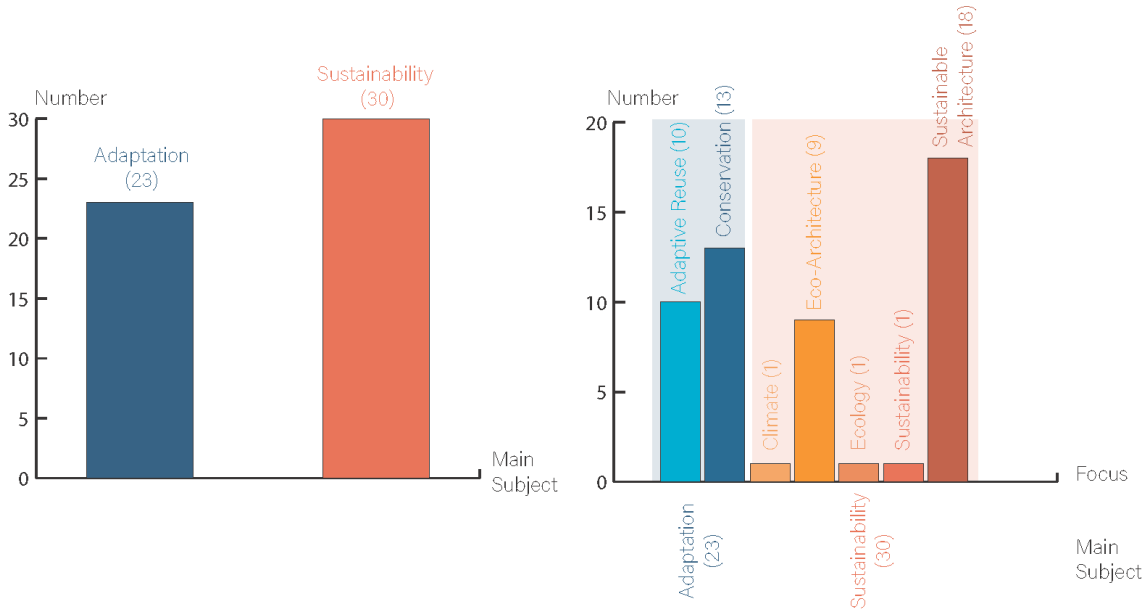

Figure 3: *The distribution of the main subjects and focuses of the CC-related graduate courses*

[4] Seminar and research methodology courses are included in this number since their contents and teaching methodologies vary in universities and therefore there might be a possibility of CC-related events, organizations, or subjects in these courses. However, thesis and specialized field topic courses are not included in this number, since they are directly related to the students' theses subjects, and the theses are evaluated in the 3rd phase.

[5] Only completed theses are examined within this study.

University name / Institute name / Subject: "*İç Mimari ve Dekorasyon* = Interior Design and Decoration"

However, during the search, it was observed that not every thesis that was conducted within the selected graduate program used the "Interior Design and Decoration" subject tag. Therefore, to reach the real number of overall conducted theses, the search string is changed to be based on the departments. Nevertheless, there are various department titles in the interior design discipline that can be found in Yök Tez's database, and it is observed during the study that sometimes theses can be uploaded under different department titles even for the same universities' same graduate programs. Therefore, to be more inclusive, all of these department titles are searched for every university one by one, separately. Instead of one search string, 6 strings are used for every graduate program:

University name / Institute name / *İç Mimarlık Ana Bilim Dalı* (Department of Interior Architecture)
University name / Institute name/ *İç Mimari Tasarım Ana Bilim Dalı* (Department of Interior Design)
University name / Institute name/ *İç Mimarlık Ana Sanat Dalı* (Art Major of Interior Architecture)
University name / Institute name/ *İç Mekan Tasarımı Anabilim Dalı* (Department of Interiors' Design)
University name / Institute name/ *İç Mimarlık ve Çevre Tasarımı Ana Bilim Dalı* (Department of Interior Architecture and Environmental Design)
University name / Institute name/ *İç Mimarlık ve Çevre Tasarımı Ana Sanat Dalı* (Art Major of Interior Architecture and Environmental Design)

As a result, 1639 master's, 174 Ph.D., and 109 D.A. theses are determined. To conduct a systematic assessment, firstly, the titles of the theses are scanned to determine their relation to CC. In this step, not a set of keywords, but the determined main subjects and sub-concepts are used to spot the relevance. 205 theses are spotted to be related or focused on CC according to their titles. Then this number is decreased to 191 with the examination of their abstracts. To investigate the scopes of the theses further, their structures are evaluated together with their abstracts and results & discussion parts. As a result of this process, 165 theses are determined to be CC-related while only one thesis is observed to be CC-focused (Figure 4). These related and focused theses are categorized according to main and sub-focuses, along with the problem approaches to interpret the network of relations of the research phases in the nexus of CC and interior design education in Türkiye.

Figure 4: *Systematic assessment diagram of theses*

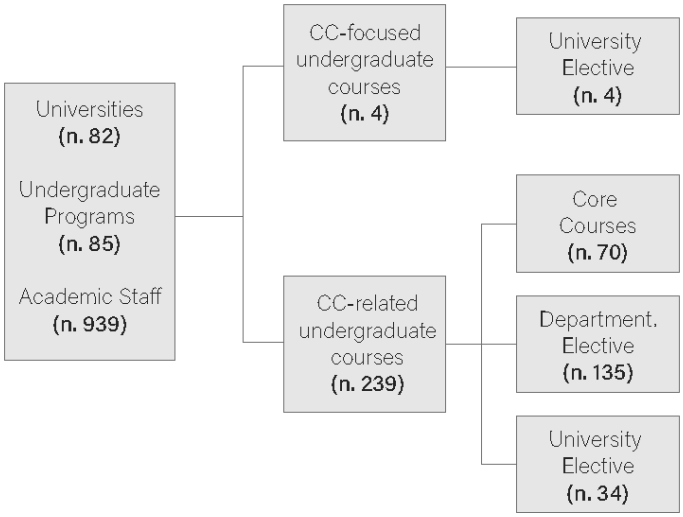

Figure 5: *Summary diagram for CC-focused and CC-related undergraduate courses*

4. Results

4.1. Results of the 1st Phase: Undergraduate Courses

As explained in the methodology section, to be more inclusive, all the courses that a student can choose during his/her undergraduate studies are considered. This indicates that there are 3 types of courses included: core courses which are mandatory to participate, departmental elective courses which are open only to interior design or (in some cases) architectural faculty students, and university elective courses which are open to students from all disciplines (Figure 5).

At the end of the systematic assessment, 239 courses are determined to be CC-related, while only 4 are observed to be CC-focused at the undergraduate level. When the significance of the number of interior design programs (n.85) is considered, the number of CC-focused courses indicates an important gap in the curriculums. Furthermore, it should be noted that all of these 4 courses are university electives, which indicates that they only aim to frame a general knowledge about climate change (Table 1) instead of connecting it with the interior design discipline to create a professional/self-awareness in the interior design student.

Nevertheless, the number of CC-related courses is determined to be higher than the focused ones. Even though some of them are classified as university electives (n. 34, 14.2%), a significant portion of the courses are core (n.70) or departmental elective courses (n.135), which can trigger the connection between the impacts of CC and the interior design profession. While only 3 main subjects could have been determined during the classification of the

Table 1: *List of CC-focused courses at the undergraduate level*

University	Code	Name of the Course
Maltepe University	GED164	Global Warming and Climate Change
Istinye University	UNI208	*Çevre ve İklim Değişikliği* (Environment and Climate Change)
Bahçeşehir University	GEP0631	*Sürdürülebilirlik ve İklim Eylemi* (Sustainability and Climate Action)
Kütahya-Dumlupınar University	USDG046	*İklim Değişimleri* (Climate Changes)

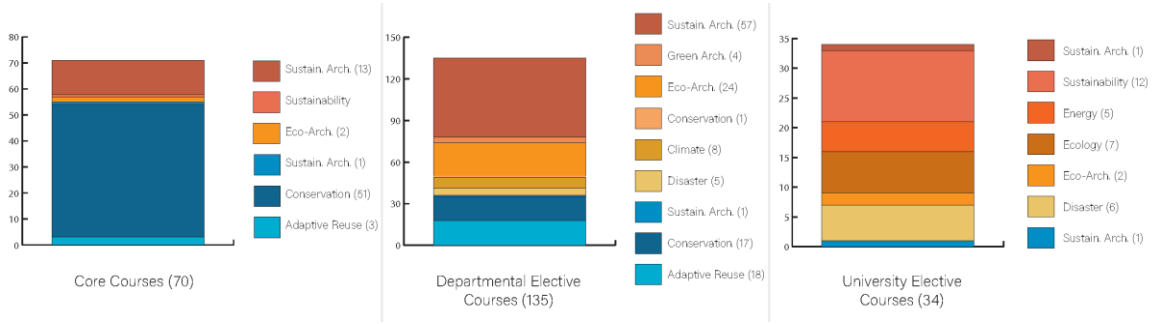

Figure 6: *Focuses of the CC-related undergraduate courses*

courses, their sub-focuses are observed to have more variety. For the main subject of "adaptation": *adaptive reuse*, *conservation*, and *sustainable architecture*, focuses are noted. For "sustainability": *climate*, *conservation*, *eco-architecture*, *ecology*, *sustainable architecture*, *sustainability*, *green architecture*, and *energy* focuses are observed. However, the only sub-focus of the subject "resilience" is determined as *disaster* (Figure 6).

At this point, two comments can be deduced from the results: (1) the non-existence of key CC and climate action terms such as mitigation, adaptive capacity, climate adaptation, vulnerability, etc., should also be noted as a lack of capacity against the impact of CC. Furthermore, even though the existence of some vital keywords, such as adaptation and resilience, their scopes are observed to be significantly limited (e.g., resilience->disaster). (2) The repetitive appearance of some of the sub-focuses, such as *conservation* and *sustainable architecture*, under different subjects can indicate the nexus of the terms but also the most parallel aspects of the existing curriculums and CC.

The existence of the core courses even on the CC-related list is seen as a significant indicator to determine the existing capacity since they are mandatory for all interior design students. Nevertheless, a considerable number of the core courses are categorized under the subject of "adaptation" (Figure 6). Thus, the courses of conservation (n.51) and adaptive reuse (n.3) refer to the restoration and survey courses in the interior design curriculums. Even though, in theory, restoration and conservation promote adaptation, and hence, climate action, when the syllabuses of these courses are examined, it can be seen that the scopes of these courses are rather general which aims to explain the history of the restoration practices or teach the tools and methods of architectural survey. Since these courses are referred to as 77,14% of the core courses, the number of CC-related core courses in which students can make the connections between CC and interior design drops dramatically from 70 to 19.

On the other hand, the number and variation of the CC-related departmental electives frame a more positive picture. Although they are not CC-focused, courses such as sustainability in interior architecture, sustainable design, or sustainable interior materials can give some of the core ideas of climate action from an interior designer's perspective. Despite these promising results, it should also be noted that many students can graduate as interior designers without participating in any of these courses since they are electives. Moreover, some of them might not be active in the current course schedules even though they are listed in the most recent academic packages on the universities' websites, due to a lack of academic staff or schedule conflicts.

4.2. Results of the 2nd phase: Graduate Courses

In parallel with the undergraduate courses, the number of CC-focused and CC-related graduate courses indicates a lack of knowledge and awareness, and therefore, capacity in interior design education (Figure 6). Since universities offer only core and departmental elective courses at the graduate level, there is no CC-focused course determined. The only exception in this matter is Ihsan Doğramacı Bilkent University, which offers a significant number of university electives also in its master's (n. 641) and Ph.D. (n.631) programs. Therefore, this is also the reason for the high number of total offered courses within 46 graduate programs in 33 universities (Figure 7).

Zero CC-focused courses can result from the lack of academic expertise in the nexus of CC and interior design in Türkiye[6]. Therefore, it is consistent to expect zero or a few theses in the next phase of the assessment. This possibility is also in parallel with the lack of scientific publications on the topic. Similar to undergraduate courses, almost half of the graduate courses (n.53) are categorized as "adaptation" (n.23), which refers to the adaptive reuse and conservation practices in interior design (Figure 2). However, there is still a high percentage of "sustainability" courses (n.30; 56,6%) in the graduate programs. Even though all of the CC-related courses are electives at the graduate level, it is important to note that while some of the graduate programs do not offer core/mandatory courses (except seminars, etc.),

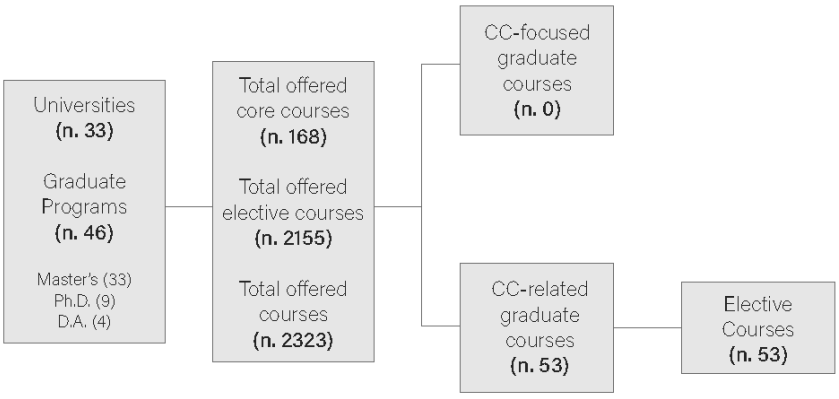

Figure 7: *Summary diagram for CC-focused and CC-related graduate courses*

[6] To support this argument, an additional search was conducted in TÜBİTAK's project database. The keywords "*iklim**" (climate), "*sürdürü**" (sustain*), and "*adaptasyon*" (adaptation) were searched alongside the subject label "architecture." Examination of the project teams (researchers, advisors, and scholarship holders) among the limited results revealed that no interior design scholar participated in these projects. Consequently, neither the scope of the projects nor the scholars involved in these TÜBİTAK projects were found to relate to the interior design discipline. Furthermore, some of the leading (according to YÖK's database) interior design departments' BAP (*bilimsel araştırma projesi* – Scientific Research Projects) databases are scanned to have a general overview. Yet, no CC-focused or CC-related projects were determined. However, it should be noted that these additional studies on the databases are not structured as systematic assessments, and thus, they can only be interpreted to provide a general understanding of the matter. Nevertheless, we encourage further research that focuses specifically on the awareness level and adaptive capacity of interior design scholars regarding climate change, which should include a systematic assessment of various types of projects such as TÜBİTAK, BAP, EU, etc.

Table 2: *Percentages of the CC-related courses within all offered courses in graduate programs*

% of CC-related courses	Number of programs
0%	20
0.1% - 5%	10
5.1% - 10%	8
10.1% - 15%	3
15.1% - 20%	4
20.1% +	1

others offer a relatively small percentage of the curriculum as mandatory courses. Therefore, the possibility of a graduate student participating in one of these courses before his/her graduation is higher than an undergraduate student. However, even though there is a *relatively* higher possibility of creating a more concrete inference, it should also be noted that almost half of the programs do not offer any CC-related courses (Table 2). There is only one program determined to have more than one-fifth of the offered courses that are CC-related.

4.3. Results of the 3rd phase: Graduate Theses

The assessment results in the graduate theses are consistent with the results of the undergraduate and graduate courses (Figure 8). As can also be seen in Figure 3, 165 theses are determined to be CC-related while only one thesis is observed to be CC-focused. This CC-focused master's thesis titled *Investigation of Ithaca eco-village according to sustainable design criteria in the framework of climate crisis* was conducted in 2019 (Algur Marşoğlu, 2019).

Almost half of the theses are focused on the *adaptive reuse* of existing structures (n.72). This is followed by *sustainable architecture* (n.61) and *eco-architecture* (n.21). However, when looking at the big picture, one can see that only 8,6% of all theses that were conducted in interior design discipline is observed to be CC-related. Therefore, adaptive reuse is only 3,75% while sustainable architecture is 3,17% of the theses. Nevertheless, adaptive reuse and sustainable architecture are both relatively new

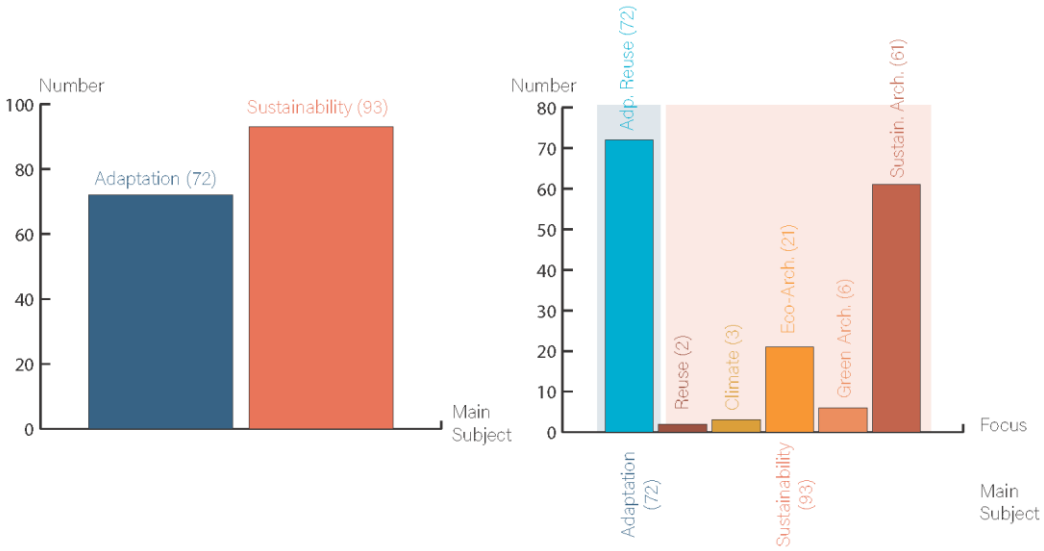

Figure 8: *The distribution of the main subjects and focuses of the CC-related theses*

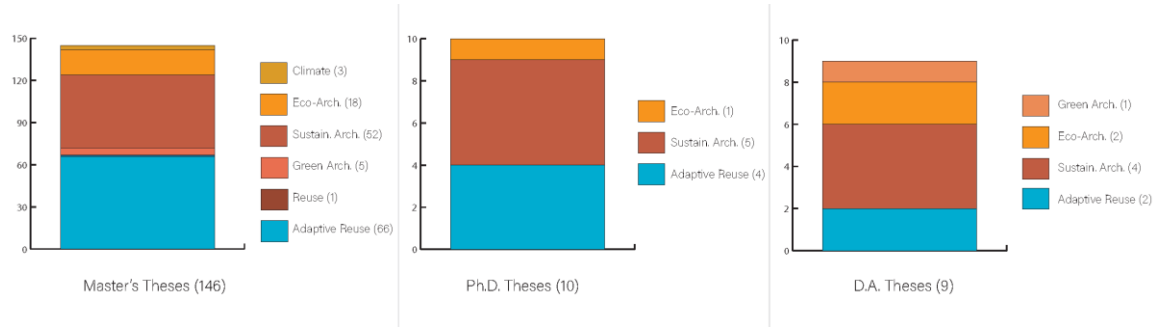

Figure 9: *Focuses of the CC-related theses*

terms studied within the interior design discipline; their small ratios in the overall number of theses should not be seen as an absolute negative indicator.

Consistent with the overall number, most of the CC-related theses are observed to be master's theses (n.146). This is followed by Ph.D. theses (n.10) and D.A. theses (n.9) (Figure 9). At the doctoral level, sustainable architecture becomes more prominent while adaptive reuse is slightly more dominant in master's theses. It can be seen that the ratios in Figures 1,2, and 8 are all parallel to each other. Students are inclined to conduct theses on the topics they have already had a grasp on during their undergraduate and graduate studies. Therefore, when some of them obtain the title of "educator" in interior design departments, they transfer the knowledge acquired during their studies. This creates a "learning loop" that can be employed to promote CC studies in the interior design field. Hence, this again refers to the significance of higher education institutions in creating the capacity for coping with the impacts of climate change.

To deepen the understanding of the existing capacity and thus, approaches in interior design education in Türkiye, the adopted methodological approaches of the theses are examined (Figure 10).

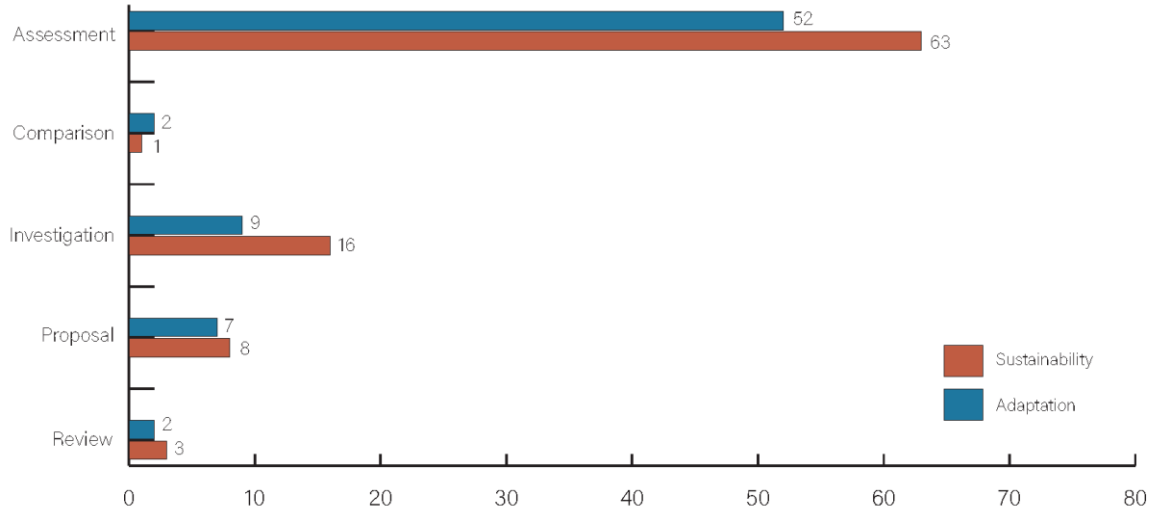

Figure 10: *The distribution of the main subjects and approaches of the CC-related theses*

While assessment is determined as the most commonly utilized approach in both sustainability and adaptation-based theses, comparison, investigation, proposal, and review approaches are also observed to be used. The high number of assessment-type theses is compatible with the high number of master's theses, along with the general research approaches in the sustainability and adaptation fields.

5. Discussion

In parallel with the developments in the world, the interior design discipline, both in education and practice, transforms itself into something that invests in and cares more about personal and environmental issues. It is known that the new generation, called Gen-Z, tends to consider mental health issues alongside environmental concerns, such as the carbon footprint of their actions (CIDA, 2021, 2024a). Similarly, the industry aims to promote more sustainable and resilient designs to meet the requirements of the new era (CIDA, 2024a). Yet, it should be noted that even though the new generations are growing up hearing the terms "climate change" or "carbon footprint", it is not always indicated that they are *all* aware of the impacts, their roles, or the root causes of global warming itself (Wachholz et al., 2014), especially in terms of their design decisions. Nevertheless, this general awareness can be transformed into professional and educational awareness. Therefore, this situation still draws a promising framework in which institutions of higher education should take the responsibility to trigger this specific awareness and play their roles in climate action (Hurlimann et al., 2021; Mochizuki & Bryan, 2015; *THE 17 GOALS | Sustainable Development*, 2015; Wachholz et al., 2014) .

Thus, within this promising framework, it can be expected that both curriculums and professional practices will progressively become more related to climate change and climate action in the near future. However, despite the existence of global accreditation processes, participating in climate action might not occur simultaneously around the world but rather as an iterative cycle due to the various perspectives of governments and the range of scholars' research interests. At this point, it becomes significant for countries and institutions to regularly evaluate their approaches to be able to take action when needed. Therefore, this study aims to contribute to the self-evaluation process and encourage local institutions in Türkiye to take this assessment a step further.

Following these, the findings on the awareness level and existing capacity of interior design education in Türkiye are consistent with the other studies in the various regions around the world and across different disciplines (Alves et al., 2018; Gürol-Öngören et al., 2024; Hurlimann et al., 2024; Santos et al., 2016; Wachholz et al., 2014). Therefore, this indicates a significant lack of awareness and gaps in knowledge that are specific to design actions, which are the key concepts to build or improve the capacity.

Two points require acknowledgment in this discussion section: (1) the reappearance (frequency) of the sub-focuses of *conservation* and *sustainable architecture* in both sustainability and adaptation subjects, and (2) the employment frequency of *assessment* methodology in the CC-related theses. These two points indicate the key nexus of interior design education and climate change. They also refer to existing capacity. Hence, they can be utilized as an entrance/inclusion point for the introduction of CC to interior design education in Türkiye.

Nevertheless, this study can and should be seen as the first step of the capacity assessment due to its limitations. This study is based on the data collected from the curriculums and theses; however, to conduct a comprehensive and, therefore, more realistic assessment, additional data on the actors' (students, educators) perspectives is required. Merging these two steps and combining them with the literature on CC and adaptive capacity can depict not only the existing capacity but also the improvement methodologies. Various studies from different disciplines suggest that "obtaining discourses" is a significant approach to having a grasp on

more social, cultural, economic, or environmental dimensions of CC (Cotton & Stevens, 2019; Dryzek, 2021; Leichenko & O'Brien, 2024; Lo, 2016; Zobeidi et al., 2016) which have been mostly neglected compared to physical ones so far (Adger & Vincent, 2005; Brooks, 2003; Smit & Wandel, 2006).

Therefore, this study aims to encourage further studies on the nexus of interior design, education, and climate change to provide vital information and data in Türkiye, especially at the higher education level, which does not currently exist.

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An Investigation of How the Circular Economy's Upcycling, Repair, Reuse and Recycling Strategies Might Increase Resource Efficiency and Reduce Fabric Waste Generation in Nigeria

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Abstract: Growing fashion trends and the problems of massive waste generation, pollution, and the depletion of natural resources has led to an intense search for alternative ways to obtain raw materials for the production of textiles and other related products. In recent times sustainability have become the focus of attention due to the desire to reduce the use of natural resources and guarantee a healthier environment. Circular economy has appeared as a sustainable solution to this global economic, environmental, and social problem. Globally, the public and business sectors, as well as academia, are becoming more conscious of the circular economy. The circular economy presents a novel strategy aimed at altering our perspective on the creation and consumption of products and services. Nigerians haven't, however, fully benefited from the circular economy. The traditional textile industries operate in a linear fashion, extracting raw materials and using them to make cloth that is then discarded after a short period of time. This method is unsustainable since it produces a lot of garbage. Adoption of the circular economy offers a new model for keeping textile resources in use for as long as possible, resulting in a reduction of the quantity of textile waste generated. This is in response to resource depletion and the environmental pollution that arises from improper disposal of textile waste. The study used a mixed research strategy that included both exploratory and qualitative research. As a useful tool for moving towards a circular economy, the study aims to explore and encourage Nigerians to adopt reuse, repair, recycling and upcycling of textiles strategies. The aim was accomplished by reviewing existing practices on adoption of reuse, repair, upcycling and recycling of textile. Financial and environmental advantages of reusing, repairing, recycling and upcycling of textile were also examined. Waste fabric that was turned into a rope band used to conduct a hands-on investigation of upcycling and worn fabric was recycled into insulated pot holder. Visits was made to churches providing free worn fabric for reuse. Highlighted were the steps involved in weaving a table mat out of leftover fabric and the finished result, a tablemat. The study found that these tactics can be used by both individuals and cooperative organizations to address the issue of environmental pollution, save resources and money, particularly in current difficult economic climate, and provide income for young people without jobs.

Keywords: Circular economy, Reuse, Repair, Upcycling, Recycling, Fabric waste

1.0 Introduction

The aftereffects of industrial revolution and its production processes are problems such as, huge waste generation, environmental pollution, and a shortage of raw materials, particularly in the textile sector. The availability of inexpensive and more visible fast fashion products made it possible for people to purchase more clothing than they actually need, which are often thrown away after a short period of time generating waste. The textile sector is one of the biggest sources of environmental contamination. According to Swarna (2023) it emits 1.7 million tonnes of CO2 annually, equivalent to 10% of global greenhouse gas emissions, making it a major contributor to global warming. This has resulted in the quest for alternative ways of producing textiles that will reduce the quantity of waste generated as well as the consumption of natural resource. The circular economy has come to light as a viable answer to this global issue.

The circular economy is a system where materials never become waste and nature is regenerated. Products and materials are kept in circulation for as long as possible through processes like maintenance, reuse, refurbishment, remanufacture, recycling and composting (Ellen MacArthur Foundation) The traditional textile industry has a linear approach to its operations. This process is unsustainable since raw resources are taken and utilized to make cloth that is used and then thrown away after a short period of time, generating a great deal of waste. According to estimates, the rate at which natural resources are consumed is twice that of their production, and by 2050, it may triple, leading to unprecedented exploitation of natural resources with carbon footprints and water-related environmental effects (Aranda, Zuniga, & Rivas, 2023).

In light of resource depletion and the pollution caused by improper disposal of fabric waste, applying circular economy in fabric production provides a new model for the manufacturers and consumers of textiles to reduce the amount of textile waste produced by extending the life of resources. Additionally, it will support the preservation of our natural resources, provide jobs and economic success while fostering local and sustainable growth. In addition to environmental considerations, the circular economy also considers economic and social advantages (Aranda et al., 2023).

However, despite these advantages, the global economy in 2023 was estimated to be just 7.2% circular, with the linear economy model still dominating, (Bellini, Anderson, Klungseth, and Tadayon, 2024). Since clothing is one of the basic needs of man whose production processes and consumption generates a lot of waste that are not properly managed, it is expedient that more people get committed to implementing circular economy model for fabrics through simple do it yourself strategies. In the face of the current economic challenge facing the country, this solution could also bring sustainable growth.

One of the numerous ways circular economy models can be implemented is through reuse. Reuse is defined as when a different customer uses a discarded product that is still in good shape and can still perform its original function (Malooly and Daphne, 2023). Reuse strategy of the circular economy can be applicable in items such as furniture, electronics, books, fashion accessories such as handbags, jewelry among others. An excellent illustration of this, is Nigerian Okirika market where the buying and selling of second hand clothing, footwear, and bags are carried out. Clothing with classic styles and long lifespans when reused promotes less consumption, saving money and virgin resources. According to Delanoeije and Bachus (2020) reuse is seen as circular since it can remove products from the waste stream and save raw materials by replacing new ones.

Recycling is another way to embrace the circular economy paradigm. According to Jarvis (2023) there are two different types of recycling; open-loop recycling and close-loop recycling. Open- loop recycling is a type of recycling that takes one item or material and turn it into a different item or material. Jarvin (2023) maintained that it is a handy solution for keeping resources out of landfills, but it does not really reduce the demand for new virgin

resources for example, there will still be need to produce new plastic bottles to replace the ones recycled into a sweater. On the other hand, closed-loop recycling is a system that closes the loop on resources and actively reduce demand for new, virgin resources. For instance, when aluminum can, is recycled back into another aluminum can.

This cutting-edge method when applied on fabrics, reduces reliance on virgin resources by converting worn material into usable fibers that might be used to create brand-new clothing. In certain cases, recycled pallets made from post-consumer plastic bottles or other polyester items can be spun into fresh polyester fibers. In recent times, entrepreneurs in Nigeria have started solving the problem of waste pollution by recycling plastic bottles, aluminum cans, pure water sachet, nylon bag, tires among others into something similar or more valuable. For instance, Chaja Datti company in Abuja and Unizik Plastic Production Line.

Repurposing and upcycling are more ways to adopt the circular economy paradigm. This generally refers to the transformation of products or materials into new and value added products. When adopted on fabrics it could mean turning used or fabric waste into valuable items such as table mats, appliqued bags, using waste fabric to applique designs on new dress among others. For instance, Adejoke Lasisi a Nigerian entrepreneur is developing fashion products from pure water sachets and textile waste. These fashion products are 90% nylon and 10% textile material (Adeoyejo, 2021).

Repair or upgrading is another crucial circular economy tactic that is applicable on used items. This could be professional repair services or do-it-yourself repair. When there is still life left in a used product, repairing it, prolongs the product's lifespan rather than discarding it. By doing this, virgin resources are preserved, waste is decreased, the carbon footprint associated with processing virgin raw materials is reduced, and significant financial savings are also realized. Worldwide, a lot of work is being done to promote user participation in product lifespan extension techniques through corporate and governmental laws. In Nigeria repair or upgrading is mostly common with electronics materials. If it is properly applied to fabrics, it will help in reducing the quantity of used fabrics that is dumped after a short time.

The expansion of fabric fashion trends resulting in the construction of more clothes by dressmakers generates a lot of off cuts, when these cannot be put into further use disposing them becomes a challenge. In some cases, these fabric waste are disposed by dumping it in water ways or by burning. Either way, these methods of disposing fabric waste causes environmental pollution. The blocked drainage channels increase the occurrence of flooding during the rainy season as some of the fabrics are not biodegradable.

The aim of this study is to investigate and encourage the use of upcycling, repair, recycling and reuse techniques as a useful tool for the reduction of fabric waste, conservation of resource and the shift to a circular economy in Nigeria. The application of the strategies of reuse, recycling, upcycling, and repair of textiles in Nigeria will undoubtedly benefit the general populace. It would not only save money and lessen pollution in the environment, but it can also give the hundreds of thousands of young Nigerians without jobs a way to make a living. Existing literature on strategies of reuse, upcycling, recycling and repair will be examined. Interviews will also be conducted with field actors such as tailors, shoemakers and church groups promoting reuse of worn fabrics. The economic and environmental benefits of these circular economy strategies will be highlighted. The second part of the study will explore repair, recycling and upcycling strategies, showcasing works produced using these strategies to encourage designers and general public to adopt these strategy as a contribution to a sustainable environment in line with the twelfth Sustainable Development Goal; responsible consumption and production.

1.1 Statement of problem

Despite the increasing awareness being created around the world about adopting a more sustainable production and

consumption pattern, practical implementation of circular economy in Nigeria is still at its early stage (Ajibesin, 2023). With a number of people already tapping into the inherent opportunities of circular economy through recycling of plastic, polythene bags, metals and organic waste, but scarcely fabric waste. Chemical recycling of textiles is more complex process and the technology for doing this is currently not readily available, however, the mechanical recycling can be easily carried out by individuals. Likewise, the circular economy strategies of reuse, repair and upcycling. Yet, reuse, repair, recycling and upcycling of fabric waste, have not been given enough attention when it comes to circularity in Nigeria. With the growing fashion trend enhanced by the *aso- ebi* culture and consumer demand, fabric waste challenge is expected to build up. Scraps of cut-off fabrics are common sight in tailors' shops, and they are typically disposed of carelessly. Some people also dispose their used items which includes used fabrics in the gutters during the rain, blocking the drainage channel which often leads to flooding. According to Edom (2023) citing world bank, Nigeria generates 2.2 million tons of solid waste annually a substantial portion of which comprises of textiles. If reuse, repair, recycling and upcycling strategies of the circular economy is pushed in Nigeria, it could play a significant role in addressing the concern posed by the amount of fabric waste generated by fashion industry. These methods will lessen the negative environmental effects of inappropriate textile waste disposal. It will also minimize the impact of hazardous chemicals and waste water discharged into the environment during the production of new fabrics. It can also be a means of saving money particularly for low income earners.

1.2 Purpose of the study

The aim of the study is to investigate how reuse, repair, recycling and upcycling strategies of the circular economy can be employed to reduce the environmental impacts of fabric waste and increase resource efficiency in Nigeria. The aim was accomplished by achieving the following objectives:

1. Identifying the environmental harm caused by indiscriminate disposal of textile waste.
2. Practical exploration of reuse, repair, recycling and upcycling strategies enhancing resource efficiency and reducing waste generation.
3. Examining the environmental and economic benefits of implementing reuse, repair, recycling and upcycling strategies in promoting a circular economy

Research Questions

1. What are the environmental harms caused by indiscriminate disposal of textile waste?
2. In what ways can the strategies of upcycling, repair, recycling and reuse be used in reducing fabric waste?
3. What are the economic and ecological benefits of putting the circular economy's reuse, recycling, repair, and upcycling techniques into practice?

1.3 Significance of the Study

The achievement of this research has environmental, economic and social significance. On the environment it can minimize the quantity of fabric waste generated. Since textile production often involves utilization of harmful chemicals and processes that pollutes the environment, adoption of circular economy can reduce pollution and promote sustainable production process. By promoting reuse, repair, recycling and upcycling, the demand for new raw materials and production cost can be reduced, saving resource for the producer and the consumer. Circular economy strategies of reuse, repair, recycling and upcycling is an innovative business model that could create jobs for the teeming unemployed Nigerian youths. Access to affordable, repaired or upcycled textiles can benefit low-income communities in Nigeria. Above all, the twelfth Sustainable Development Goal, responsible consumption and production is promoted.

2.0 Literature Review

The literature review was carried out based on the following conceptual frameworks.

Circular Economy

European parliament (2023) described circular economy as a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible thereby reducing waste to a minimum. The study affirmed that reusing and recycling products would slow down use of natural resources, reduce landscape and habitat disruption as well as help to limit biodiversity loss.

In their study, Akanj, Amoah, Akpoveso, and Atanya (2023) used interviews to portray the lived experiences of nine entrepreneurs in Nigeria who were associated with CE. To describe the shift from government, waste management, and public rhetoric around CE to active enterprise development, a framework was created. According to the study, there is a greater understanding of circular processes in Europe, which is backed by well documented case studies of multinational firms. Additionally, it noted that the majority of CE initiatives occur in East Asia, North America, and Europe. Small-scale actors in CE are spearheading the shift towards a CE in order to realize the potential for revenue generating and job creation, in contrast to the Global South, which includes Africa

Consequently, the study proposes that macro – level catalysts such as government policies, infrastructure, and culture, along with micro-level catalysts such as passion, experience, and attitudes, will enable the shift from discussion to implementation of CE principles through business creation. Results from their interviews highlighted key challenges faced by CE enterprises in Nigeria and this includes lack of clarity about the concept of CE, lack of supportive policies and infrastructure, need for improved waste management culture, and difficulty accessing funding and materials. The study noted that micro-level actors, multinationals businesses, and nonprofit groups are the ones driving the shift to a full CE and recommended collaboration between government and private sector, for infrastructure improvements, incentives and education to further foster CE adoption in Nigeria.

Ajibesin (2023) Maintained that Nigeria generates 32,000,000 tonnes of waste annually, which makes it the 7th largest polluter in the world. Less than 30% of this waste is recycled while the rest ends up in landfills, sewers, beaches, and water bodies. According to Ajibesin (2023) waste management is a large business in other parts of the world, but Nigeria is still in its early stages. As a result, there is ample opportunity to explore various waste materials such as plastic, glass, textile, food, metal, and electronics, amongst others, which are in abundance. The study recommended that Nigeria circular economy road map must outline concrete actions that can accelerate the transition to a competitive circular economy in Nigeria. It should be a channel for sustainable development, economic growth, and environmental transformation, where the waste that originates from Nigeria and its recycled products can be used in Nigeria.

Nkanta (2024) in a recent study examined how Nigeria, as a nation, could benefit by shifting towards a circular economy rather than continuing with linear economic model. The study listed such ways as resource efficiency and reduced environmental impact, waste reduction and management, economic growth and job creation, innovation and technological advancement, reduction in greenhouse emissions, policy and institutional support for circular economy transition. However, the study noted that waste management is a major challenge in Nigeria, with urban areas generating significant amount. The study while maintaining that circular economy practices encourage rethinking waste as a resource, suggested that recycling initiatives could transform plastic waste into new products,

Nonetheless, the study observed that despite the prospects of circular economy in Nigeria there are barriers that are hindering its successful

implementation. These includes lack of infrastructure for waste collection, recycling, and processing, particularly in the rural arears. Low awareness among consumers and businesses regarding the benefits of circular economy practices. Limited access to financing for SMEs and startups looking to adopt circular models and Regulatory gaps and weak enforcement of environmental laws.

Reuse Strategy

The term "textile reuse" describes a variety of techniques for extending the useful life of textile items by giving them to new owners, either with or without previous alteration such as patching (Peters and Sandin, 2018). In another study, Sai,Quansah and Acquanye (2022) citing Delia states that reuse is to use an item again after it has been used and this includes conventional and unconventional reuse. Conventional reuse is where the item is used again for the same function. For instance, the use of fabrics bought from second hand market popularly known as Okirika in Nigeria. Unconventional reuse on the other hand is based on the concept where an item is used for a different function after it has performed its intended purpose of manufacture. For this study the focus is on conventional reuse of abandoned textile products that are still in good shape and capable of serving their original purpose by another user such as reusing second hand clothes.

There are different ways of getting used clothes to be reused such as trading, swapping, renting, borrowing, inheriting and donating. However, only when durable materials are used for initial manufacture can the circular economy's reuse approach be implemented. Okirika, the second-hand market in Nigeria, has been a booming industry that has given many Nigerians a source of income and allowed middle-class and lower-class people to get alternative clothing at a lower cost. However, these used clothes are imported from other nations, like the USA, China, Germany, and the UK. One starts to wonder what happens to textiles that are created in Nigeria and utilized there. Most often these are discarded in water ways or burnt, because people would rather buy foreign used clothes than Nigeria used clothes.

Haq and Rakifull Alam (2023) did a study on the application of circular economy principles in the apparel production process, which focuses on reusing pre-consumer waste for environmental and economic sustainability, after collecting and classifying the reusable cutting waste produced in a Bangladeshi factory, obtained 218.6 kg of surplus fabric, 212.3 kg of reusable cutting waste, and 210 reusable rejected cut panels that can be used to create about 2238 pieces of circular products. The method used in the study has shown the shortest circular economy loop, which includes the steps of collecting, sorting, redesigning, re-cutting, and sewing. The investigation concludes that in terms of concern for ecological sustainability and economic feasibility, the direct reutilization of pre-consumer waste cutting sections could prove more efficient than recycling, landfilling and incineration.

A social Enterprise promoting re-use and re-cycling of used textile known as Africa Collect Textiles (ACT), observed that the global textile and fashion industry extracts resources and inexpensive labour from some developing countries, and ships its fast fashion products to rather well off countries, which then often dump unwanted clothes as second –hand items onto other developing countries. “With little regard for societal and environmental consequences worldwide, such a linear model creates a tremendous loss of value, both ecologically and economically, estimated to more than USD 500billion every year due to underutilization of clothing and lack of recycling”. As a result, the (ACT) is out to make sure that circularity is not only put on reports, but practically implemented all over the world including Africa. To facilitate this, Africa Collect Textiles (ACT) aims to install collection and recycling models for used textiles in cities across Sub- Saharan Africa. Presently, Africa Collect Textiles (ACT) already has a collection, sorting and re/up-cycling system in Nairobi, Kenya.

Their work is centered on collecting unwanted clothes and other textiles and fashion items at churches, shopping malls, universities and schools. The collected items are subsequently sorted and then donated or resold or recycled or upcycled. Their success story in Kenya led to the feasibility study that was conducted in 2019/2020 in Lagos, Nigeria to answer the questions "In what way, if any, could the Act model be implemented in Lagos to allow for long-term, financial and technical feasibility of a local textile collection and recycling business? In conclusion, the study affirmed that an implementation of a textile collection and recycling scheme similar to the one implemented by ACT in Nairobi is feasible in Lagos. Nonetheless, the study suggested that the final business model for Lagos will need to deviate from the one in Nairobi. Because of the relative absence of wool and acrylic from clothing worn in Lagos, the inability of potential industry partners to recycle broken pieces into new fibres, and the potential of *aso ebi* culture as motor for unwanted but high quality fashion pieces among others.

Textile Recycling

Abrishami, Armineh and Doustdar (2024) in a study on textile recycling and recovery; an eco-friendly perspective on textile and garment industries challenges, looked at the available technologies and methods for waste recovery and recycling as well as the uses of products after recycling. The study observed that despite the progress made in waste recycling processes of fashion industry, many deficiencies and challenges still exist. Among these challenges are the problem of collecting and classifying textile waste materials and the presence of contaminants including blends and chemicals. The study also suggested that there is need to create awareness among consumers about the importance of fibre to fibre recycling process, because currently the process in this area is out of proportion to its necessity. This is one of the reasons why the practice of textile recycling is not commonly done by individuals

Jarvis (2023) defined textile recycling as reprocessing pre- consumer and post- consumer textile waste for use in new textile or non-textile products. The study went further to describe pre-consumer textile waste, as textile waste produced in the manufacturing process of items that are destined for our hands. For example, pieces of fabric that are left after a t-shirt is cut out. While post- consumer textile waste is textile waste created by the consumers when unwanted used clothing is thrown away. According to Jarvis (2023) there two types of textile recycling, the mechanical and chemical textile recycling. The mechanical textile recycling involves the physical shredding of textiles into their components source which often results in lower quality materials, while the chemical textile recycling involves adding chemicals to textiles to break down the polymers that make up the materials. This type of recycling produces the same quality of materials as the virgin material but the technology for doing this is currently not readily available

Jarvis (2023) noted that, it is preferable to employ the mechanical textile recycling method, which is simple to undertake on a personal level for unwanted clothing that cannot be upcycled or repurposed. For example, old clothing can be torn up and used as stuffing for pillows and beds, or it can be used to make heat-resistant pot holder pads or dusters. Foot mats can be woven from the torn old fabric by twisting it into a rope. Additionally, they could be utilized as rags for another purpose.

Labayen, Yuan, and Labayen (2022) in a study made a review of textile recycling practices and challenges. The study observed that only 25% of textile waste get recycled or reused while the remaining ends up in landfills. The study aimed to establish reuse and recycling technology (anaerobic, digestion, fermentation, composting, fibre generation and thermal recovery) to manage textile waste. However, it was observed that improved collection systems, automation of sorting and discovering new technology for textile recycling has remained a challenge. Consequent on this the study reaffirmed that reuse is a more preferable option than recycling.

According to Fibre2Fashion (2014) one of the main obstacle in increasing the textile recycling productivity is that clothing comprises of various fibres. Sorting and reprocessing such clothing is a big challenge. Some fibers can be reused but petroleum based fibres like polyester have very little chance of reuse.

Upcycling Strategy

Aus. et al. (2021) made a study on Designing for circular fashion: integrating upcycling into conventional garment manufacturing processes, the paper summarized the result of a more than 5years practice led study on the use of upcycling design and production methods in garment mass production. It was noted that depending on the size of the factory, the fabric leftovers and textile waste generated in garment production ranges from 25%-40% of the total fabric used. The study reported that from experiments 50% of that material can be upcycled into new garments and for some types of leftovers, mainly spreading loss and excess fabric, it can even be up to 80%

According to Behera and Kamble (2021) in a study, textiles are used in many facets of daily life, including the home, where they are used for carpets, window shades, towels, tablecloths, bed linens, and handkerchiefs. In the workplace, they are utilized for things like tents, flags, nets, kites, sails, parachutes, and filters, among other industrial and scientific operations. Automotive applications, medical applications, geotextiles, agro textiles, protective apparel, packaging, and the creation of sophisticated materials like composites are all examples of industrial uses for technical textiles. When it comes to clothing, fast fashion has raised textile consumption, which has raised textile waste. According to the report, the continuous rise in the production and consumption of non-traditional materials has made textile waste a more significant hazard to contemporary civilization.

The study noted that from previous studies, much of what is termed waste textile could be upcycled to produce value- added products. However, the full potential of textiles waste is yet to be realized due to reasons, such as lack of adequate textile waste management system, the complexity of the required treatment of some types of textile materials and poor organization and control over supply chains. The study examined the application of upcycling of waste textiles and ways of utilizing waste textiles to produced upcycled products were explored.

Simple Ecology (2021) acknowledged the growing trend within the sustainability community toward the upcycling strategy of the circular economy which gives textiles waste material purpose by turning them into something more usable. The study noted that the upcycling strategy is most appropriate for fashion, clothing and other textile based items, as they are notorious for producing large amount of waste and various types of pollutions. But upcycling can also be applied to other forms of waste from furniture to tablecloths to empty jars. The study asserted that upcycling is one of the best and (craftiest) strategy of the circular economy. And to buttress this assertion stated that according to National Geographic, only 9% of all the plastic that has ever been created has been recycled. Unlike other materials that remain highly durable and usable after recycling, plastics breaks down and degrade in quality after every use, meaning they cannot be effectively reformed into the same items. For example, it is impossible to re-form the original plastic bottles into new ones.

According to the Ellen MacArthur Foundation, less than 1% of the materials used to make textiles are recycled into new apparel. Thirteen percent of clothing that can be recycled is frequently down cycled for use in lower-value products, such as stuffing and insulation. According to the report, using leftover textiles and resources to make new products is one of the most reliable ways to address the expanding textile waste issue. Although people can upcycle unwanted apparel and textiles, businesses and brands must begin repurposing the leftover materials they generate by upcycling.

Chudi-Duru (2023) maintained that developed countries, have used re-making, re-cycling and

re-purposing different types of materials as strategies to solve problems in their built environment, whereas in Nigeria these strategies have not been properly harnessed. The study focused on the entrepreneurial potentials in recycling, remaking, re-purposing and reproducing fabric wastes and used clothing in Nigeria. And thus observed that wealth and entrepreneurship could be created through the sales of re-made and recycled products.

Repair Strategy

A study by Van der Velden, Maitre-Ekern, and Wanja (2023) looked at the role of independent repair, which is people, organizations, or businesses that fix products without the brand owners' formal consent. The study claimed that repair, and independent repair in particular, is essential to achieving a paradigm shift rooted in regenerative sustainability. The study conducted 25 semi-structured interviews with repairers working in commercial independent repair shops, focusing on the opportunities and challenges in independent repair. The findings of the interviews revealed that the independent repair sector uses various business models and strategies to address the difficulties associated with obtaining reasonably priced and high-quality spare parts.

Additionally, it bridges the gap between throwing away a defective product and paying for a costly authorized repair that is typically covered by warranty or insurance. Likewise, both locally and globally, independent repair supports circular spare part economy. Although Oslo's independent electronic repair industry was the study's primary emphasis, repair techniques can also be used for a wide range of goods, including apparel, shoes, bags, and other related items.

Zhang and Hale (2022), in an earlier study used a theoretical domains framework to examine the factors influencing UK people' repair and reuse of garments. A representative sample of 300 residents of the United Kingdom participated in the survey. Using self-report scales and free text items, the prevalence of and factors influencing clothing repairs and repurposing behavior were assessed. To determine the factors that hinder and facilitate behavior, both quantitative (logic regression) and qualitative (thematic) analysis were employed. According to study results, participants generally engaged in the habit every six months. The primary obstacles were insufficient expertise, poor product design, the high cost of repair services, and identity inconsistency. According to the study, specific behavior change wheels, such training workshops and the offering of free repair and repurpose services, could be used to alter these tendencies.

3.0 Methodology

The study adopted mix research approach. Specifically, descriptive and exploratory research methods were used. Data for the study were collected from primary and secondary sources. The primary data was sourced from personal experience and observations on practical works of repair and upcycling, as well as interviews with field actors such as Tailors, Shoemakers and church groups. While the secondary data was sourced from textbooks, journals and articles relevant to the topic.

The theoretical framework

The theoretical framework for this study is based on the 12th Sustainable Development goal of Responsible Consumption and Production. SDG 12 provides a framework for understanding the environmental, social and economic implications of consumption and production patterns. In the context of this study it encompasses resource efficiency, waste reduction.

3.1 Exploration of upcycling, repair and recycling strategies and items produced.

3.1.1 Upcycling of Pre- consumer textile waste.

Scraps from cutting and trimming during the creation of clothing are examples of pre-consumer textile waste, which is textile waste produced during industrial operations. Awka capital territory's tailor shops produce a significant amount of textile waste, which is frequently disposed of carelessly. Reusing this textile waste through upcycling enables the production of value-added items from the trash,

in addition to reducing the amount of textile waste.

Procedure for producing Table mat by Upcycling Fabric waste

Step 1: The waste fabric will be sorted according to texture and colour.

Step 2: The fabric will be washed to remove dirty, after which it will be dried.

Step 3: The cut out fabric will then be sown into tiny band of continuous rope by constantly attaching the pieces on sewn band until the desired length is obtained see plate 1.

Step 4: The band of rope produced from the waste fabric can be warped on a tapestry loom or arranged in warp yarn formation on a flat surface using masking tape to hold it down firmly onto the surface. See plate 2a.

Step 5: The band of waste fabric that will be used as weft yarn is then interlaced with the warp band at right angle (that is crossing the horizontal band with the vertical band to create a basket weave woven fabric effect until the warp band is exhausted See plate 2b and 3a.

Step 6: After the weaving, bias is used to hem the edges to make it neater. Crocheting is then used on the edges to create salvage and make the piece more appealing see plate 3b.

Plate 1: Waste pre consumer fabric cut out sown into band of rope (Okeke, 2024)

Plate 2a: Warp arrangement of the band of waste fabric

Plate 2b: Preliminary stage of weaving.

(Okeke, 2024)

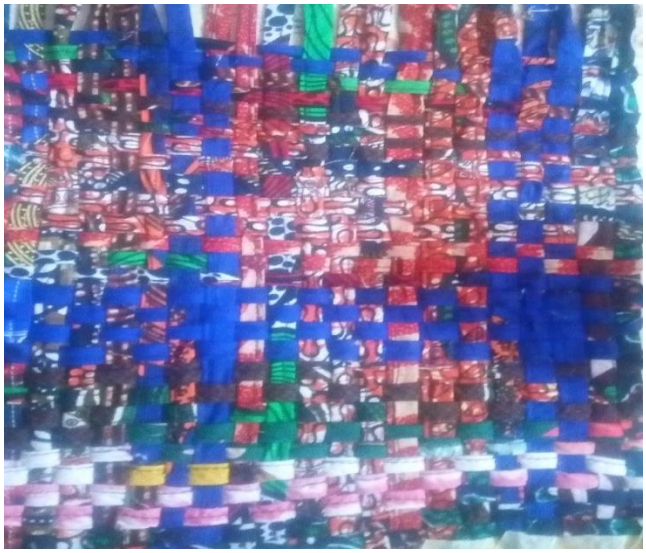

Plate 3a: End of the weaving stage (Okeke, 2024)

Plate 3b: Finished table mat weaved with waste fabric that was turned into a rope band and embellished with crocheted salvage. (Okeke, 2024)

3.1.2 Repair and refurbishing of old sandals

Procedure for refurbishing old sandals using fiber extracted from waste plantain pseudo stem.

The Polyurethane coating or poly coating on the fabric used for the sandals peeled off after using it for some time, but the sole was still strong so instead of discarding the sandals the following procedure was used to refurbish the sandals to extend its life cycle. A Polyurethane is a type of polymer applied to the surface of fabric to give it the appearance of leather.

Step 1: The remaining polyurethane or poly coating on the sandals was scrapped out and the
surface cleaned with wet brush and allowed to dry see the sandal on the right side of
plate 4a

Step 2: The dyed plantain fiber was braided into tiny rope.

Step 3: The rope was laid on the surface of the fabric using glue to hold it onto the surface firmly,

to replace the poly coating on the sandals until the whole surface is covered with the braided fiber. See plate 5

3.1.3 Reuse of Nigeria made and used clothes

It is important to encourage the reuse of Nigeria- made and used clothing here in Nigeria, since exporting it for sales in foreign countries might not be feasible. In this manner, traditional Nigerian clothing that is influenced by the culture can be reused and marketed at a lower cost, protecting the environment from the impact of disposal by burning or dumping in

Plate 4: Sandal with polyurethane coating scrapped out and the preliminary stage of refurbishing with dyed fiber from waste plantain Pseudo stem. (Okeke, 2023)

Plate 5: Repaired or refurbished sandals (Okeke, 2023)

water ways. It will also save natural resource as well as income needed for purchasing new textile material. One of the ways reuse of Nigeria-made and used clothes can be encouraged is through donations.

Clothes that are still in good condition can be donated to extended family members, nonprofit organizations such churches, motherless baby's or old people's home. The researcher during a fieldwork conducted on March 2, 2025, at the Regional Head Quarters of Redeemed Christian Church of God, Seed of David Parish Awka, noted that the Welfare Department, under the direction of Mrs. Nnonyelu, has put up a strategy in place to encourage the reuse of Nigeria used clothes. The area headquarters of Redeemed Christian Church of God, Precious People's Parish under House of Faith zone Awka, have a similar strategy which is called Heaven shop. This strategy involves collecting used clothes from church members and displaying them on every first Sunday of each month for individuals to freely select as needed see plate: 6 and 7.

3.1.4 Recycling of used clothes

Procedure for Recycling of used clothes into insulated pot holder.

The old worn out fabric is usually washed and dried to ensure that it is free from dirt and contaminations.

Step 1: The outer covering of the pot holder is measured according to desired size, and cut out in two pieces.

Step 2: The two pieces are joined by sewing or stitching the edges.

Plate 6: Display of Used cloth and shoes by Welfare Department RCCG Seed of David Church Awka Field work at RCCG Regional H/Qtrs. Awka, Anambra state. (Okeke, 2025)

Plate 7: Selection of Used cloth by people at Welfare Department stand of RCCG Seed of David Church Field work at RCCG Regional H/Qtrs. Awka, Anambra state (Okeke, 2025)

Step 3: The worn fabric that will be used for the stuffing is then shredded into tiny pieces see plate 8a.

4.0 Results and Discussions

4.1 Findings from Interview and Fieldwork

In certain industrialized nations, repair professionals charge by the hour, which is typically very costly. As a result, consumers would rather sell their spoiled goods to developing countries as used goods while purchasing new ones. However, despite the lack of statistics, the repair of worn textiles and associated items like shoes and bags has continued in Nigeria, most likely as a result of the difficult economic climate, and has no connection to the circular economy. Ajibesin (2023) supported this assertion by stating that Nigeria as a country has had circular activities for many years, largely within the informal sector and driven by poverty rather than green thinking. In the field interview carried out at Eke Awka Market, this was affirmed by Stephen, O., a shoe maker and repairer in Eke Awka market Anambra State (personal communication, October 17 2024). According to Stephen who also makes new shoes and sandals the number of people that patronize new shoes have reduced this year in comparison with last year. People rather mends their used shoes and sandals and these days the least he charges for any minor repair is #500.00. Haruna A., another shoe maker in Market 3, Eke Awka market Anambra state (personal communication, October 17 2024) corroborated that more people patronize them for shoe repairs in recent times unlike before.

Plate 8a: Old worn fabric shredded into pieces

Plate 8b: Outer covering of pot holder sewn along with band to serve as hanger.

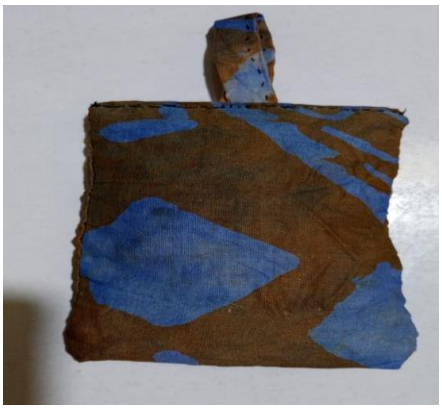

Plate 8c: Finished insulated pot holder

(Okeke, 2025)

There are also cloth menders, bag menders, Madam Okafor Theresa is noted in Eke Awka market 3, for mainly mending used cloths and she charges between #1000-#1500 for minor mending. Most often people pay these charges without complaining, because it is usually difficult to get the regular tailors to accept repair works. However, the paucity of studies on textile repair and related items indicates that researchers have not given this topic enough attentions.

It was also observed from the fieldwork carried out that some churches such as Redeemed Christian Church of God and Living Faith Church has put in place strategies that encourages donation and display of used clothes for their members to pick according to their needs. This tactic has given people a way to donate their unwanted clothing rather than burning it or throwing it in a landfill, which would harm the environment. However, more efforts need to be put in place by other organizations to encourage the reuse of made in Nigeria and used in Nigeria clothes because it does not require special skill to practice. More so, Sandin and Peters (2018) asserted that textile reuse has a higher positive impact on the environment than recycling.

4.2 Results from Review Literature

Results of the review indicated that the global economy in 2023 was estimated to be just 7.2% circular, with the linear economy model still dominating, despite the push for a move to a circular economy in the developed countries (Bellini, Anderson, Klungseth, and Tadayon, 2024).

Jarvis (2023) went further to state that, it is preferable to employ the mechanical textile recycling method, which is simple to undertake on a personal level for unwanted clothing that cannot be upcycled or repurposed.

Haq and Rakifull Alam (2023) in a study on the application of circular economy principles in the apparel production process, which focuses on reusing pre-consumer waste for environmental and economic sustainability, after collecting and classifying the reusable cutting waste produced in a Bangladeshi factory, reported that 218.6 kg of surplus fabric, 212.3 kg of reusable cutting waste, and 210 reusable rejected cut panels can be used to create about 2238 pieces of circular products. Compared to recycling, landfilling, and incineration, the study found that direct reutilization of pre-consumer fabric waste is more advantageous for ecological sustainability and economic viability. Jarvis (2023) affirmed this assertion too, stating that mechanical textile recycling is preferable since the technology for chemical recycling is not readily available for everyone. Inference from this, is that strategies such as upcycling, reuse and repair are better options in terms of ecological concern

Though there are pockets of practices of circular economy strategies of reuse, repair, recycling and upcycling in Nigeria, researchers have not given it much attention. This is because scholarly works on these strategies seen were mostly from foreign scholars. Findings from the review, showed that though there is a massive campaign for a shift to circular economy, its application in real world industry setting is majorly by recycling of plastic waste. Recycling is a more complex option, because some fabrics come in poly/cotton/elastane blends, making it very difficult to recycle. In real-world industrial settings, the use of other strategies of circular economy such as reuse, repair and upcycling is yet to be fully exploited. The success of the practical exploration of refurbishing or repairing of spoilt sandal, recycling of old worn out fabric and upcycling of pre consumer fabric waste, is a testament to the effectiveness of this strategies in reducing waste, saving new resource and even creating jobs. Observation made during the fieldwork of people picking Nigeria made and used clothes for reuse has proven that textile reuse can be used to increase resource efficiency and reduce fabric waste generation in Nigeria.

4.3 Benefits of adopting reuse, repair, recycling and upcycling strategy of the Circular Economy

Reusing second hand fabric, shoes and bags is common in Nigeria particularly among low income earners. The second hand market gives

them the opportunity to get fabrics, shoes and bags that meets their different needs at a reduced prize, thus saving the money that would have been spent for the new products as well as saving the environment where it would have been thrown after discarding.

By repairing damaged clothes or restoring worn-out or damaged shoes or bags, you can increase their usefulness. It also saves the customer money that they would have spent on a new bag or sandal. In light of the toxic effects of the polyurethane production techniques used to cover the sandals or bags, repairing or renovating outdated sandals or bags also lessens these effects. According to Yu-City (2013), the synthetic polymer polyurethane, which is used to coat garments to give them the look of leather, is derived from petroleum and poses health and environmental risks. For example, flame retardants are frequently used on polyurethane fabrics due to their inherent flammability, which has been connected to both environmental and health issues. Flame retardants can be harmful, particularly to young children, as they can interfere with hormones and impede growth. The chemicals have the potential to leak into the environment and contaminate it, causing long-term pollution that could damage ecosystems. Repairing products made from polymer polyurethane will minimize the production of new items, thus saving the environment of its negative impact (Yu-City, 2013).

In Nigeria, some unemployed youngsters have found a source of income through repairing or refurbishing leather goods; however, proper paperwork is lacking. The process of upcycling scrap textiles or old clothing into new goods also increases the fabrics' utility while reducing pollution from new production and careless disposal of textile waste. For young people without jobs who decide to investigate these tactics, it can foster innovation and generate employment. It will also be extremely beneficial to those with low incomes who may not be able to pay for the expense of frequently purchasing new goods.

5.0 Conclusion

Nigeria has pockets of reuse, repair, recycling and upcycling processes, therefore the idea of these practice is not wholly new. However, this approach is not taken because people wish to be good environmental stewards, but rather as a coping mechanism for the severe economic realities. In order to motivate more individuals and businesses to adopt the circular economy strategy in the use of textile and related items, it is now critical to increase knowledge of the advantages of these strategies. Some advanced countries have already begun to undergo this change in their textile, polymer, and related industries; Nigeria should accelerate its efforts to avoid falling behind. Creating a sustainable model that maximizes value and reduces waste is the goal of the circular economy. This can be accomplished by moving away from fashion that is meant to be thrown away and toward long-lasting designs that use materials that are reusable, repairable, recyclable, or upcyclable.

Adopting the circular economy particularly as it relates to textile production and consumption will allow Nigeria's textile and related industries to employ less expensive materials for manufacturing by creating new opportunities for innovation and development. They earn money while using fewer new raw materials. Reducing waste, protecting natural resources, and lowering carbon footprints all help the environment. Because the materials are long-lasting and repairable, consumers can save money by not having to purchase new items as often. In addition to helping people cope with the harsh realities of the economy, this study aims to inspire individuals to embrace the reuse, repair, recycling and upcycling strategies as a method to preserve our natural resources, reduce waste, and maintain a healthy environment. Thus, the twelfth Sustainable Development Goal responsible consumption and production is promoted

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Investigating the Impact of Effective Green Design Factors in the Formation of Green Hospitals

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Abstract: With the growing population and increasing human dominance over nature, the disruption of nature's order has emerged as a new phenomenon. One of the results of environmental destruction has been the emergence of green architecture, aimed at saving energy and optimizing the use of natural resources. In this regard, sustainable development, which involves the continuous and rational use of natural resources, has been proposed. Among these, the relationship between nature and buildings has been introduced as a fundamental principle of green architecture. This topic has garnered more attention from architects in recent years. Hospitals, considered one of the most polluting sources of the environment, are a particular focus for designers to create more environmentally friendly hospitals by considering effective green design factors.

In this regard, the use of modern technologies, green architecture, and design and construction of green hospitals are being studied. The present research aims to examine the topic and effective factors in the formation of green hospitals with a focus on quality and efficiency.

Keywords: Green architecture, Energy conservation, Green hospital

1. Introduction

Human, nature, and architecture are three interconnected elements that have always guided designers in their plans . Humans have always sought tools from architecture for living in nature (Wazir,2019), because energy is dynamic and derived from nature, making its denial impossible (Wakhidah,2024). Since the 1970s, with increasing awareness of the environmental crisis, sustainable development emerged to preserve nature, leading to sustainable architecture as one of its branches (Yakut,2022). Green architecture is also considered a nature-friendly technique that promotes environmental protection.

Recent studies further reinforce the significance of integrating green design principles with emerging smart technologies and environmental modeling tools. For example, Shafa (Shafa,2024(a)) highlights how smart materials like ETFE membranes and phase change materials (PCMs) play a critical role in increasing the energy efficiency and environmental adaptability of buildings, aligning perfectly with the goals of sustainable hospital design. Similarly, the importance of integrating intelligent energy management systems in smart buildings—particularly through lighting systems, environmental sensors, and renewable resource optimization—has been ranked as a crucial factor for

sustainability by experts in the field (Shafa,2024(b)). Complementing these architectural insights, Shafa (Saghaei,2025) demonstrate how machine learning models for drought classification can support climate-responsive design strategies, offering data-driven tools to assess site-specific environmental risks and optimize building performance under varying ecological conditions. These interdisciplinary approaches underscore the necessity of combining smart systems, data science, and material innovation to enhance the ecological footprint and operational efficiency of green hospitals.

In fact, the emergence of sustainable development and green architecture stems from the increasing demand for energy caused by population growth and the need to counteract the destructive consequences of industrial civilization. In global discussions on sustainable development, green architecture is considered one of the primary strategies. The main goal and primary principle of sustainable development is to protect natural resources and the environment to meet human needs on Earth. Green hospital architecture technologies have been proposed as one of the responses to sustainable development. These technologies aim to save resources and prevent waste, not only for hospitals but also for other public facilities like schools and universities (Ragheb,2016). The current research focuses on the factors of green design in the architecture of hospitals.

2. Research Method

The current research can begin by asking how green design factors, sustainable approaches, and green design can be incorporated into hospital architecture. The aim of this research is to investigate the impact of effective green design factors in the formation of green hospitals.

The research method is descriptive-analytical and uses library studies as its foundation. This includes gathering data from reliable sources. In this method, theoretical concepts are presented in a diagrammatic format based on the researcher's perspective and the reality of the subject. The selection of design factors was primarily derived from an extensive literature review and supported by expert opinion and international standards in sustainable hospital design. Researches that interpret the data themselves and provide qualitative descriptions are descriptive-analytical studies. The researcher uses content analysis and interpretation to express the outcomes and achievements of others' work. In this research method, it is believed that effective green design factors in hospital architecture can be described and evaluated.

3. The Concept of Green Architecture

Today, as a result of the negative consequences of the industrial world, the preservation and conservation of the world's natural resources have become one of the most important concerns of modern times. In this direction, green architecture can be seen as a way to seek solutions to minimize the negative impacts of buildings on the environment (Williams,2007). From energy conservation, reducing the use of fossil fuels, and building materials, to creating harmony between buildings and residents' environmental and cultural behaviors, green architecture can be defined as such. Rogers (Rogers,2005) defines green architecture as an approach aimed at reducing environmental damage and enhancing human health and the environment.

In the definition by Shafa (Shafa,2024(b)), green architecture is a form of architecture that is in harmony with nature and the environment and is considered one of the branches of sustainable architecture. Sustainable architecture is shaped by understanding nature and using it in the building process, and it aims to coexist with nature by increasing energy efficiency, optimizing the use of resources, and expanding space.

Green architecture strives to select materials and building methods compatible with the environment and suitable for water and air, and to protect the land. Green design goals can be presented clearly in this way.

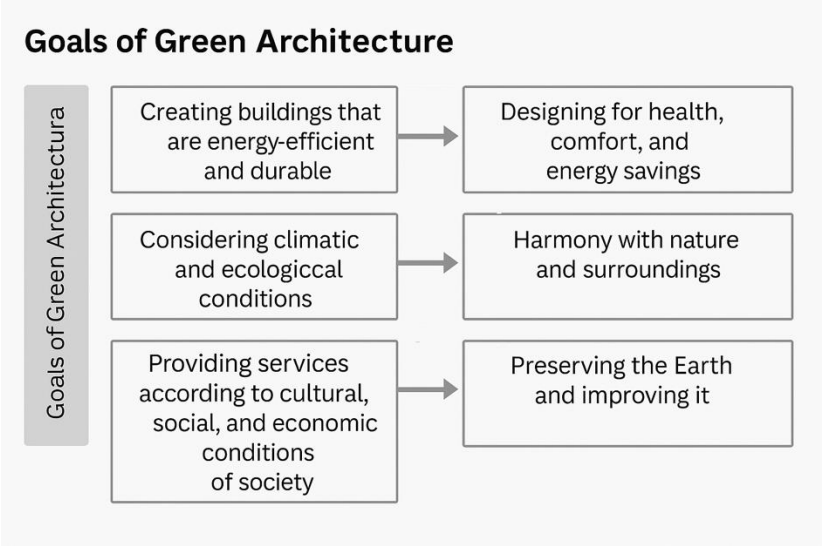

Figure 1: *Goals of Green Architecture – highlighting the core objectives such as energy efficiency, user well-being, and environmental harmony in hospital design.*

4. Principles of Green Architecture

A. First Principle: Energy Conservation

Every building should be designed in such a way that the need for fossil fuels is minimized (Calder,2021). The necessity of embracing this principle, given the construction methods and materials of the past, is undeniable in today's era due to the vast diversity of materials and modern technologies. This principle, once fundamental in traditional buildings, has largely been forgotten in contemporary architecture. Today, with the use of diverse and combined materials, buildings and environments are being adapted to the changing needs of users.

B. Second Principle: Working with the Climate

Buildings should be designed in a way that utilizes the local climate and energy resources. The layout and positioning of a

Figure 2*: Resource Efficiency Cycle – showing the cyclic process of resource usage in sustainable buildings.*

building and its interior spaces should allow for a design that improves comfort levels inside. For example, proper insulation can lead to a reduction in fossil fuel consumption. Designing based on climate to provide comfort inside the building is not limited to heating regulations; in many climates, architects must design cool spaces to provide suitable internal conditions. In today's world, mechanical air conditioning systems are commonly used, often in contradiction with climate conditions, and are accompanied by significant energy consumption and pollution. Even the energy efficiency systems used today can be highly wasteful if incorrectly implemented (Yuan,2017). Figure 2 illustrates an example of energy-saving and efficiency based on this principle in building design.

C – Third Principle: Reducing the Use of New Resources

Buildings should be designed in a way that the use of new resources is minimized, and at the end of their useful life, those resources can be reused to create other structures. Although this approach is emphasized in other green architecture principles, it must be remembered that most of the world's existing resources are artificial materials already used in buildings. Improving and renovating the current condition of these buildings to reduce environmental impacts is just as important as creating new, eco-friendly structures.

D – Fourth Principle: Respect for Users

Green architecture respects all the individuals who use a building because it addresses both their physical and emotional needs. Therefore, it gives special importance to human dignity. The green architecture process includes respect for all shared human resources involved in the construction of a building. This respect is not only limited to users outside the structure but also applies to everyone building it, since buildings are created by humans and for humans.

In some cases, this truth is observed in the dimensions of human presence in the design process. For example, greater respect for human needs and energy can lead to a distinct path from conventional professional construction. Attention to safety and the health of materials and processes used in the building is crucial. Also, it is important for society, especially

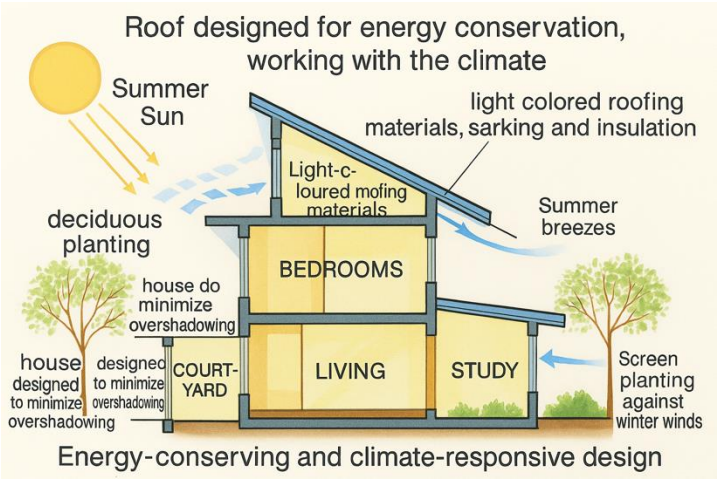

Figure 3: *Energy-Conserving Design – illustrating practical building strategies for energy reduction.*

the labor force and users, who are the main beneficiaries. Moreover, collaboration and the involvement of users in the design and construction process is another form of human-centered engagement.

E – Fifth Principle: Respect for the Site

Every building must gently and calmly touch the earth. A building that consumes energy flows, produces pollution, and causes discomfort to its users is considered alien.

F – Sixth Principle: Holism

All principles of sustainable architecture must be applied in an integrated process that leads to the creation of a healthy environment. Green architecture must be viewed as a comprehensive process because building an artificial environment requires integrated collaboration. In fact, green architecture should include a system that goes beyond the individual building. The city, a broader existence than the building itself, is a system of forms that constantly interact and evolve. These forms, when seen as keys, help us visualize and design the face of future cities.

5. Green Design

Green design is a method of designing whose rules are rooted in nature and is grounded in combining diverse perspectives in the areas of energy, environment, and ecology (Shafa,2024(b)). This design approach encourages interdisciplinary cooperation, including mechanical engineering and architecture. In addition to common design factors such as creativity, beauty, adaptability, shading, and freshness, green design also emphasizes long-term environmental, economic, and human factors. The core principles of green design can be summarized into three basic foundations (Shafa,2024(b)):

1. **Resource Conservation Phase**: This principle focuses on the proper and efficient use of resources and renewable energy, such as fossil fuels, to reduce consumption. On the other hand, it involves controlling and optimally utilizing natural resources as renewable storage. The resource utilization process can be illustrated as shown in Figure 3.

2. **Design Phase for Life Cycle Return**: The second principle of sustainable architecture is based on the idea that any material must be reusable in another form without losing its effectiveness. This allows it to become beneficial again without turning into waste.

3. **Design Phase for Humans**: This principle emphasizes maintaining the quality of life for all components of the ecosystem. It can be considered aligned with the humanitarian goals of respecting all pillars and various resources of life (Reller,2000).

6 – Green Hospital

Hospitals around the world aim to innovate in patient care while maintaining high standards. In implementing this innovation, hospitals always consider the impact on the natural environment to reduce harm to patients, staff, and surrounding communities. Therefore, hospital administrators prepare management programs to preserve energy, properly handle medical waste, and ensure safe drug administration. These programs introduce the concept of a green hospital (Reller,2000).

A green hospital is one that continuously reduces environmental impacts and contributes to eliminating diseases by improving public health. These hospitals recognize the connection between human health and environmental health. They identify and understand environmental needs and align their operations and strategies accordingly. Through environmental measures and active community participation, they commit to improving health and the economy. They take preventive measures to minimize environmental damage and demonstrate a strong commitment to both environmental and public health. A green hospital, often assessed through certifications such as LEED (Leadership in Energy and Environmental Design) or the WELL Building Standard, meets specific criteria in energy

efficiency, environmental quality, and resource management.

One of the key features of green efficiency strategies in hospitals is economic efficiency, which, alongside care quality, targets reducing healthcare costs. With a new focus on environmental health and the use of green technologies, tools, and methods, these hospitals aim to minimize environmental consequences. Accordingly, various hospitals worldwide have practically implemented these green strategies. For instance, the Dell Children's Medical Center in Austin, Texas, became the world's first hospital to achieve LEED Platinum certification, demonstrating the feasibility and success of comprehensive green hospital strategies.

7. Conclusion

A green hospital is a branch and subcategory of sustainable architecture; however, there are key differences in its perspective compared to green buildings. The first foundational principle is that the hospital must be patient-centered. The architecture should improve healing outcomes, making it effective in treatment.

Secondly, hospitals and medical centers are considered major contributors to urban pollution. With a sustainable and green approach in design, they can transform into clean environments. One of the main discussions in green hospital design is the ability to receive green certification.

The current study aims to present effective design factors for green hospitals, which are referenced in Table 1.

Table 1: *Effective design factors*

Factor	Description
Site Selection	Choosing a suitable location for hospital construction before design and project implementation, considering local environmental conditions, land usage, topography, distance from pollution sources, and ecological conditions.
Transportation and Access	Creating access for patients and staff via public transportation and eco-friendly routes.
Energy	Using renewable and clean energy technologies, reducing fossil fuel consumption, and improving equipment and system efficiency.
Environmental Pollution Control	Reducing environmental pollutants like CO2, hospital waste, and sewage; adopting waste treatment technologies and eco-friendly materials.
Material Selection	Selecting materials with low pollution potential and energy use; using recyclable, local, durable materials to reduce environmental impact and cost.
Water Management	Controlling water consumption in all areas including gardens and toilets; using advanced water-saving technologies.
Indoor Environmental Quality	Improving indoor air quality through ventilation systems, natural lighting, and non-toxic materials.
Green Presence	Incorporating green design into hospital layout using green spaces, green roofs, and sustainable materials.

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Flipped Learning in Architecture: A Study on Student Comprehension and Performance in Materials and Building Construction Studios

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Abstract: In an era where architectural education must evolve to meet the expectations of digital-native learners, traditional lecture-based approaches often fall short, particularly in courses requiring both theoretical understanding and hands-on application. This study investigates the implementation and impact of flipped learning in a Materials and Building Construction studio for third-year architecture students at the National College of Arts, Rawalpindi. Using a robust mixed-methods approach—including surveys, classroom observations, focus group interviews, and academic performance analysis—the research offers a comprehensive examination of flipped learning's effect on student comprehension, engagement, and outcomes. Results reveal an 85% improvement in students' conceptual understanding, a 15% average increase in academic performance, and a 20% rise in critical thinking abilities compared to peers in traditionally taught studios. Qualitative feedback from students highlights the flexibility, autonomy, and increased peer interaction that flipped learning enables—elements they felt were more aligned with the iterative, collaborative nature of architectural design studios. However, the findings also underscore implementation challenges, particularly regarding digital access and varying levels of self-directed learning readiness. Despite these barriers, the study strongly supports a blended pedagogical model that combines flipped and conventional strategies to enhance both the depth and adaptability of architectural education. This research contributes critical insights to the ongoing discourse on pedagogy in architecture, providing empirical evidence that flipped learning not only fosters deeper learning but also aligns closely with the future trajectory of architectural training—making it a transformative tool in preparing students for the complex realities of design practice.

Keywords: Flipped learning, Student comprehension, Performance, Material and Building Construction studio, Architecture pedagogy.

I. Introduction

A. Background and Rationale

Teaching and learning in architecture is already undergoing a transition as it seeks to cope with the changes of the twenty-first century learner. The traditional approaches to knowledge delivery, during which students listen to the lectures and have few opportunities for hands on engagement, may not cope with the needs of modern studio-based education. Since Generation Alpha will be enrolling in higher education institutions shortly, education approaches will require even more modification to accommodate their preferred learner environments: highly interactive with technology enablement (Ziatdinov & Cilliers, 2022). This generation should expect more dependency in the use of technologies, an

aspect that may boost the need for policies such as flipped learning in architectural education. This is well illustrated by the fact that students in architecture courses for instance derive benefit from dynamic learning approaches that enable them to apply knowledge in action. These methods may not seem a fully appropriate approach to managing the current generation of students particularly those in university who seem to appreciate more technologies or interactive methods of learning and teaching (Brown & Green, 2016; Rudolph et al., 2017). The materials and building construction studio is a good example of this challenge since the learning activity realizes the application of knowledge in the architectural design classroom, in the built environment hence forcing students to apprehend the epistemological gap between their established knowledge and real architectural environment (Kvan, 2001). In these studios students have to map ideas into design products – which is not just a matter of knowledge but practical skills and meta-cognition. Due to the pedagogical shift towards more practice oriented lessons in architecture, there is a demand for instructional approaches that match these intentions while also captivating the Gen-Z architecture students.

The flipped learning model, which encourages students to engage with instructional material before class and participate in active learning exercises during class, is gaining popularity across various disciplines (Bishop & Verleger, 2013; Hamdan et al., 2013). By shifting foundational content outside the classroom, flipped learning frees up class time for practical, interactive activities that can foster deeper engagement with architectural concepts. This model, rooted in constructivist and active learning theories, shifts the focus from instructor-led lectures to student-centered learning, thereby fostering a more collaborative and flexible educational experience (Prince, 2004). While flipped learning has shown promise in fields such as medicine, engineering, and education (Chen et al., 2017), its application within architecture, particularly in studio-based courses, remains underexplored. Exploring flipped learning in the context of architecture could uncover its potential to enhance the student experience in ways that traditional methods cannot, particularly by addressing the unique demands of studio courses.

B. Research Problem

As architecture students from Millennial and Gen Z generations increasingly fill classrooms, there is a pressing need for teaching methods that resonate with their learning preferences. These students, who are digital natives, prefer learning environments that are not only tech-integrated but also highly interactive and self-directed. These students thrive in environments that are dynamic, interactive, and self-directed, making traditional lecture-based approaches less effective for promoting sustained engagement and learning. In studio-based courses, where engagement and practical application are critical, passive content delivery often fails to meet students' expectations and learning needs. This generational shift poses a significant challenge in studio-based architectural education, where passive content delivery methods may no longer suffice to engage students effectively or enhance their critical thinking skills (Brown & Green, 2016).

As a direct student-centered model that engages a learner’s content before classroom learning and employs group collaboration in and out of class environments, flipped learning caters for students of Millennial and Gen Z eras since it allow them for autonomy, flexible, and practical applications of knowledge and skills they gain in class (Bishop & Verleger, 2013; Hamdan et al., 2013). This model provides a means of integrating theoretical learning with field based activities so that students can subject content learned in a course to a number of practical activities. Also, flipped learning fosters the cyclical approach of designing learning activities inherent in most architectural studio learning environments because students can quickly get feedback from their peers. However, despite its successful implementation across disciplines like engineering and medicine, flipped learning has yet to be fully explored in architecture, particularly in the

hands-on, experiential context of studio courses (Strayer, 2012).

This generational challenge is addressed in this study by focusing on how flipped learning has the potential to revolutionise studio based architectural education. But more importantly, it intends to assess if applying this model can address the current needs of the students in terms of elaboration, analysis, and constructive interaction with the contents and materials encountered in building construction studios. In this context, addressing the learning preferences of the Millennial and Gen Z students who require technology to be at the core of their learning processes, this research aims at filling an essential gap in architectural education while attempting to provide guidelines for preparing the younger generation for the challenges ranging from the architecture profession itself to small practice, predicated on technology and aspiring to apply the advances of digital tools to the practice of design and construction. Lastly this study seeks to give grounds for reconsidering the way that technical studio courses are delivered in architecture and from that perspective change a system of concepts and their delivery to the perspective in which key competencies necessary for the work of architect in professional practice can be developed.

C. Research Objectives

To address the identified problem, this study sets out the following objectives:

1. Evaluate the Effectiveness of Flipped Learning: To assess how flipped learning impacts student comprehension and critical thinking in a materials and building construction studio setting.
2. Analyze Academic Performance: To examine the impact of flipped learning on students' academic performance, with a focus on grades, content engagement, and the development of critical thinking skills.
3. Investigate Student Perceptions: To understand architecture students' attitudes towards flipped learning, including the challenges and benefits they perceive.
4. Provide Recommendations for Curriculum Integration: To offer practical suggestions for integrating flipped learning into architecture education, informed by the study's findings.

D. Research Questions

1. How does the flipped learning model influence architecture students' comprehension and engagement in materials and building construction studios?
   - Purpose: This question aims to evaluate the effectiveness of flipped learning on two critical aspects of student outcomes: comprehension of course materials and active engagement during studio sessions.
2. What impact does flipped learning have on students' academic performance, particularly in terms of critical thinking and problem-solving skills?
   - Purpose: This question is designed to investigate whether flipped learning can enhance not just general academic performance but also higher-order skills such as critical thinking and problem-solving, which are vital in architectural education.
3. What are the students' perceptions of the flipped learning model in architectural education, and what challenges do they identify with its implementation?
   - Purpose: This question seeks to capture qualitative insights regarding student attitudes toward flipped learning, including perceived benefits and potential barriers, to evaluate its overall feasibility and acceptance among architecture students.

These refined questions align with the research objectives, targeting comprehension, engagement, academic performance, and perceptions of flipped learning to provide a comprehensive assessment of the model's potential in architectural education.

E. Hypotheses

H-1: The concept of flipped learning improves student understanding in learning architecture.

H-2: In materials and building construction studios, flipped learning has a positive impact on student academic performance.

F. Scope and Limitations

Scope

The study has no intention to generalize but limited to designing architecture third years undergraduate students at National College of Arts, Rawalpindi for a materials and building construction studio course only. The results of the study may be applicable to different architecture programs or studio environment to the specific group and university of the study. Furthermore, the study mainly focuses on the short-term measures and the outcomes depend on partly subjective data.

Limitations

- Generalizability: These findings cannot be said to be generalizable across all the architectural programs.
- Sample Size: A special group of people working or studying at one organization.
- Short Term Analysis: Because of the constraints of funding and time, most of the studies are normally done with a view of achieving short term objectives.• Contains somewhat questionable data; much of it being derived from self-report (Subjective Data).

G. Significance of the Study

The significance of this study is to enhance the architectural education and offer an evaluation of how this approach could enhance student understanding through the application of the F.L approach (Hamdan et al ., 2013). With more changes taking place in the world of architecture,a whole new generation stepping in professional colleges and ever evolving technological landscape, meeting the learning needs of those students entails the use of technology and active learning approaches. Therefore, the objective of this work is to contribute the closure of the gap between conventional teaching methods and new generation student expectations for improving the relevancy and quality of architectural education. It is only when the applicability of the flipped learning method in material and construction studios is clear, that there could be teaching practices based on this knowledge, which enhances interaction and offers a more profound level of learning. They will enhance the analysis of options for delivery of effective teaching activities and techniques, and add new components to enhance the value of the architectural education as well as the preparedness of the students for demanding career paths.

The implication of the result of this study would be useful in architecture education as the paper intends to address important issues on flipped learning model and its ability in improving understanding, innovation and student involvement during studios (Hamdan et al., 2013). Apart from advancing contemporary discussions about effective teaching approaches, this study also offers empirical data for subsequent investigations of the versatility of the FL concept in various architectural settings and among students of different backgrounds.

Literature Review

Responding to the growing demand for student-centered and technology-integrated teaching methods in architecture, this literature review explores flipped learning as a constructivist pedagogical model with the potential to transform studio-based education. It draws upon a wide range of studies from disciplines such as medicine, engineering, and education, where flipped learning has been implemented successfully, while also highlighting the unique challenges of applying it to architectural studios. The review begins by introducing key definitions and principles of flipped learning, followed by a discussion of its theoretical foundations and evidence from other academic fields. It then focuses on the model's emerging use in architecture, especially within construction and design studios. These studies suggest that while flipped learning promotes engagement and deep learning, its adaptation to architectural education requires careful consideration of contextual needs—such as iterative processes, spatial cognition, and

hands-on collaboration. By mapping out both the opportunities and constraints of flipped learning, this section establishes a theoretical foundation for evaluating its relevance and effectiveness in architecture pedagogy.

Research has proved that flipped learning has a lot of advantages in different disciplines of studying but architecture learning has its own difficulties, which must be investigated more thoroughly. It was also evident from Bredow et al. (2021) that whereas flipped learning improves understanding and students' participation, its impact on critical thinking varies with context, thus the necessity to introduce the context of architecture studios where critical thinking dominates. In order to make the reader appreciate the value of flipped learning particularly in architecture education it is crucial to discuss about the theoretical framework of flipped learning and how flipped learning has been practiced in other fields and the emerging area it deals with flipped architectural studios. To start this review, the authors provide an overview of the constructivist and active learning theories that govern flipped classroom and then discuss the opportunities and challenges of the flipped classroom in various contexts.

A. Flipped Learning in Education

As the teaching paradigms in architectural education receive increasing attention on innovation with regards to teaching strategies, this study further explored how flipped learning, which is a constructivist standpoint, can solve some challenges that Generation Alpha and Gen z Architecture students face.This review highlights previous studies comparing flipped learning in different disciplines and provided evidence of the scope and difficulties of implementing this initiative within architectural courses especially studio ones. The present review provides opportunity and literature review done on flipped learning across fields and it presents opportunity and challenges inherent in adopting it within the field of architectural education especially studio based courses. In order to establish background for this study, the below theoretical review seeks to: introduce the concepts of flipped learning; emphasize its implementation across disciplines; and discuss its application in the field of architecture education. These meta-analyses and empirical studies emphasise that

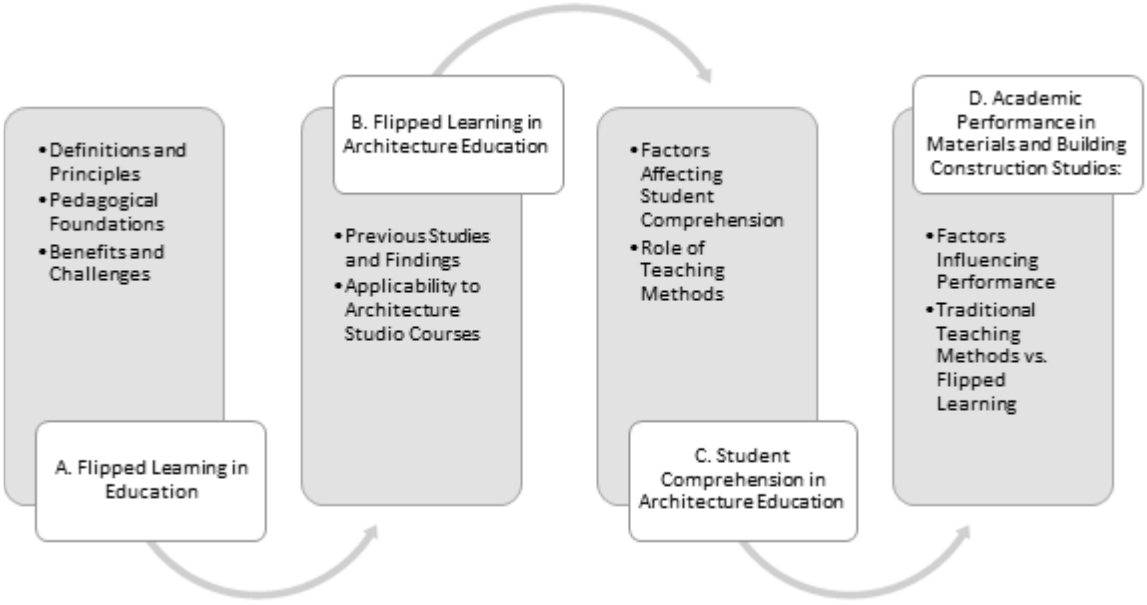

Figure 1: *Literature review flowchart (source: author)*

flipped learning is not only more effective on a general level, but also highlight the areas in which architecture's specific demands compel further investigation. Derived from available literature, this review aims at both showcasing the benefits of adopting the flipped learning model towards transformation of teaching studio-based courses while acknowledging its drawbacks – if any.

Research has proved that flipped learning has a lot of advantages in different disciplines of studying but architecture learning has its own difficulties, which must be investigated more thoroughly. It was also evident from Bredow et al. (2021) that whereas flipped learning improves understanding and students' participation, its impact on critical thinking varies with context, thus the necessity to introduce the context of architecture studios where critical thinking dominates. In order to make the reader appreciate the value of flipped learning particularly in architecture education it is crucial to discuss about the theoretical framework of flipped learning and how flipped learning has been practiced in other fields and the emerging area it deals with flipped architectural studios. To start this review, the authors provide an overview of the constructivist and active learning theories that govern flipped classroom and then discuss the opportunities and challenges of the flipped classroom in various contexts.

Definitions and Principles

Flipped learning, also referred to as the inverted classroom model, is a pedagogical approach where students engage with instructional content—typically through videos, readings, or tutorials—prior to attending class sessions (Bergmann & Sams, 2012). The class period is therefore allocated towards interactive student-centric learning strategies such as discussion, problem-solving, and group activities (Lage et al., 2000). This is to shift the focus away from passive absorption of information and onto active building of knowledge. With regard to construction and architecture learning, Mojtahedi et al. (2020) added that the flipped classroom builds students' ability to link theory to practice, thus improving experiential engagement. Flipped learning hinges around giving more control to the learner, with maximum utilization of the class period in high-level cognition and building abilities.

Pedagogical Foundations

Flipped learning is grounded primarily in constructivist theory and active learning pedagogy. Constructivism argues that students build new knowledge by integrating existing information with new experience, making learning an active and contextualized process (Prince, 2004). This theoretical model is particularly applicable to architectural education, where conceptual frameworks are continually tested through design iteration and critique cycles. Herreid and Schiller (2013) explain that flipped classrooms enable learner autonomy by requiring students to complete instructional content before class, so that class time can be devoted to participatory, experiential learning. Shaw and Patra (2022) argue that this instructional model is positively aligned to support a variety of cognitive states and inform individualized learning pathways—particularly critical in architecture studios, where students possess different levels of ability and creative strategies. Through enabling collaborative exploration of design challenges through class sessions, flipped learning enables a feedback-rich environment that mirrors the iterative nature of studio pedagogy.

Benefits and Challenges

Several studies demonstrate the benefits of flipped learning in creating active and independent learning environments. Bishop and Verleger (2013) found students enjoyed learning instructional content at their own time, thus developing customized learning and improved retention. Strayer (2012) underscored that flipped classrooms ensure higher engagement, cooperation, and problem-solving in classroom discussions. In construction education, Mojtahedi et al. (2020) posited that students enjoyed the independence provided by flipped learning, thus allowing them to learn complicated content confidently. Such approaches have also been linked with increased motivation, improved attendance, and

student satisfaction (Chen et al., 2017; Abeysekera & Dawson, 2015).

While it has its advantages, deployment of flipped learning is not without challenges. Disparities in access to digital content and high-speed internet restrict students' opportunities for preclass engagement with content, highlighting a persistent digital divide (Strayer, 2012). Further, maintaining student responsibility for preparation before class remains problematic, especially for students unfamiliar with independent study. Bredow et al. (2021) caution that the flip in pedagogical roles from instructor to facilitator may be difficult for veteran instructors not familiar with coping with open-ended learning processes—this difficulty may carry over to architectural educators as well, despite being familiar with studio critiques. For flipped learning to succeed in architectural education, both structural and cultural barriers must be addressed through intentional design and support.

B. Flipped Learning in Architecture Education

Previous Studies and Findings

Although flipped learning has expanded to various disciplines, its implementation within architecture education is an area of recent exploration. Tune et al. (2013) study occurred in a medical school that introduced an example of flipped methods and found beneficial results concerning student performance as well as engagement. Flipped learning in design studios has been researched by Hall (2016) being described as giving students flexibility, autonomy, and opportunities to explore deeper into concepts of designing. Mojtahedi et al. (2020) observed similar results in construction education, where flipped learning facilitated autonomy and critical thinking, indicating potential alignment with architecture's iterative studio process. In a course in architectural construction technology, Ransdell (2018) explored the application of flipped class within this forensic study and pointed out the presence of considerable effects on students' engagement. Milman (2012) observed increased students learning and participation during an architectural history classroom study when flipped learning was employed.

Relevance to the Architecture Studio Courses

Krause (2018) made sure the application of Flipped Learning only in construction studio sessions. They named the flipped model as enhancing the abilities of critical thinking and problem solving. Students in the study also valued opportunities to revisit content, and had high regard for the use of class time for collaborative design (Krause et al., 2018). This is supported by Shaw and Patra's (2022) argument about the flexibility to accommodate cognitive conversion in the flip technique, which would be of considerable benefits to architecture students by catering to different modes of cognition required in a design studio. Rudolph et al also pointed it out that in addition to 'lecturing' in the arch, lectures and active learning strategies are needed in architecture studios (Rudolph et al. 2017). Barman and Yun (2019) conducted a study about flipped learning in a design studio and found that students paid more attention to what they are learning, as well as seemed to have a better understanding of design.

In an architectural construction technology course, Ransdell (2018) examined the use of flipped class within this forensic study and indicated significant effects on student engagement. In an architectural history classroom study, Milman (2012) noted higher student engagement and understanding of historical concepts when flipped learning was used.

Applicability to Architecture Studio Courses

Krause (2018) checked the use of Flipped Learning simply in construction studio lessons. They focused on the flipped model as improving critical thinking and problem-solving skills. Students in the study appreciated being able to review information at their own pace and put a high value on using class time for collaborative design (Krause et al. 2018 This is further supported by Shaw and Patra (2022) who mention the potential of cognitive adaptation in flipped learning, a design studio

appropriateness that can cater to the different cognitive processing needs of architecture students. Rudolph et al. also shows that a blend of traditional lectures and more active learning in an architecture studio is required (Rudolph et al. 2017) A Barman and Yun (2019) are also among the ones who studed this method in a design studio setup to reveal not only enhanced engagement with subject material but a significant improved knowledge of design principles.

C. Student Comprehension in Architecture Education

Factors Affecting Student Comprehension

Multiple elements determine the comprehension abilities of students within architectural education. Students find hands-on activities together with practical theoretical applications vital for better understanding their lessons according to Brown and Green (2016). According to Kember students will learn better if instructors align teaching methods with individual learning preferences (Kember et al. 2006). The study from Mojtahedi et al. (2020) proves flipped learning helps students relate classroom theories to practical settings to boost their learning effectiveness in multi-dimensional abstract design fields. Aksamija (2014) demonstrated through research that digital technology delivers essential assistance to students' learning process and design thinking development. Roudsari investigated teaching methods through his research to understand design learning and discovered interactive and experiential approaches generate equivalent understanding of different designs (Roudsari et al. 2018).

Role of Teaching Methods

Rudolph described that an examination of teaching styles in architectural education focusing on a mix of classic lectures and more interactive approaches is essential. While studying complex architectural concepts, students' comprehension may be improved when active learning strategies are implemented (Turner & Ireland 2005). Ostwald later commented on the role of design studio pedagogy in building architectonic understanding and advocated an iterative process-driven approach (Ostwald 1997). As supported by Bredow et al. (2021), flipped learning could support iterative learning in architecture, reinforcing comprehension through hands-on engagement and feedback loops critical to the design process. Mallory-Hill studied the effect of different educational methods on architectural student achievement and found that theory must be combined with practical work to get a full understanding of design principles (Mallory-Hill et al. 2016).

D. Academic Performance in Materials and Building Construction Studios

Factors Influencing Performance

The elements that determine performance in materials and building construction studios are multifaceted. Prober and Heath (2012) emphasized the need for students to face real-world problems properly in order to improve their performance. According to Shih (2017), instructors are required to facilitate effective communication between the learners and themselves to enable group learning on a shared platform. Mojtahedi et al. (2020) found that flipped learning enhanced practical skills, supporting collaboration and active learning that could translate into higher performance in construction studios. Kilinc's study from the Department of Building Surveying at Istanbul Technical University (2015) examined how project-based learning affected students' performance in construction management classes with a positive impact. One of the strategies for improvement that has been proposed by La Roche (2002) is teaching theory and practice assimilated to each other to enhance student performance.

Traditional Teaching Methods vs. Flipped Learning

Mason discovered that flipped learning is more effective than traditional teaching methods in architectural education. According to Mason et al. (2013), flipped learning improves student performance by increasing face-to-face teaching discussions and individual engagement outside of class. In a civil engineering materials class, Jensen et al. (2015) found that flipped learning improved student

achievement. Various researchers conducted a study on flipped learning in a construction management course and found that students' understanding and performance increased (Chuang et al. 2016; Bettihavas et al. 2016). These findings echo the results of Mojtahedi et al. (2020), who observed significant performance gains in construction education when flipped learning was applied, attributing these improvements to the model's emphasis on real-world problem-solving and collaboration. This synergy between flipped learning and hands-on, project-based approaches aligns closely with the pedagogical needs of architecture studios.

But while these studies show that flipped learning can potentially deliver positive outcomes to different learning settings, they also show that the success of this model is dependent on discipline-specific needs, technology access, and teacher readiness. For architectural education, where the studio setting requires much guidance and ongoing design critique, it is crucial that the flipped model is properly adapted to maintain the integrity of the learning process.

In summary, while flipped learning shows promise in many areas of scholarship, its application in architecture, particularly in studio-based pedagogies, needs more empirical research. Empirical studies by Bredow et al. (2021), Mojtahedi et al. (2020), and Shaw & Patra (2022) recently highlight the promise of flipped learning as well as the challenge of applying it in settings that prioritize critical thinking, collaboration, and instant feedback. This current study aims to contribute to this body of knowledge by investigating the impact of flipped learning in particular in the context of architecture, filling gaps related to cognitive flexibility and collaborative engagement in studios. In fulfilling this aim, it will offer thoughtful insights towards how flipped learning can be applied to enhance the unique, practice-oriented learning experiences typical of architecture training.

III.Research Methodology

A. Research Design

Flipped learning's effectiveness in architectural education students' understanding and performance at materials and building construction studios was examined using a mixed-methods research design that combined quantitative and qualitative methods *(Creswell & Creswell, 2017).*

B. Population and Sample

The study included all third-year undergraduate students of architecture of batches 2022 and 2021, who were pursuing two sessions of the material and building construction studios in the Department of Architecture, National College of Arts, Rawalpindi. Both the populations of these two batches, i.e., 100 students, were included in the study to evaluate the impacts of flipped learning in the context of a studio.

A census method was used, with all students from the enrolled sessions. This method ensured that the study represented the experiences and outcomes of the cohort as a whole, including the diverse views and educational levels of the cohort. By researching all enrolled students, the study could provide an equitable assessment of the impact of flipped learning on architectural education here.

All the participants were briefed on the aims of the study and provided informed consent prior to data collection, ensuring compliance with ethical standards and encouraging transparency throughout the research process. This approach enables the findings to more accurately represent the overall target population, thus enhancing the strength and validity of conclusions on the effectiveness of flipped learning in this specific educational context.

C. Data Collection Instruments

Surveys

Quantitative data was gathered using a Likert scale survey to assess student knowledge, participation, and preferences for flipped learning. The survey instrument was in the format of closed-ended questions that yielded structured data amenable to quantitative

analysis and, in addition, open-ended questions amenable to qualitative analysis of student attitudes and experiences. The survey method conformed to the design set forth by Dillman, Smyth, & Christian (2014), and the design was well-suited to collect complex educational preference data in higher education settings.

Classroom Observations

To monitor student participation and engagement rates in real time, structured observation was carried out in the material and building construction studio classes. The process of data collection became easy with an elaborate observation check sheet, where particular indicators of participation and understanding were noted within the flipped class lessons. Several observations were undertaken over the span of six weeks, allowing deep insight into flipped learning's effects on classroom interaction (Emerson, Fretz, & Shaw, 2011). This ethnographic method provides depth descriptions that could be lost through quantitative data.

Student Interviews

Semi-structured interviews were also held with a representative sample of students to find out their experiences, concerns, and attitudes about the flipped learning model. Using the model developed by Rubin & Rubin (2011), interviews were used as a tool for students to explain concerns about understanding, engagement, and their general learning experiences. A purposive sampling technique was used to select 15 students for each session based on their different levels of performance to gain a diverse set of views.

Academic Performance Data

Objective performance measurements of academic outcomes in the form of grades and assessment scores were retrieved from institutional databases after proper permissions. The sample consisted of evaluations due to examination tests and project evaluation, thereby providing an appropriate comparison of student outcome between cohorts adopting flipped learning versus those exposed to traditional pedagogy (Miles, Huberman, & Saldaña, 2014). Pre- and post-intervention performance measurements were analyzed to determine the impact of flipped learning on academic outcomes.

D. Data Collection Procedure

Surveys

Surveys were distributed manually to participants. Participants were informed about the purpose of the survey and provided with clear instructions for completion. Survey responses were anonymized to ensure confidentiality

Classroom Observations

Observations were conducted during scheduled materials and building construction studio sessions. Observers used a predefined checklist to record observations. The duration and frequency of observations were systematically planned to capture a representative sample of class activities

Student Interviews

Participants were invited to voluntary interviews, and informed consent was obtained. Interviews were audio-recorded and transcribed for analysis. The interviews were conducted in a private and comfortable setting to encourage open and honest responses

Academic Performance Data

Academic performance data were collected from the institution's records with the consent of the participants. The data were securely stored and used solely for research purposes

E. Data Analysis:

Quantitative Analysis

Statistical analysis was conducted using SPSS to evaluate survey and academic performance data. Descriptive statistics provided a foundational overview of student responses and performance measures. To assess significant differences between the flipped learning and traditional teaching groups, independent samples t-tests were used at a significance level of $p < .05$, with a particular focus on comparing comprehension and critical thinking scores pre- and post-intervention (Field, 2013). This approach allowed for robust comparisons between groups, enabling the identification of

key trends and outcomes associated with flipped learning.

Qualitative Analysis

Thematic analysis, as outlined by Braun & Clarke (2006), was applied to the coded interview transcripts and observational notes. This process involved familiarization with the data, initial coding, and the development of themes related to comprehension, engagement, and flipped learning challenges. NVivo software facilitated the coding process, enhancing data organization and analysis. Themes were iteratively reviewed and refined, ensuring that they accurately captured recurring patterns and significant insights within the qualitative data.

Mixed Methods Analysis

To provide a comprehensive interpretation of the study findings, a mixed-methods approach was employed, integrating quantitative and qualitative data. Data triangulation was used to validate findings across surveys, interviews, and observational data, enhancing the study's reliability and validity (Creswell & Plano Clark, 2017). Qualitative insights were mapped against quantitative trends to enable a side-by-side comparison, which offered a nuanced understanding of how flipped learning influenced both cognitive and affective learning outcomes.

F**. Data Validity and Reliability: Triangulation**

A questionnaire, observation protocol sheet, interview guide questions, and students' academic performance records were used to triangulate data and improve study reliability and validity.

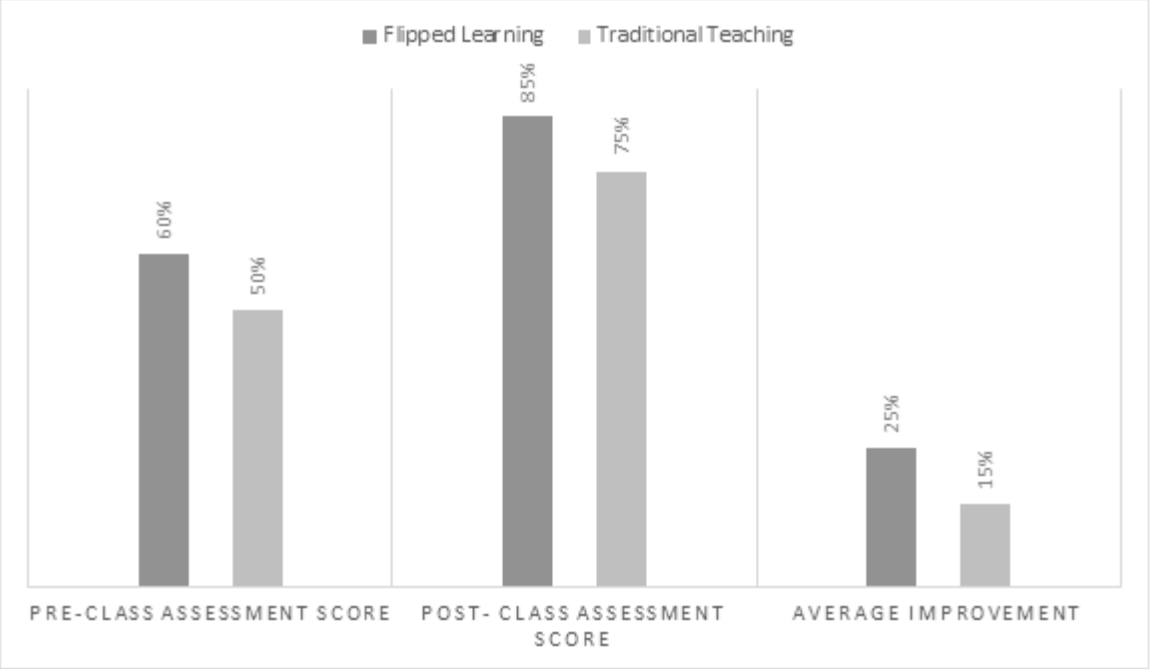

Figure 2: *Comprehension Improvement comparison (source: author generated)*

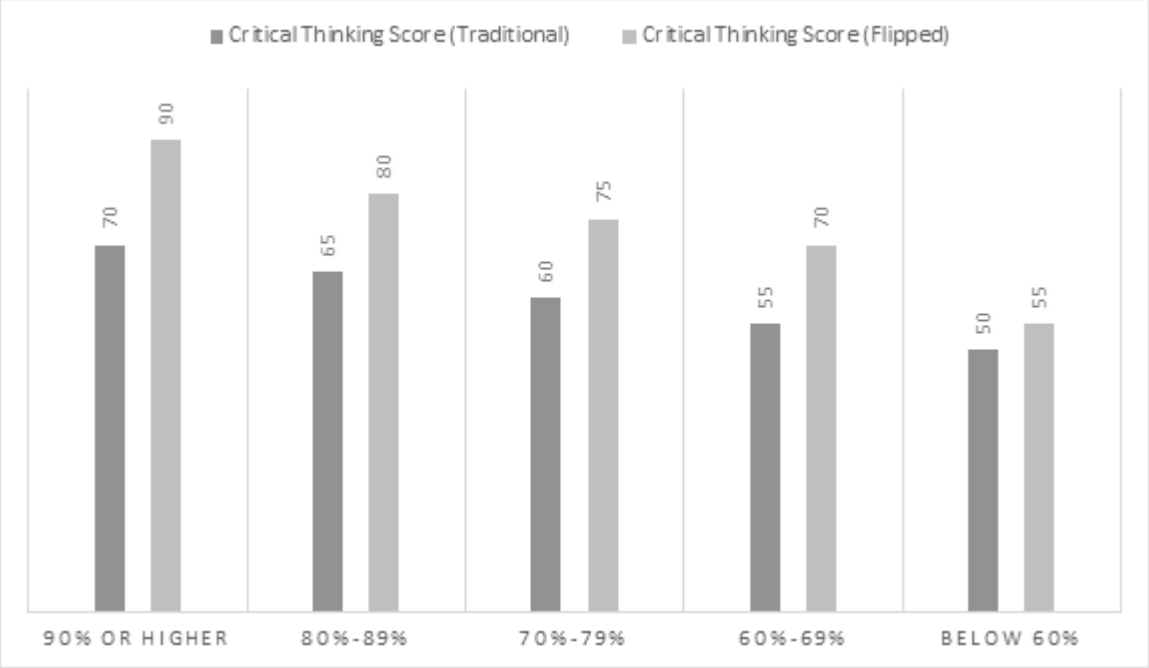

Figure 3: *Attendance wise Critical score comparison of traditional and flipped learning method (Source: author generated)*

IV. Findings

A. Student Comprehension Results:

Positive Impact on Understanding Concepts

Survey responses reflected across-the-board agreement on the influence of flipped learning in helping students to grasp material and construction concepts. Remarkably, 85% of those who took part said they had learned much more than with traditional teaching methods.

As illustrated in Figure 3, a bar chart comparing comprehension improvement percentages between flipped learning and traditional methods reveals a significant margin of improvement as compared to traditional teaching methods.

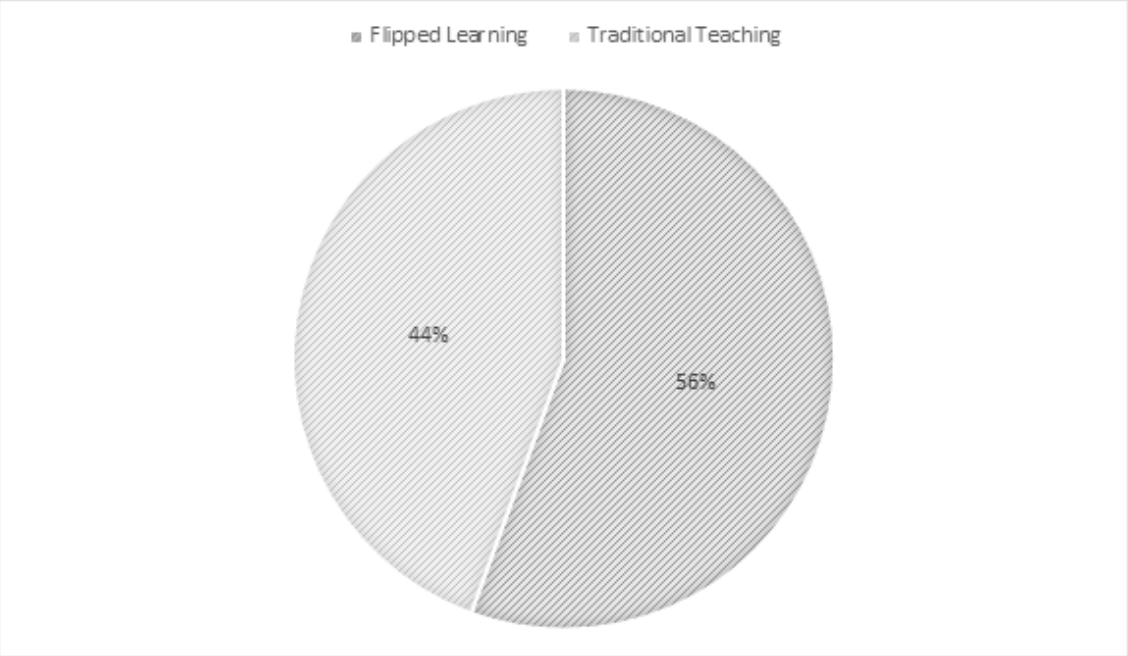

Figure 4: *Distribution of comprehension improvement (Source: author generated)*

Enhanced Engagement and Critical Thinking Skills:
Beyond traditional grading metrics, the incorporation of project process evaluations shed light on the development of critical thinking skills. Students engaged in flipped learning consistently demonstrated a deeper understanding of theoretical concepts, as evidenced by their ability to apply these concepts in practical design scenarios. Performance rubrics, which assessed analysis, evaluation, inference, and explanation, revealed a 20% increase in critical thinking scores compared to the control group.

A side-by-side comparison chart (Figure 4) displays critical thinking scores for both flipped and traditional learning groups with respective attendance percentages.

Problem solving, integration of knowledge and research ability:
Instructor observations during studio timings revealed a notable enhancement in problem-solving skills, integration of knowledge, and a research and inquiry mindset among students engaged in active learning compared to those passively listening to lectures. For instance, 85% of students participating in active learning sessions successfully identified and addressed design challenges creatively and effectively, while only 60% of passive learners demonstrated similar capabilities. Additionally, 90% of active learners integrated insights from various disciplines into their projects, compared to 65% of passive learners. Furthermore, 80% of students involved in hands-on projects and collaborative exercises exhibited a strong research and inquiry mindset, as opposed to 50% of those who primarily listened to lectures. These students consistently showed a proactive approach to learning, questioning assumptions, and exploring innovative ideas, resulting in a more dynamic and enriched educational experience.

Varied Impact Based on Prior Knowledge:
Further examination of survey data revealed interesting nuances. While the overall impact was positive, students with a stronger foundation in the subject matter, as evidenced by project process evaluations, seemed to derive slightly more benefit from flipped learning, showcasing a 12% higher comprehension improvement compared to their peers from previous batch.

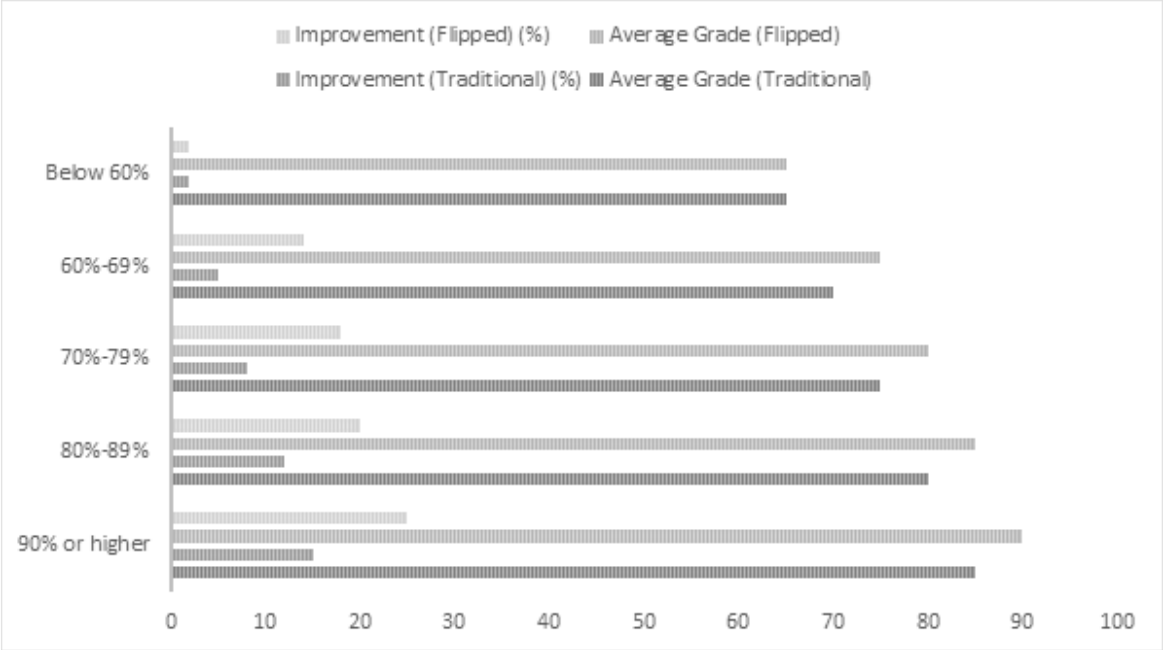

Figure 5: *Correlation between attendance and grades – a comparison of traditional and flipped learning method (Source: author generated)*

Figure 5 depicts a pie chart showcasing the distribution of comprehension improvements based on students' prior knowledge levels.

B. Student Performance Results:

Measurable Improvement in Academic Performance:

The academic performance data provided compelling evidence of the effectiveness of flipped learning. There was 83% increase in average class attendance during flipped learning studio sessions. A comparative analysis of attendance records and grades demonstrated a statistically significant correlation ($p < 0.05$) between consistent participation in flipped learning sessions and higher academic achievement. Students with an attendance rate of 90% or higher exhibited an average grade improvement of 15%.

The correlation between attendance rates and average grades is visually represented in Figure 6.

Instructor observations during studio timings revealed a significant improvement in portfolio quality among students participating in flipped learning compared to those in traditional lecture-based settings. Specifically, 80% of flipped learning students received positive employer reviews during their internship searches, while only 55% of their peers in traditional settings garnered similar feedback. Additionally, peer and faculty feedback during project displays highlighted that 85% of flipped learning participants produced portfolios that showcased a higher level of creativity, technical skill, and comprehensive design thinking, in contrast to 60% of students from traditional settings. By the end of the session, 90% of flipped learning students demonstrated a deeper understanding and more refined presentation of their projects, which was consistently recognized and praised by both their peers and faculty members. This approach fostered a more engaging and effective learning environment, resulting in higher quality work and better preparedness for professional challenges.

Figure 6: *Campus pictures from review day and exhibition (Source: author generated)*

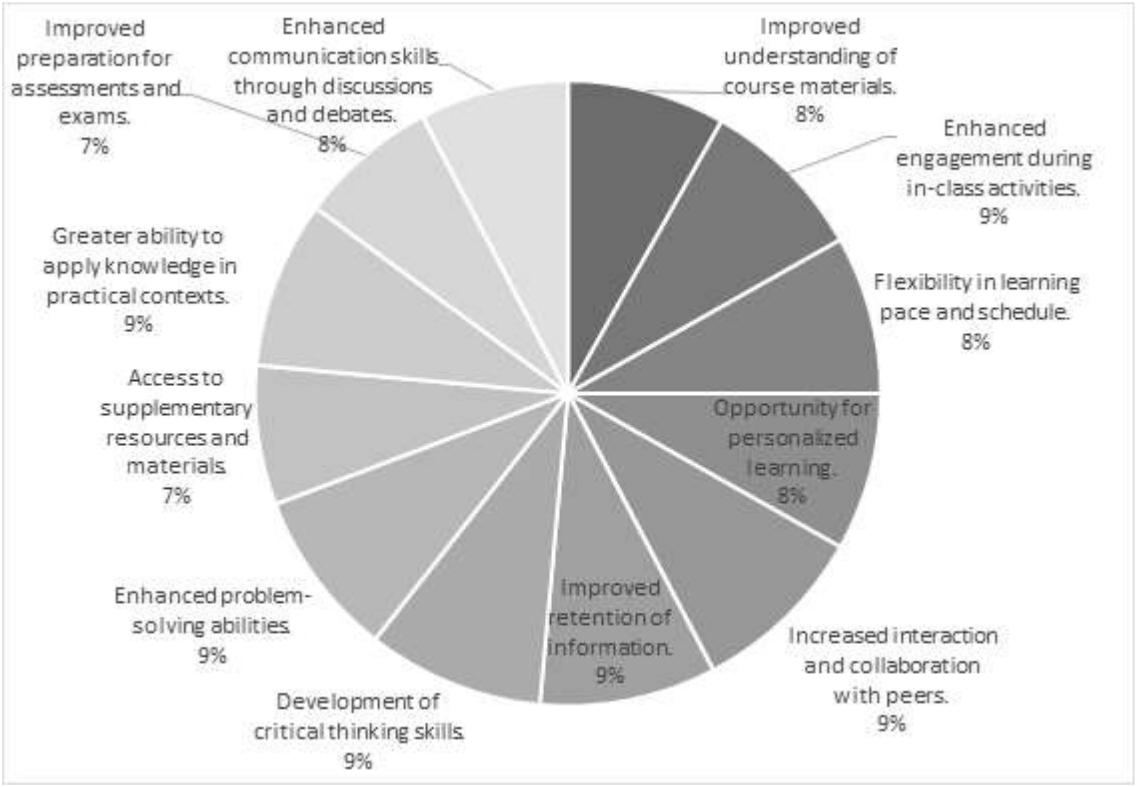

Figure 7: *Benefits of flipped learning method (source: author generated)*

C. Student perception:

Benefits of Flipped Learning:

The qualitative analysis of open-ended survey responses provided rich insights into the perceived benefits of flipped learning. Students appreciated the flexibility of reviewing materials at their own pace, as evidenced by the 95% completion rate of class assignments. The project process evaluations highlighted increased collaboration and peer-to-peer learning during in-class sessions, reinforcing the benefits of active engagement.

The percentage of students who found flipped learning beneficial for various aspects is highlighted in Figure 8.

Challenges and Considerations:

Key point on an average 12% of students expressed concerns which are as following:

V. Discussion

Interpretation of Findings

The findings of this study indicate that flipped learning can significantly enhance architecture students' engagement, comprehension, and performance in studio-based courses. The positive correlation between student attendance, active engagement with projects, and performance scores aligns with the pedagogical goals of the flipped classroom model, reinforcing its suitability for architecture education. By allowing students to engage with course content before class, flipped learning transforms in-class time into a platform for active, hands-on learning, which is essential in architectural education where practical application is critical.

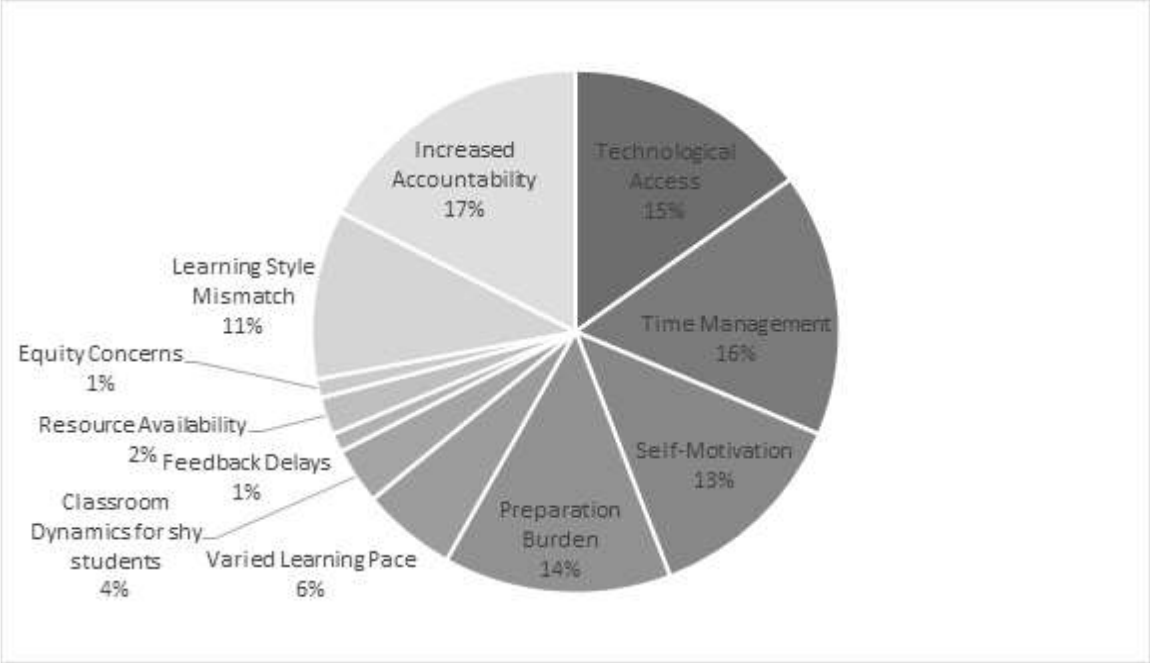

Figure 8: *Challenges of flipped learning method (Source: author generated)*

Implications for Architecture Education

The results indicate that flipped learning can be a valuable pedagogical tool in architecture education, especially in courses that demand the practical application of theoretical knowledge. In studio-based settings, where traditional lectures may limit students' active participation, flipped learning enables educators to optimize class time for skill-building exercises, design critiques, and peer learning.

1. Practical Applications for Curriculum Design

To implement flipped learning effectively in architecture curricula, educators should consider the following strategies:

- Maximize In-Class Time for Hands-On Activities: With pre-class materials covering foundational content, instructors can dedicate class time to activities that foster collaborative problem-solving and design iteration. For example, instead of lecturing on structural principles, class time can be used for students to apply these principles through model-building exercises or design challenges.
- Encourage Peer Learning: In flipped classrooms, students can benefit from peer discussions, where they critique each other's design concepts and share diverse perspectives. Such an approach not only improves critical thinking but also mirrors the collaborative nature of architectural practice.
- Provide Accessible Pre-Class Resources: It is crucial that pre-class materials are well-tailored to architecture students, incorporating interactive elements like virtual simulations, videos, or digital design tools that reflect real-world applications. These resources should be easily accessible, ensuring that students from diverse backgrounds can fully engage with the content.

2. Potential Barriers and Solutions

Despite its benefits, implementing flipped

learning in architecture education may present challenges:

- Technology Access: Not all students may have equal access to digital tools or high-speed internet, which can affect their ability to engage with pre-class materials. To mitigate this, institutions could provide on-campus facilities where students can access necessary technology, or offer downloadable resources that can be accessed offline.
- Student Preparedness for Self-Directed Learning: Some students may struggle with the shift to self-directed learning, especially if they are accustomed to lecture-based teaching. Educators could incorporate scaffolded support, such as periodic quizzes or short assignments to gauge pre-class preparation, and provide additional guidance to those who need it.

Future Directions for Research

While this study focused on materials and building construction studios, future research could explore the impact of flipped learning across other areas of architectural education, such as design studios, sustainability, or history courses, where different types of practical skills are emphasized. Longitudinal studies would also be valuable to examine the long-term effects of flipped learning on architecture students' skills development, particularly in areas like spatial reasoning, critical analysis, and design innovation.

Implications for Faculty Training and Development

Implementing flipped learning requires instructors to adopt a new role as facilitators rather than traditional lecturers. Professional development programs should be available to help faculty members gain proficiency in digital tools, active learning strategies, and flipped classroom facilitation. By equipping educators with these skills, institutions can ensure a smoother transition and greater success in implementing flipped learning models.

Addressing Research Questions

The research questions are explicitly addressed, demonstrating the tangible benefits of flipped learning as a pedagogical approach that not only enhances student comprehension but also

Table 1: *Visual summary (Source: author generated)*

1. Effect of Flipped Learning on Architecture Students' Comprehension	a. Impact on understanding materials and construction concepts vs. traditional methods	85% of participants reported a significant improvement in comprehension compared to traditional teaching methods.
	b. Variations based on prior knowledge and experience -	12% higher comprehension improvement
2. Impact on Student Performance in Materials and Building Construction Studios	a. Measurable impact on academic performance and grades	Students with an attendance rate of 90% or higher exhibited an average grade improvement of 15%.
	b. Contribution to engagement and critical thinking development	20% increase in critical thinking scores compared to the control group
3. Students' Perceptions and Experiences with Flipped Learning	a. Attitudes and preferences regarding flipped learning in studio courses	23% increased average attendance and participation
	b.Benefits	10 key benefits identified
	c. Challenges encountered	12 % students reported concerns
		11 key areas identified

improves academic performance and engagement. The project evaluations highlight the development of hard skills, such as technical drawing and construction knowledge, while also fostering soft skills like teamwork and self-regulation.

In Table 1, a visual summary is provided to encapsulate how each research question is addressed, offering a clear depiction of flipped learning's effectiveness in meeting the study's objectives.

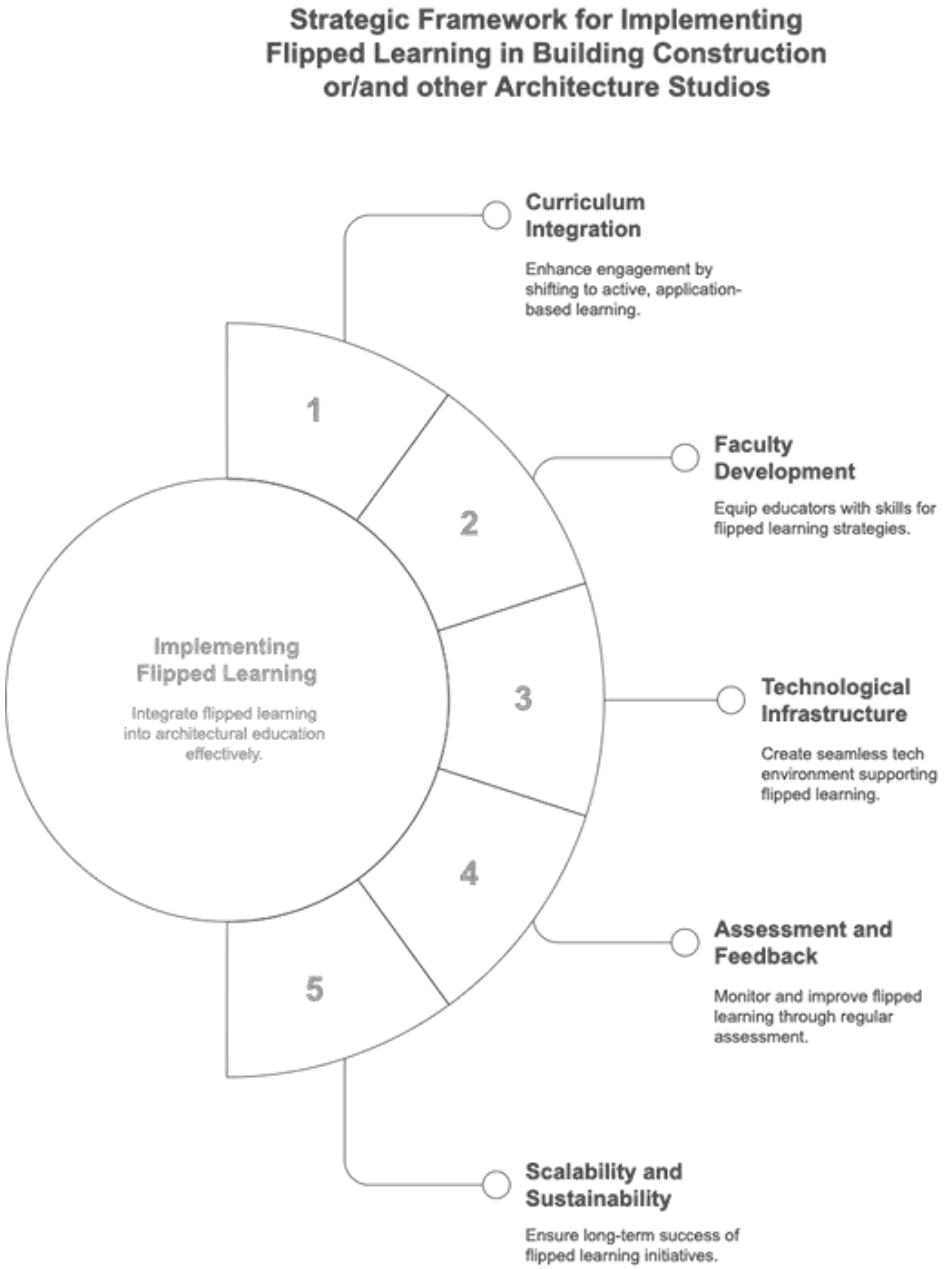

Figure 9: *Strategies for implementing FL in architecture*

VI. Conclusion

A. Summary of Key Findings

This study demonstrates that flipped learning significantly enhances architecture students' comprehension, engagement, and academic performance in studio-based courses. By leveraging pre-class content delivery, flipped learning frees in-class time for active, hands-on learning—a crucial element for architecture education that traditional lecture-based methods often overlook. The findings reveal an average improvement in student performance by 15% and a notable increase in critical thinking skills, highlighting flipped learning's potential to address the needs of today's tech-savvy architecture students.

B. Contribution to the Field

This research contributes to architectural education by showcasing flipped learning as an adaptable teaching method that aligns with the generational shift toward interactive and technology-integrated learning environments. The study not only bridges the gap between theoretical and practical knowledge but also addresses the need for new pedagogical approaches that cater to Gen Z and Millennial learners.

Furthermore, by examining flipped learning within a materials and building construction studio context, this study underscores the model's capacity to promote critical thinking, collaboration, and self-directed learning; skills that are essential for the evolving architectural profession. These insights can inform curriculum development and support architecture educators in creating more engaging and effective learning experiences.

C. Practical Recommendations for Curriculum Integration

To maximize the benefits of flipped learning, architectural curricula should incorporate this approach across diverse studio-based courses to guage its effectiveness for each course. Educators might consider developing accessible digital resources and pre-class assignments that allow students to familiarize themselves with core concepts.

To successfully implement flipped learning in architecture studios, institutions must begin by identifying courses where this model can bring meaningful improvement, such as construction technology or design studios. This involves reviewing existing curriculum structures and selecting content that can be converted into modular pre-class materials like video lectures or targeted readings. These materials should be carefully aligned with course objectives so that in-class time can be freed for interactive learning; discussions, critiques, and hands-on activities that reinforce concepts and encourage application.

Equally important is preparing faculty to shift from traditional lecturing to facilitating active learning. Workshops and collaborative planning sessions can help educators understand flipped learning methodologies and integrate digital tools effectively. Ongoing support should be available to address challenges and maintain consistency in delivery. This ensures the teaching staff are not only technically equipped but also confident in adapting to this evolving pedagogical model.

Technological support plays a foundational role. A reliable and user-friendly learning management system must be in place to host content and manage communication. It's also critical to ensure equitable access; students should not be disadvantaged due to lack of devices or internet connectivity. Institutions should provide alternatives or create support systems that remove such barriers. A responsive helpdesk is essential to resolve technical issues that might otherwise disrupt learning.

Monitoring student progress is key to sustaining quality. Formative assessments, such as pre-class quizzes or reflective tasks, help measure understanding, while peer review during studio sessions promotes collaborative thinking. Feedback from both students and faculty should be regularly collected and acted upon to refine the flipped model. This ensures that implementation remains adaptive and responsive to real needs.

Finally, starting with pilot programs allows educators to test and refine their approach before scaling. Once success is evident, resource allocation and supportive policies can help expand the model across more courses. With thoughtful planning, faculty engagement, and strong institutional backing, flipped learning can become a sustainable and transformative approach in architectural education.

D. Future Research Directions

While this study focuses on immediate impacts within a specific studio setting, future research should explore flipped learning across different architectural domains such as design theory, urban planning, or sustainable architecture. Longitudinal studies could provide deeper insights into the long-term effects of flipped learning on skill development, retention, and professional readiness.

Moreover, investigating the model's adaptability in varied cultural and institutional contexts could broaden its applicability. As architecture education continues to evolve, further research is essential to understand how flipped learning can be optimized to enhance cognitive engagement, foster innovation, and ultimately prepare students for the multifaceted demands of the architectural profession.

E. Concluding Remarks

Flipped learning, when contextually adapted, offers a transformative model for architecture education. It nurtures autonomous learning, critical engagement, and studio-based collaboration; cornerstones of professional readiness. By equipping both educators and learners with the tools and mindset needed, institutions can foster an education model that mirrors the dynamic, interdisciplinary, and problem-solving nature of architectural practice.

Notes: N/A
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A Review of Green Building Certification Systems through the Lens of Sustainable Architecture

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Abstract: Today, the building sector, with its investments, consumes 30–40% of the world's primary resources and is continuing to grow. Energy saving through energy efficiency in buildings has become essential globally. The construction industry has thus become a crucial element not only economically but also in terms of its significant environmental impacts. Therefore, recognizing various aspects of sustainability in green buildings is worth considering. The present study has been conducted using a descriptive and analytical method, relying on quantitative data and library research. First, the principles of sustainable buildings were thoroughly examined, followed by a review of various rating systems such as BREEAM, CASBEE, GBTool, U.S. Green Globes™, and LEED®.

It was found that the LEED rating system, compared to other systems, enjoys broader global acceptance. However, the research shows that each rating system reflects the policies and approaches of different countries regarding sustainability. Thus, the green building topic is a global issue that requires regional solutions. In fact, warming, climate change, and all environmental concerns confronting the world cannot be addressed with a single system. Instead, solutions must consider local conditions—not only primary climate characteristics but also regional policies. This paper aims to review and compare major green building certification systems from the perspective of sustainable architectural principles.

Keywords: Sustainable buildings, Green building rating systems, Environmental impact

Introduction

Buildings have a significant economic impact on society. They also account for a major portion of material and energy consumption and the production of greenhouse gases, both nationally and globally. Given these factors, the construction industry has received increasing attention from the standpoint of sustainable architecture. Sustainable buildings, which emphasize high energy efficiency, are a key component in the development of a sustainable and environmentally responsible future. Sustainability is a broad and complex concept that has become one of the most critical industrial issues. The ultimate goal of sustainability is to enhance quality of life. Consequently, those involved in the construction industry have paid more attention to controlling and mitigating environmental damage. Architects, designers, engineers, and other stakeholders in the building industry are increasingly seeking to reduce environmental impacts by implementing sustainability goals during various phases of a building project. Green certification systems aim to reduce environmental impact, including lowering

greenhouse gas emissions, minimizing water consumption, and promoting responsible material use . The green building movement, which focuses on energy efficiency and environmentally conscious design, has led to the development of green building certification systems such as LEED, established by the U.S. Green Building Council (USGBC) in 2008.

Previous studies show that no independent work has been conducted so far under this specific title in the field of architecture or visual arts. This study attempts to provide a resource by reviewing green building rating systems and identifying the general aspects and principles of sustainability in the construction industry. Green building is gaining momentum globally, as evidenced by rising LEED-certified square footage, increasing government incentives, and stronger public awareness of climate-resilient design. It aims to assist in the development of sustainable architecture and ensure that all steps of sustainable construction are based on reliable sources. While some research has been conducted in the area of rating systems, this study focuses on the principles of sustainable buildings and the dimensions of sustainability, as well as sustainability strategies and holistic approaches. A holistic approach in sustainable architecture refers to integrating environmental, social, and economic considerations into every phase of the building process—from site planning and design to construction, operation, and end-of-life reuse. Various rating systems have been fully explained. This research can serve as a comprehensive reference for individuals active in this field. Furthermore, this study answers the question: What are the dimensions of building sustainability and the strategies and methods for achieving sustainable buildings? In this regard, rating systems have been reviewed and analyzed. The study also clarifies which system is more applicable and flexible across different countries and explains the reasons for the effectiveness or limitations of each rating system.

The LEED system provides strategic guidance for the design and construction of sustainable buildings, awarding certification to projects that achieve specific sustainability goals. The main reason for using such strategies is to turn sustainability objectives into clear and actionable steps. Even if a new project does not fully align with these strategies, tools like BREEAM and BEES have been developed to evaluate environmental and economic performance. These systems continue to evolve and expand, aiming to integrate sustainability goals more comprehensively into building design, energy use, and environmental impact.
Recent studies further reinforce these sustainability goals by examining the integration of smart systems, materials, and data-driven environmental analysis into building design. For instance, Shafa's research (Shafa,2024(a)) on smart building design factors underscores the significance of efficient energy management systems and renewable resources in shaping intelligent, responsive environments. Her complementary work on smart materials (Shafa,2024(b);Shafa,2025), including ETFE and phase change materials (PCMs), demonstrates how innovative materials can enhance energy performance, comfort, and environmental adaptability—key qualities emphasized in sustainable architecture. Moreover, the integration of machine learning-based drought classification models into environmental assessments offers a new layer of intelligence in site planning and geotechnical analysis (Saghaei, 2025). These contributions align with the broader objectives of sustainable construction by turning abstract sustainability principles into practical, locally responsive design strategies that inform material choices, energy use, and environmental planning.

The main objective of sustainable buildings is to minimize their effect on human health and the environment through efficient use of energy, water, and materials. Green building certification systems like LEED help raise awareness among designers and developers and serve as effective marketing tools to meet client expectations and economic demands. However, some researchers believe that due to various regional needs and environmental factors, a one-size-fits-all certification system is not ideal. Instead, alternative systems or localized

adjustments to LEED could better address specific environmental conditions.

1. Principles of Sustainable Buildings

It is estimated that by the year 2056, global economic activity must increase fivefold, while the world population is expected to grow by more than 50%. Consequently, global energy consumption must nearly double, and global production activity must at least triple (Matthews, 2000). The building sector is undoubtedly one of the most energy-intensive sectors at the global level. Compared to other sectors, the building industry is rapidly growing in terms of energy consumption and the use of fossil fuel resources. This issue is currently a major concern due to problems such as the depletion and limited availability of fossil fuels, emission of pollutants like carbon dioxide, global warming, and environmental changes (Ilha, 2009).

Since 1990, the production of building materials has increasingly consumed energy. During the construction phase, buildings consume a significant amount of energy for production, transportation, and lighting. Furthermore, during operation, energy consumption continues. Therefore, the building sector is considered a major contributor to environmental pollution (Kukadia, 2004).

Table 1: *Issues Related to Sustainable Buildings*

Title	Main Topic	Main Issues
Economic Sustainability	Maintaining a high and sustainable level of economic growth and local employment Project improvement and delivery Increasing profitability and efficiency	Improving productivity; sustainable profit growth; employee satisfaction; customer satisfaction by minimizing defects, reducing completion time, and providing cost-effective and efficient services that deliver customer value; emphasis on customer-oriented commerce and joint development.
Environmental Sustainability	Effective protection of the environment Pollution prevention Conservation and strengthening of biodiversity Transportation planning	Minimizing pollutant emissions; preventing disturbances from noise, dust, and improper storage and management of materials and waste; removing pollutants and avoiding environmental damage; creating health and environmental systems; establishing protective and sensitive environmental monitoring systems; green transportation planning; and integrating commercial activities with environmental concerns.
Energy Sustainability	Conservative use of natural resources Improved energy efficiency Efficient resource use	From an energy consumption perspective, reducing energy usage in warehouses and sites; using local materials; designing for longevity and reusability; using recyclable and reusable products; reducing water consumption and

		improving water use efficiency; applying design and construction strategies that lower operational and life-cycle energy costs.
Social Sustainability	Social advancement that meets everyone's needs Respect for workers Cooperation with local communities and road users Participation	Providing education and effective communication; enabling tools for public participation; preserving public comfort and safety; minimizing traffic disturbances and maintaining communication; supporting the local economy and job creation; strengthening local culture and heritage; and creating relationships based on energy value to develop commerce focused on shared customer interests.

The sustainable building approach is considered a path for the construction industry that, by taking into account environmental, social, and economic issues, can lead development toward sustainability. As shown in Table (1), this direction is clearly illustrated. These factors serve as a roadmap for outlining the industry's responsibility in protecting the environment (Ofori, 1998; Shen et al., 2010).

2. Strategies for Constructing Sustainable Buildings

Greater use of renewable resources in buildings

There is a need to use more renewable energy sources to achieve higher electricity generation. This is one of the most important and fundamental steps toward the adoption of renewable energy. Utilizing natural resources efficiently not only meets human needs more effectively but also helps establish a balance between human demands and optimal resource usage, minimizing harm to the environment. The use of renewable energy itself is a core principle of environmental sustainability (Good et al., 2015).

Figure 1: *Solar-powered building at the University of Science and Industry of Iran*

- **Use of natural and local materials**
  Natural materials are renewable, require less processing, and cause less environmental harm. When natural materials are used in construction, they are more likely to be sustainable products. Locally produced materials help reduce environmental loads; as a result, transportation is reduced, which significantly lowers air pollution (Cabeza et al., 2014).

- **Increasing the durability of materials and components in construction**

  Today, synthetic materials are less durable than natural materials, which have greater strength and higher resistance under harsh environmental conditions. A strong and durable structure must be built with a proper understanding of materials and their characteristics. If unsuitable materials are used, the lifespan of the building is reduced and the structure will be damaged in the short term (Cabeza et al., 2014).
- **Considering material life-cycle in construction**

  The construction industry is one of the largest producers of waste. Environmental, social, and economic problems, along with unwanted materials and increased costs, have made waste reduction essential. Waste in residential construction can be significantly reduced by using recyclable materials (Akadiri et al.(a), 2012).
- **Reusing recycled materials** (Prior recycling in buildings)

  Recycling is essential from an environmental perspective. If the fuel used in recyclable materials and their transportation is compatible, it will reduce emissions. Recycling building materials on-site is ideal; however, if unavoidable, off-site recycling should be considered (Gu et al., 2007).

  Waste has been called "black gold" due to its high potential for energy generation. The materials in waste can be burned to produce heat energy. This thermal energy can be used to boil water and create steam and pressure to turn turbines and generate electricity. Moreover, burying waste can also yield a reasonable amount of biogas for industrial applications.
- **Resource Conservation** (Reducing Resource Consumption)

  Using natural resources in a way that provides maximum benefit for current generations while preserving their capacity for future generations is essential. Protecting renewable resources plays a significant role in building projects. Sustainable development relies on proper energy management of resources such as water. Energy production from water, extraction of raw materials, and other processes can result in environmental damage and pollution. Additionally, construction and product manufacturing and transportation generate air pollutants like sulfur dioxide, acid rain, and smoke (Akbari et al.(b), 2010).

Air pollution not only lowers air quality but also negatively impacts human health (Cabeza et al., 2014). Reducing air pollution ensures cleaner air for employees, residents near service locations, and workers. Using appealing and shaded pedestrian paths encourages people to walk or bike, improving health while also reducing fuel consumption. Therefore, designing energy-efficient transport systems helps improve air quality and reduce noise and vibration. Using eco-friendly public transport systems plays a vital role. If cities offer well-developed public transport, reliance on private vehicles will drop to a minimal level.

To encourage sustainable road construction, the use of electric or hybrid vehicles must be prioritized, as well as strategies to reduce traffic congestion and air pollution (Akbari et al. (b), 2010).

The principles of sustainable development in the environment have encouraged researchers to focus more on efficient buildings. As a key factor, the building's facade plays a vital role in protecting indoor environments and regulating the interaction between indoor and outdoor spaces. However, conventional building facades can lead to low natural ventilation, insufficient daylight, and poor thermal comfort, which can result in increased energy consumption. These issues are often significant in modern spaces with large glass surfaces. Glass causes excessive sunlight absorption, leading to high heat and increased energy use for cooling (Shameri et al., 2011). In contrast, proper thermal insulation of walls and facades significantly reduces energy consumption.

Therefore, the building facade is considered an effective solution to improve indoor-outdoor

Table 2: *Sustainability Rating Systems (Source: Fowler et al., 2006)*

Number	Name
1	BREEAM (Building Research Establishment's Environmental Assessment Method)
2	CASBEE (Comprehensive Assessment System for Building Environmental Efficiency)
3	GBTool
4	Green Globes™ U.S.
5	LEED® (Leadership in Energy and Environmental Design)

interaction and energy management (Peng et al., 2013). These two aspects must be properly designed to achieve optimal interaction between the interior space and external environmental conditions. The amount of energy stored depends on the façade's design and material selection (Gratia et al., 2004).

3. Evaluation of Green Building Rating Systems Based on GSA

Among green building rating systems and sustainable design tools, there is a package known as GSA that includes effective technical criteria for building design. In this section, a classification of sustainable building rating systems based on U.S. federal drivers and GSA is presented, as detailed in Table (2).

GSA has identified that rating systems must consider the following elements:

- A system applicable to large-scale and complex federal buildings.
- A sustainability rating system that evaluates building performance without being overly sensitive to fluctuations.
- A system that tracks quantitative achievements in sustainable design.
- A third-party evaluation by an approved, independent assessor.
- A system that is currently recognized and used in the marketplace.

Further explanations about how sustainable building rating systems operate are provided in Table (3).

Table 3: *Characteristics of Sustainable Building Rating Systems by Source Systems*

No.	Rating System	Description
1	BREEAM	• Has a long history in the UK • Widely used in the UK • Not widely used by U.S. design professionals • Can be used for all types of GSA projects • Requires annual licensing • Not freely available for public purchase • Must be purchased through a licensed distributor • More professionals are familiar with sustainable design through BREEAM • Many sustainability systems have used BREEAM as their base model
2	CASBEE	• A relatively new system • Targeted for Japanese market,

		mostly in Japanese • Not widely used in the U.S. • Cannot be used for most GSA projects or unique U.S. buildings • Training required by Japanese specialists • Each level of the system must be learned separately • Not available in the U.S. market
3	GBTool	• A flexible system to evaluate environmental performance of buildings • Referred to in GSA project evaluations • Suitable for many project types, though butanent (local adaptation) is needed • Not widely available in the U.S. market
4	Green Globes™ U.S.	• Derived from Green Globes Canada in 2004 • Currently being customized for GSA project evaluation in the U.S. Information related to the design and construction of sustainable buildings for individual certification is submitted online through a certified green design plan and reviewed and approved by Green Globes experts. The **Green Globes™ US** rating system is generally not consistently available online. The official online version of the system was also not publicly accessible during the evaluation period. Although in recent years there has been extensive advertising about **Green Globes™ US**, particularly with the **Green Building Initiative**, and despite the promise of providing services, it has only registered 63 green-rated buildings. This suggests that its broader adoption may require further future development.
5	**LEED**	LEED® is currently the most widely used system in the U.S. and globally.

		With numerous markets around the world aligned, **LEED® rating systems** are currently available for use and applicable to all types of buildings and GSA projects. All major guides including **Product Development and Maintenance** are publicly available. The application of LEED® is straightforward, and its rating system is clear. At every development stage, from product selection to green building certification, **LEED®** provides defined steps and documentation. The U.S. Green Building Council (USGBC) oversees the process and ensures quality control. The registration system is clearly defined and publicly accessible. Each version of **LEED®** is updated approximately every 3 to 5 years. Users are informed of the release of new versions in advance, which gives them time to transition and adapt. Additionally, detailed guides for design, certification, and personal project certification are provided. With the development of the **LEED Online** tool by the USGBC, LEED® continues to expand and facilitate sustainable building certification processes. More than 400 LEED®-certified buildings currently exist in the U.S., and over 3,400 buildings have been registered for LEED certification.

Based on Table (3), which outlines the characteristics of sustainable building rating systems, the LEED® system is considered superior to other systems. Moreover, it currently dominates the U.S. market and has been widely accepted. In fact, as of 2024, there are over 195,000 LEED-certified projects across 186 countries, encompassing more than 29 billion square feet of certified space (USGBC, 2024). Below, we further elaborate on the advantages and significance of the LEED® rating system.

This study also attempts to compare the strengths and weaknesses of green building rating systems, especially in the context of information transparency, ongoing updates, and widespread accessibility.

Starting in the 1980s, with the expansion of environmental standards and global agreements such as the Kyoto Protocol, green building guidelines and certification systems were introduced in many countries. These systems aim to provide a clear roadmap and transparent process for developers and customers by respecting the environment and minimizing harmful impacts.

Project managers and developers now have the opportunity and time to improve their designs and follow the certification process, which ultimately leads to customer satisfaction. The transparency of these systems allows individuals to evaluate themselves and ensure that they are progressing toward sustainable goals. Such systems also help contractors communicate with clients and differentiate their services from others in the market. For instance, the LEED certification process allows for an online submission and review platform, which facilitates energy-efficient construction with minimal paperwork and supports environmentally conscious development.

Table (4) outlines the reasons various countries adopt and apply different rating systems.

***Table 4**: Countries' Approaches Toward Utilizing Rating Systems for Green Buildings*

No.	Country	Approach / Description
1	France	Reducing greenhouse gas emissions by protecting the environment and encouraging public participation. Part of the legislation requires that buildings consuming more than 472 kWh/m² (mainly non-residential buildings) be limited. Additionally, a fourth of the emissions must be reduced, and a priority is set for reducing energy consumption.
2	Scandinavian Countries	Focusing on renewable energies due to the limited global reserves of fossil fuels and their high environmental impact. Since September 2002, all housing-related construction projects must be registered with ART to comply with thermal regulations (RT 2000). These regulations cover all housing projects, including new and replacement buildings (residential and non-residential), and stipulate that the maximum energy consumption must not exceed 75 kWh/m². The goal is to gradually reduce the annual allowable energy use. New standards and building classifications have been introduced to encourage the construction of buildings that

		consume less energy and produce lower emissions. By 2020, new regulations require that all new buildings be nearly zero-energy and include renewable energy use. Norway has gone further by requiring public buildings to meet energy performance standards at least 50% better than the baseline requirement.
	Sweden	From an energy consumption perspective, like other European countries, Sweden complies with EU directives concerning building energy performance and aims to establish the necessary infrastructure for renewable energy and energy efficiency. The Energy Declaration Act of 2006 (SFS 2006:985) mandates the creation of an energy certificate for every building. This system allows for practical analysis of actual energy use and provides an opportunity to evaluate energy-saving measures. Due to the importance of sustainable housing development, the Swedish government has taken steps to promote green building practices. For example, financial incentives are offered to investors and developers for reducing CO_2 emissions. If a building's energy performance exceeds baseline standards, it will be eligible for government support. The goal of these programs is to gradually increase investment in energy-efficient residential buildings.
Denmark	Denmark's government acknowledges that buildings in a single energy zone may differ from those in various climate zones, which is why buildings often have very long lifespans. Denmark is one of the pioneers of green construction, where buildings around the world are often evaluated with Denmark's green standards. Therefore,	

	sustainability standards are emphasized in Danish construction. Denmark has launched the DGNB certification system to evaluate sustainability. Denmark has localized and adapted the international DGNB system to fit its own context. The country also uses its national DGNB license and adjusts the assessment criteria to match local environmental, social, and economic conditions. Denmark also issues building permits only for projects that meet at least the silver level of the DGNB rating.	
	Norway	The Norwegian Green Building Council has decided to develop **BREEAM-NOR**, an energy-efficient localized version of the UK-based **BREEAM** system to enhance compatibility with local environmental conditions. BREEAM is one of the most widely used and comprehensive building rating systems globally. Established in 1990 by **BRE Global**, BREEAM provides independent, third-party certification services. BREEAM performance evaluation tools are widely used for energy-efficient building design. These tools assess a building's energy and water consumption, indoor environment quality, transportation, materials, waste, land use, and pollution. The trusted BREEAM rating system continues to play a special role in evaluating sustainability.

4. Analysis of Green Building Rating Systems with a Sustainable Architecture Approach

The findings of this study indicate that sustainable building principles are directly tied to sustainable architecture. Emphasizing this connection, the research aims to identify how a sustainable building functions as a comprehensive system—one that should not only be economically viable (i.e., profitable and efficient), but also environmentally conscious to prevent pollution, and socially responsible to enhance community well-being.

In the next section of this study, sustainable building strategies such as use of renewable resources, recycled materials, and locally sourced materials will be evaluated. This is done in order to understand how these strategies improve energy efficiency, increase building lifespan, and reduce dependence on non-renewable materials in construction.

In addition, the research highlights the role of reusing construction materials (recycling from existing buildings), resource conservation, and use of renewable energy sources in sustainable construction. The study aligns with previous social research that supports the need for renewable energy and environmentally friendly solutions. Strategies such as minimizing construction waste, using recycled or natural materials, and increasing durability are considered essential for reducing pollution and addressing environmental concerns.

In this study, the rating systems examined included BREEAM, CASBEE, GBTool, Green Globes™ U.S., and LEED. Among these, LEED has been identified as one of the best green building rating systems, widely accepted and used in the United States. Many researchers and experts believe that LEED is one of the most successful systems currently available.

The development and success of the LEED system began in the United States but quickly gained global traction through its structured design methods, user-friendly interface, and comprehensive criteria. As a result, it has been used in numerous international and national projects, including significant developments in the Middle East. The World Green Building Trends 2016 report confirms LEED's influence and expanding use.

Over the past few years, the number of LEED-certified projects and buildings has increased significantly, showing that LEED, due to its comprehensive criteria and adaptability to local contexts, is a highly suitable model for sustainable design and construction and continues to grow.

Conclusion

In this study, building sustainability factors were fully examined. The research identified 7 key sustainability factors based on previous articles and scientific studies. Then, five different international green building rating systems were compared.

The results indicate that the LEED system is the most comprehensive and widely accepted both globally and across most countries.

Sustainable development and green building construction are global issues that require region-specific solutions. If the environmental problems like global warming continue, we need global strategies that also consider the unique conditions of each continent and region. Therefore, the path to sustainable development must include the characteristics of local climates and natural materials. In this context, governments should provide opportunities and responsibilities to local companies to align green building solutions with local realities. If local companies are unable to meet green building standards, they should be encouraged and supported through licensing systems or other incentives. Countries that export building products must adapt their standards to the markets they target. For example, BREEAM in the UK or LEED in Europe are among the most commonly used green building standards. Due to the global evolution of green construction, these countries have created green building systems that have evolved over several decades and align with their own local regulations. As such, each country should adopt or develop a sustainable green building system that reflects both international best practices and local regulations.

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Interior Design in the Age of Digital Addiction: The Role of Digital Detox Spaces

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Abstract: Digital addiction has become an unavoidable reality of modern life. The excessive use of technological devices can adversely affect individuals' mental, emotional, and physical well-being. In this context, the concept of digital detox emerges as a crucial process that allows individuals to temporarily disconnect from technology in order to enhance their awareness and support their psychological wellness.

Interior design plays a pivotal role in optimizing the digital detox experience. In particular, the minimalist design approach characterized by simplicity, functionality, and the elimination of superfluous stimuli can reduce cognitive load and promote a sense of calm and relaxation. Additionally, the integration of natural elements serves to reinforce individuals' connection to nature while contributing to a reduction in stress levels.

This study aims to examine the influence of minimalist and nature-based approaches in the design of digital detox spaces. The research addresses the causes of digital addiction and its detrimental effects on individuals, subsequently exploring how minimalist design principles, natural components, and sensory equilibrium can enhance the effectiveness of the digital detox process.

The findings demonstrate that minimalist and nature-oriented interior design strategies support individuals' digital detox experiences by fostering psychological and physiological relief. This study aspires to serve as a guiding reference in the future development of digital detox environments.

Keywords: Digital addiction, Digital detox, Interior space design, Sensory design, Well-being, Spatial experience

Introduction

The most defining characteristic of the 21st century is the pervasive influence of digital technologies on all aspects of life. From the moment we wake up, we step into a digital realm: the day begins with checking the time on smartphones and continues with social media notifications, emails and news feeds. Throughout the day, we access information, communicate, work and even attempt to relax via screens. Although this state of constant connectivity initially appears beneficial, over time it has started to adversely affect individuals' mental, physical, and social balance. By nature, human beings need periods of silence, solitude, contact with nature, and an inner equilibrium. However, today's digital order neglects these needs and constructs a system that poses a threat to both the mental and physical well-being of the individual. Consequently, conscious disengagements from the digital world are no longer a luxury, but a

necessity for a healthy life. (Collins & Halverson, 2010; Sagbas, 2001).

Digital addiction is one of the most serious problems faced by contemporary individuals. Particularly common among younger age groups, this condition is characterized by an uncontrolled increase in the time spent in front of screens. The use of digital devices is no longer limited to work or school; people also turn to them during leisure time, weakening their ties with the real world. Symptoms of addiction include reduced social interactions, feelings of loneliness, attention disorders, anxiety, depression, and physical health problems (Kılıç et al., 2017; Weinstein et al., 2014). Digital platforms are filled with stimuli that constantly capture users' attention: colorful icons, endlessly scrollable pages, notifications, and instant messages. These design strategies encourage users to stay online, unintentionally leading to mental fatigue and burnout. Digital addiction is no longer just a habit; it is recognized as a form of dependency that requires professional intervention a problem that reduces quality of life, diminishes productivity, and disrupts psychological balance. (Becan & Eaghanioskoui, 2019; Keskin et al., 2018).

As the pressure of digital addiction on individuals intensifies, new pursuits have emerged to counterbalance this burden. One such pursuit is the concept of a "digital detox." A digital detox refers to a period during which an individual deliberately refrains from using digital devices, allowing both mental and physical recuperation. The duration of a detox can vary from person to person; while some find a few hours sufficient, others may require several days or even weeks of digital cleansing. The crucial aspect is that this process should be consciously planned and turned into sustainable habits. (Enli, n.d.; Genuis et al., 2013; Mirbabaie et al., 2022). The benefits of a digital detox are multifaceted: increased attention span, improved social interactions, better sleep quality, enhanced creative thinking skills, and reduced overall stress levels. All of these indicate that as individuals' distance themselves from the digital realm, they can reconnect with their inner world and establish a healthier relationship with real life. This demonstrates that a digital detox is not merely a temporary relief, but a holistic recovery process (Becan & Eaghanioskoui, 2019; Dragano & Lunau, 2020; Miksch & Schulz, 2018; Syvertsen & Enli, 2019).

One of the prominent approaches for supporting interior spaces during the digital detox process is minimalism. Minimalism is not merely an aesthetic preference, but a form of mental, emotional, and even spiritual cleansing. Spaces stripped of unnecessary details, designed with simplicity and functionality, eliminate distractions and contribute to mental clarity. Environments filled with clutter, complex color schemes, and chaotic arrangements often induce a sense of mental disorder. In contrast, a minimalist space offers the user a feeling of calm and clarity. From an interior architecture perspective, this is not only about organizing physical space but also about guiding the user toward inner peace. The emotional connection established through a few yet meaningful objects transforms the space from a utilitarian setting into a healing environment. Time spent in a minimalist setting helps individuals become more aware of their digital habits, listen to their inner voice, and focus their attention on the present moment. In this context, minimalism transcends being a mere design style and emerges as a philosophy of life (Anandpara et al., 2024; Gumber, 2023).

Although digital detox is often perceived as a short-term disconnection, under the right conditions, it can create lasting awareness.This awareness arises not solely from the absence of devices, but also from the internal transformation experienced during the process. Interior architecture provides the spatial infrastructure for this transformation. A well-designed digital detox environment offers a platform for individuals to hear their own thoughts and reconnect with their inner self (Anandpara et al., 2024). This reconnection fosters critical reflection on one's relationship with technology, promotes reconsideration of digital habits, and encourages the cultivation of a more balanced lifestyle. Such lasting

awareness is only possible through a holistic experience—an environment enriched with sensory stimuli, integrated with nature, and shaped by tranquility and simplicity. Here, design assumes not only a formal but also an ethical, psychological, and cultural role. Digital detox, through this conscious spatial interaction, evolves from a mere cleanse into a transformative lifestyle shift ("Health and wellness resort," 2020; Horuz, 2021; Oduncu, 2021; Salam, 2020).

In light of the discussion above, digital detox spaces are emerging as a new and dynamic field within the practice of interior architecture.This field should be approached not only with aesthetic concerns, but also with a holistic focus on the mental, emotional, and physical well-being of the individual. The interior designer is no longer merely someone who organizes physical space; they are transforming into an expert who curates user experience, shapes mood, and fosters awareness. Digital detox spaces can be designed in public areas, hotels, work environments, or private residences. Each scenario demands specific strategies tailored to diverse needs and user profiles. However, a common thread in all these cases is the necessity to relieve individuals from digital burdens and reconnect them with nature, their bodies, and their minds. Spatial solutions developed to meet this need further highlight the human-centered dimension of interior architecture. In the digital age, design should not only embrace technology but also ensure a balance in response to it. This study aims to contribute to this new orientation within the field of interior architecture.

Aim and Scope of the Study

The primary aim of this study is to examine the influence of minimalist and nature-based approaches in the design of digital detox spaces within the context of interior architecture. As digital dependency continues to grow, so does the need for physical environments where individuals can disconnect from technology in order to maintain a healthy lifestyle. By addressing this need, interior designers can create functional and aesthetically pleasing spaces that support the process of digital detox. Within this framework, the study seeks to answer the following research questions:

- How does a minimalist approach in interior design support the digital detox experience?
- In what ways do natural elements contribute to spatial relaxation and mental restoration?
- How should material selection, color schemes, lighting, and spatial organization be addressed in the design of digital detox spaces?
- What design approaches are adopted by digital detox spaces in different countries?

This study explores concepts unique to the discipline of interior architecture, such as minimalist design principles, biophilic design elements, and sensory equilibrium. Furthermore, by investigating the psychological and physiological impacts of digital detox spaces on users, the research offers practical recommendations for future interior design projects.

Method

This research was conducted using qualitative research methods and structured specifically on the basis of descriptive analysis model. For the purpose of the study, the interaction between the concept of digital detox and the discipline of interior architecture was evaluated based on direct observation and literature review.

Three main methods were used in the research process:

- Literature Review: National and international literature on digital detox, minimalist interior design and nature-based design approaches were reviewed. Current academic publications especially in the fields of psychology, interior architecture and environmental design were analyzed and the theoretical background on the relationship between digital addiction and spatial organization was created.
- Comparative Analysis: Digital detox spaces in different geographies were analyzed in terms of function and form. In this analysis, design commonalities, diversity of practices, and integration of nature-based components were comparatively evaluated. Particular focus was placed on interior architecture elements such

as the use of light, color palettes, material choices and spatial organization.
- Case Study: The selected digital detox spaces were selected based on the criteria of accessibility, user density, level of visual simplicity and freedom from digital stimuli. Each example was examined in depth in terms of interior architectural elements (spatial layout, material, color, lighting and natural elements).

The images and tables used in this study were specially prepared by the author in a digital environment. It is a deliberate choice to present the images from different angles because this way, it is aimed to perceive the spatial atmosphere holistically and to make a detailed aesthetic analysis. In addition, all visuals are arranged in a way to strengthen the context that the study establishes with the architectural analysis.

In general, this methodological approach aims to develop design strategies and application suggestions for interior architects by addressing the impact of the concept of digital detox on interior design with an interdisciplinary approach.

The examples of digital detox spaces used in this study are not based on direct fieldwork, but are evaluated through representative architectural arrangements determined through visual documentation and literature review. These visually analyzed space representations were selected to show how digital non-contact, sensory simplification and nature-based constructs are constructed in interior design.

Three main criteria were adopted in the selection of the images: Architectural simplicity, integration with nature, and freedom from digital stimuli. The selected examples were evaluated on the basis that they were descriptive enough to answer the research questions, provided architectural detail, and provided rich visual data for theoretical analysis.

Concepts of Digital Detox Spaces

For the modern individual, the digital world is not merely a means of communication or information, but also a form of escape, a habit, and oftentimes, an addiction. This condition weakens the individual's connection with themselves, nature, and others. Amidst the complexities of modern life, people require physical environments where they can disconnect from digital realities in order to maintain their relationship with the real world. Thus, digital detox spaces are not just an interior design trend; they are a creative response to the psychosocial needs of our era (Anandpara et al., 2024; Arenas-Escaso et al., 2024). The human body and mind are inherently programmed to be in harmony with nature, to contemplate in silence, and to exist within a simplified environment. However, urbanization, the widespread use of technology, and the rise of artificial environments suppress these fundamental needs, often leading to burnout. Digital detox spaces are environments that enable individuals to return to their natural rhythm by facilitating a conscious disconnection from technology—supported through aesthetic, functional, and psychological design strategies. Interior architecture responds to this need by maintaining a balance within the human-nature-space triad (Stäheli & Stoltenberg, 2022).

One of the most defining features of digital detox spaces is silence. Yet this silence is not merely an absence of sound; it is a strategic design element that facilitates inner tranquility. In interior architecture, silence is approached as a deliberate objective rather than a byproduct. Acoustic insulation, echo-reducing surfaces, and controlled integration of natural sounds are essential in this context. Silence halts the external data stream that typically occupies the mind, allowing users to confront their thoughts. The stimulus system constantly triggered by digital devices is consciously disengaged in such environments. Hence, users begin to hear themselves. Interior designers should not perceive silence as merely a "lack," but as an immersive experience embedded in the space. Lighting schemes, surface reflectivity, and material selection all contribute to supporting this atmosphere of silence. Especially with the use of neutral color palettes, natural textures, and soft transitions, attention is redirected

inward rather than outward. Thus, silence is transformed from an abstract notion into a functional and sensory dimension of the environment (Çetin, 2022; Meditation Interiors: Exploring Spatial Qualities for Well-Being and Spirituality, 2022; Yan et al., 2024; Yeler, 2022).

Digital detox spaces must be shaped with a functional and minimalist design language, free from ostentatious details. This simplicity is not only aesthetic but also a cognitive and emotional necessity. Visually intense and complex stimuli contribute to mental fatigue, whereas minimalistic environments offer users a space to breathe, reflect, and unwind. In interior architecture, simplicity deepens the meaning of space, as users begin to connect not with what they see, but with what they feel. Spatial sparseness unveils inner richness. Therefore, digital detox spaces must be stripped of unnecessary ornamentation, distractions, and symbolic clutter. Every object must carry a reason for its presence. This approach yields not just visual simplicity, but also sensory and intellectual clarity. Within such settings, the mind focuses more easily, relaxes, and turns inward. Hence, simplicity is not just a principle in the design of digital detox spaces—it is a necessity (Anandpara et al., 2024; Gumber, 2023; Mishra, 2024).

Each individual's detox process is inherently unique; therefore, spaces must be designed to accommodate these personal differences. For some users, natural light may be essential, while for others, silence or solitude may take precedence. Thus, interior designers should avoid rigid frameworks and instead create flexible experiential environments. For example, spaces can include quiet reading nooks, meditation zones, windows oriented for nature observation, or rest niches with floor cushions to cater to various user profiles. The aim is to enable users to establish a sense of "sanctuary" within the space. This personalization fosters not only a physical bond but also an emotional connection. The user develops a personal relationship with the space—it ceases to be merely a location and transforms into a meaningful experience. With this approach, digital detox environments move beyond standard design templates and evolve into living entities shaped by the rhythms, emotions, and psychological needs of the individual (Pawłowska-Legwand & Matoga, 2020; Rutha & Abbas, 2021; Stäheli & Stoltenberg, 2022; Xie et al., 2022; Yumeng, 2022).

Strategies for Interior Design in Digital Detox Spaces

The most fundamental strategy in designing digital detox environments is to center the user's emotional, physical, and mental relationship with the space. Interior design does more than organize visuals—it offers an experiential journey. This journey should aid the technology-fatigued user in regaining inner balance. The design process must begin with careful observation of the user profile. Questions such as: Who is this space for? For what purpose? For how long? form the basis of the design strategy. For instance, the spatial language needed by a white-collar professional seeking respite from urban life will differ from that of a yoga instructor looking to commune with nature. To understand what the user expects from the space, the designer must adopt an empathetic stance, seeing the user not as a "target audience," but as an "experience holder." This requires not only physical but also psychological design construction (Çetin, 2022; Higuera-Trujillo et al., 2021).

Every object used in a digital detox environment must have a purpose, function, and emotional resonance. The minimalist design approach is indispensable for such spaces. However, this minimalism should not be cold or sterile, but rather warm, soft, and tactile. Each object and surface is intended to help cleanse the user from mental noise. Functionality should extend beyond ergonomics—it must also serve the emotions. When a user sits on a chair, they should find comfort for both their body and their mind. In this regard, every design decision—from furniture selection to spatial circulation—should be made consciously and simply. The floor plan should be intuitive, allowing the user to instinctively understand where and how to engage without

being directed. This intuitive flow reduces cognitive load and facilitates the release from digital habits (Buuren & Mohammadi, 2021; Cheirchanteri, 2021; Circulation Realms, 2023).

In digital detox environments, lighting should not be perceived merely as a functional necessity, but rather as a therapeutic tool. The use of natural light must be prioritized in the design of such spaces. Large windows, daylight-inviting openings, shaded zones, and light-responsive materials all contribute to supporting the user's biological rhythm. Waking up in a room illuminated by morning sunlight or sitting quietly in the glow of the afternoon light helps individuals realign with nature's biological cycles. In artificial lighting setups, warm light tones, dim atmospheres, and low-glare configurations should be emphasized. This conscious relationship with light does more than offer visual comfort; it also directly influences the user's emotional state. Lighting scenarios can be diversified to reflect changes in mood throughout the day. Separate lighting arrangements may be proposed for meditation, reading, and relaxation activities. In this way, light becomes not a passive element but an active participant in the spatial experience (Shivsharan & Sundar B.T., 2021; Taşdemir & Gümüşay, 2020; Xie et al., 2022).

The colors used in interior environments have a scientifically proven impact on a person's emotional state. During digital detox processes, appropriate color choices significantly support mental cleansing. Soothing tones—such as soft beiges, earth hues, light greens, and blues—facilitate relaxation, whereas bright and vivid colors may induce stimulation. The interior designer should treat color not just as an aesthetic feature but also as a psychological tool. The color palette should reflect the overall spirit of the space, facilitating conscious slowing down, calming, and introspection. Transitions between hues should be smooth, not abrupt. Colors that interact with light bring depth and warmth to the space. Particularly pastel tones that reflect daylight enhance the natural atmosphere. When used correctly, color psychology transforms the space from a visual environment into an emotional experience. The interior design principles applied in digital detox spaces offer not only aesthetic value but also have the power to transform the user's psychological and physical experience (See Table 1).

Table 1: *Design Principles and Their Effects*

Design Principle	**Application Example**	**Psychological Impact**	**Physical Impact**
Minimalist Layout	Fewer items, furniture with simple forms	Mental clarity, stress reduction	Reduced visual load
Use of Natural Materials	Wood, stone, bamboo	Sense of safety, connection with nature	Thermal comfort, natural breathability
Acoustic Control	Sound insulation, incorporation of nature sounds	Inner silence, increased concentration	Reduction of noise-induced fatigue
Lighting Design	Natural light, dim ambient lighting	Balanced melatonin levels, relaxation	Eye comfort, sense of rhythm
Color Palette	Pastel and soil tones	Calmness, sense of security, enhanced focus	Sensory balance, spatial warmth

Thus, interior architecture is not only a matter of shaping space, but also of designing the flow of time itself (Eklemezler, 2024; Mirbabaie et al., 2022; Stäheli & Stoltenberg, 2022).

We have previously emphasized that digital detox is a process that must take into account individual differences. This awareness necessitates that spaces be flexible and adaptive. A design language that allows users to reconfigure the space according to their own needs holds value both in terms of functionality and personal connection. Solutions such as mobile furniture, portable screens, and modular seating elements enable users to reshape their environments. This turns the user into more than a passive consumer—they become an active "co-designer" of the experience. With this strategy, the interior architect shifts the emphasis from the authority of space to the freedom of user experience. This autonomy encourages the user to participate in the detox process more consciously and meaningfully. Moreover, flexible spaces allow for easy reinterpretation according to different user groups or activities (Arslan, 2022; İNAN & Yıldırım, 2021; Vuscan & Muntean, 2023).

Digital detox is no longer a need confined to personal spaces; it has become a public necessity. Particularly in large urban centers, people have very limited access to spaces where they can momentarily disconnect from technology during the day. Here, interior architecture plays a critical role—by designing digital detox zones in offices, shopping centers, schools, hospitals, and even public transit stops. These areas may be small in scale but can have a profound impact. A quiet seating nook, a meditation capsule surrounded by greenery, or a reading corner illuminated by natural light—all provide short but effective moments of rebalancing. Public digital detox spaces also raise important questions about design as a matter of social equity (Hidayatullah et al., 2022; Li et al., 2024; Liu et al., 2023; Oduncu, 2021). The ability to detox from digital overload should not be a luxury—it should be an accessible right for everyone. Design strategies developed with this mindset reaffirm that interior architecture is not only a discipline that serves the individual, but also the broader society.

Comparative Analysis: Cultural and Design Approaches in Digital Detox Spaces

Comparative analysis allows us not only to examine different design examples, but also to understand the underlying philosophies and cultural contexts that shape them. While digital detox spaces differ in form across geographies, their shared purpose is to facilitate relief from mental, physical, and digital fatigue. This analysis focuses on three key dimensions: cultural context, spatial organization, and interior architectural strategies. By examining examples from Italy, Germany, Japan, the United States, and Turkey, the study explores how digital detox design has evolved across different cultural landscapes within the interior architecture discipline. Each case is rooted in a particular philosophical foundation, and elements such as materials, lighting, spatial composition, and the relationship with nature are all shaped according to that foundation

Table 2: *Digital Detox Space Approaches in Different Countries*

Country	Concept	Spatial Characteristics	Cultural Foundation
Italy	*Forest Bathing*	Open structures, natural transitions, wooden flooring	Nature immersion, slow living
Germany	*Digitale Auszeit*	Modular spaces, functional furniture	Structure, efficiency culture
Japan	*Zen Retreat*	Quiet rooms, spatial void aesthetics	*Wabi-sabi*, spiritual purification
USA	*Wellness Spa*	Semi-natural, semi-technological environments	Comfort-centered lifestyle
Turkey	*Detox Villages*	Nature-integrated stone buildings, inner courtyards	Traditional spatial memory

(Mishra, 2024; Sancak et al., 2023; Yeler, 2022).

In Italy, digital detox spaces are often shaped around the philosophy of forest bathing, which advocates for a mindful reconnection with nature. Designs emphasize the use of completely natural materials; boundaries between interior and exterior spaces are blurred, allowing for continuous transitions. Wooden decks, open walls, stone pathways, and abundant greenery are fundamental design elements. Rather than defining a physical interior, the aim is to create immersive natural zones where disconnection from the digital realm occurs organically. The purpose of design in this context is to "return the individual to nature." Activities such as silence, walking, meditation, and nature observation are spatially supported. The near-invisibility of the design itself allows nature to function as the true interior architect (Barbiero et al., 2023; Olivetti, 2022; Yeler, 2022).

In Germany, functionality is paramount in digital detox space design. The Digitale Auszeit (digital break) concept emphasizes controlled disconnection from technology. Designs are more structured, enclosed, and orderly. Spaces are subdivided for individual or small group use, featuring quiet rooms, tech-drop areas, analog time management boards, and introspective seating arrangements. Although nature is not as prominently featured as in Italy, spatial organization is carefully crafted to support inward focus. Lighting, acoustics, and color are implemented in a systematically minimalistic manner. These German examples reveal the disciplined yet emotionally considerate aspect of interior architecture (Brichetti & Mechsner, 2023; Hira, 2023; This German Workplace Shows the Functional Power of Colour, 2023).

In Japan, digital detox spaces are deeply intertwined with the aesthetics of wabi-sabi and Zen philosophy, which prioritize simplicity, solitude, and harmony with nature. Tatami flooring, shoji screens, rock gardens, natural light modulation, and silence form the core identity of the space. In Japanese interior design, emptiness is not an absence but a presence. Users are provided with both mental and physical breathing room. Digital devices are excluded altogether, with full signal isolation and introspection-focused zones. Cultural rituals—such as bathing practices, silent tea ceremonies, and meditation corners—are integrated into the space. These Japanese examples remind us that digital detox is not merely physical; it is a spiritual journey, and the designer becomes a sort of "spiritual architect" (Alfareza, 2022; Digital Detox Japan, 2024; In Paris, a Japanese Hospitality Destination Gives You No Choice but to Be Present. Here's How, 2023).

In the United States, digital detox design is often shaped under the umbrella of luxury wellness centers. Here, nature and design coexist, though the natural element is often fused with controlled artificiality. Common examples include climate-controlled cabins in the forest, or wooden aesthetics supported by high-tech infrastructure. User experience is highly curated; spaces are embedded with smart systems, yet users are encouraged to temporarily disconnect. The goal is not full disconnection, but rather to keep technology under control. Lighting, climate, and sound are all managed through integrated smart systems. This approach frames digital detox as a service offering, and the designer prioritizes the user's comfort—balancing digital fatigue with a luxurious experience. Thus, the design takes on a more pragmatic and marketable dimension (Arenas-Escaso et al., 2024; Digital Detox®, 2023).

In conclusion, all these comparisons reveal that digital detox spaces are not merely physical voids but represent cultural and spiritual quests. The interior designer is no longer only shaping form—they are shaping meaning. A wall made of natural materials, a ceiling lit by daylight, a silent room—each of these can become a medium through which individuals reconnect with themselves. In this sense, interior architecture in the digital age is a quest to reestablish equilibrium among nature, culture, and humanity. Comparative analysis maps out

this balance, offering both inspiration and responsibility to interior architects.

Discussion

For digital detox spaces to be effective, their designs must be planned to address not only aesthetic but also functional, psychological, and sensory needs. In this context, the example analyses used in the study were conducted on four different 15 m² digital detox rooms. Each room has different spatial configurations and usage scenarios: the first is a simple meditation area, the second is a nature-focused reading corner supported by an aquarium, the third is a relaxation zone surrounded by plants, and the fourth is a relaxation room offering a silent experience in a hammock.

These rooms were examined in terms of modular plan layouts, natural material diversity, and acoustic control elements; and evaluated by considering user behaviors, perceptions of the space, and functional usage levels. For example, it was observed that users could focus on meditation for a longer duration in rooms with natural light, and that users experienced a significant decrease in stress levels in spaces containing an aquarium. Areas where plants were used intensively were described by participants as "inner peace" and "feeling connected to nature."

These findings revealed that designs offering minimal action areas but creating maximum sensory impact provide significant contributions to the digital detox experience. Particularly, spaces where simplified forms and nature-oriented details are used together not only reduce the mental load of users but also facilitate the development of positive emotional bonds with the space.

The use of natural materials is one of the most important design strategies that increases the spiritual healing power of digital detox spaces. The visual titled "Figure 2" used in the case study analyses presents a successful example of this approach. In the interior space in question,

Figure 1: *Open plan layout with multi-purpose use scenario in a compact area. Supported by stone textured floor, natural light orientation and use of modular furniture.*

Figure 2: *An example of a simplified interior in terms of material language and use of light. Wooden surfaces, soft lighting and a low-contrast color palette stand out.*

light-colored wooden claddings used on the floor and walls are integrated harmoniously with surfaces having a stone texture. Seating units and cushions are covered with natural cotton fabrics, creating a tactile sensation of softness and warmth.

Furthermore, another striking element in this space is the penetration of natural light from large surfaces. Daylight creates soft shadows as it hits the stone walls and wooden floors, which offers the user a sense of natural rhythm. This light-material unity establishes a peaceful and timeless atmosphere that contrasts with the artificial glare of digital screens.

Silence, emptiness, and acoustic balance are among the fundamental healing components of digital detox spaces. Detachment from digital stimuli should occur not only at a visual or physical level but also in the auditory realm. In this context, the visual titled "Figure 3" exemplifies the spatial reflection of these principles. In this interior space presented from a bird's-eye perspective, a spacious and empty layout was preferred despite the limited volume, offering the user freedom of movement and mental spaciousness.

Another noteworthy element in the same example is the use of soft-textured surfaces and thick textiles. These elements reduce reverberation, creating a sound-absorbing interior atmosphere. This space, where silence is a "designed quality," offers the user seeking to escape noise an acoustically isolated experience. Additionally, the surface combinations created by natural textures provide a visual coherence free from complexity.

Figure 3: *Spatial construction supporting acoustic comfort and the theme of silence. Echo-reducing surfaces, space arrangements and natural sound sources were used together.*

Digital detox processes are not solely sufficient with visual arrangement; the connection the space establishes with the user is reinforced by actively engaging all senses. In this context, the infographic titled "Figure 4" demonstrates with a holistic approach how sensory design can be integrated into architectural spaces. The visual explains the spatial correspondences of the five basic senses – sight, hearing, touch, smell, and thermal comfort – and offers applicable example design decisions for each.

According to the infographic:
For the sense of sight, the use of soft natural light, surface colors in pastel tones, and simple, non-distracting geometries are recommended. These approaches create a balance against the intense, sharp, and artificial visual stimuli of digital screens. For the sense of hearing, the use of passive sound systems that will carry natural sounds (e.g., the sound of water or birdsong) into the interior and soft surfaces that will reduce reverberation are advised. This reduces mental fatigue and increases attention span.

In the dimension of touch, natural textured surfaces – such as linen, wood, and stone – trigger a feeling of warmth and security, while relaxing scents such as lavender and cedar, recommended for smell, help to calm the nervous system. Finally, thermal comfort is a factor that directly affects how long an individual will spend in the environment and how satisfied they will be with this time. Temperature-sensitive flooring solutions and natural ventilation strategies included in the visual respond to this need.

An interior space where all these sensory decisions are considered together reveals that digital detox is not just about getting away from technology but also about reconnecting with the senses.

Design strategies that center the contact with nature are a component that directly affects spiritual healing in digital detox spaces. Particularly, plants and aquariums extending along the walls distance the user from digital

Figure 4: *Sensory centering proposal enriched with wall-to-wall aquarium, natural plants and seating arrangement. Elements such as water sound and fish movement aim to reduce digital fatigue*

burdens both visually and psychologically. In this context, "Figure 2" and "Figure 3" from the visuals examined offer two strong examples of how natural elements can be integrated into the interior space.

See: "Figure 2" and "Figure 3" The spatial connection established with nature through plants and the aquarium.

In the aforementioned examples, aquariums are treated not only as decorative but as a dynamic and living element that directly communicates with the user. The rhythmic movements of the fish, the clear sound of water, and the soft diffusion of aquarium light into the space create a sensory backdrop that supports the individual's relaxation. Especially the sifting of daylight through the translucent aquarium from behind is an effective detail that slows down the perception of time in the space and increases the feeling of naturalness.

Similarly, real plants placed in the interior space both improve air quality and allow the individual to re-establish their ancient bond with nature. The tropical leafy, large-form plants used in the examples examined in the study transform the space into a "sanctuary," while small potted plants trigger a sense of individual care, establishing an active bond with the user. The integration of such elements into the space with biophilic design principles not only reduces the effects of digital fatigue but also supports mental restoration.

The realization of digital detox spaces that are sustainable and user-friendly largely depends on a flexible and modular design approach. This understanding aims to create multi-functional spatial arrangements that can be shaped according to user needs. The plan visual titled "Figure 5," analyzed within the scope of the study, reveals a successful implementation of this approach.

In this visual as well, a multi-functional seating/lying area is located at the core of the space; this area is designed to be easily adaptable to different purposes such as meditation, reading, or short-term resting. Thanks to movable furniture, foldable bed systems, and portable plant elements, the user remains in constant interaction with the space and can rearrange the space according to their own needs.

Figure 5: *A representative design proposal in digital detox spaces that supports psychological regulation with plant and water elements. Sensory simplification, orientation to nature and internal awareness are targeted.*

Especially in terms of interior architecture education, the design of digital detox spaces provides students with significant awareness at both technical and ethical levels. Many concepts such as sensory design, material selection, light-space relationship, and the integration of biophilic elements are addressed simultaneously in such projects; thus, students are directed to design spaces that are not only aesthetically pleasing but also have a healing effect.

In this context, the design of digital detox spaces is not just a trend but a design responsibility towards the digitally overloaded individual of our age. Interior architects are positioned in these areas not only as space organizers but also as social actors who contribute to user health. Therefore, the inclusion of digital detox in architectural pedagogy has the potential to redefine both professional practice and social sensitivity.

Conclusion

The digital age has created profound transformations in a wide area from the individual's mental processes to their spatial experiences. Continuous interaction with technology increases the level of mental stimulation, which leads to destructive effects on both the individual's psychological and physiological balance. In this context, digital detox should be evaluated not only as a practice of distancing oneself from technology, but also as a multi-layered experience area where the individual reconnects with nature and oneself. The unique contribution of this study is that it suggests that digital detox should be addressed as a spatial issue within the discipline of interior architecture and that design strategies should be developed in this context.

The findings show that the digital detox experience depends not only on individual will but also on the design of the space in a way that supports this process. Minimalist interiors facilitate mental simplification, reduce distraction, and invite the individual to focus on the "now." In particular, elements such as natural materials, soft color palettes, neutral-toned furniture, and controlled use of space support the individual's process of establishing internal balance by reducing sensory load. In this respect, interior architecture is not only a physical arrangement but also a psychological reconstruction tool.

The spatial proposals developed on a theoretical basis are concretized with Figures 3, 4 and 5. These visuals were prepared by the author and produce visual responses to the conceptual implications of the study. While the plan drawing in Figure 3 brings together multi-purpose use and natural orientation, the volumetric structures presented in Figures 4 and 5 are enriched with details aimed at balancing sensory systems. For example, the wall-sized aquarium and daylight integration support the effect of visual and auditory stimuli on neurological regulation. This approach overlaps with the nature-based therapeutic effects emphasized in studies such as Barbiero et al. (2023) and Khatib et al. (2024). Space and silence were evaluated as two critical design components that stand out in this study. These frequently neglected elements offer a pause, breathing and mental relaxation area against the overstimulating environment of the digital age. Soft surfaces, echo-reducing materials and acoustic strategies supported by nature sounds were used as tools to concretize reaching inner silence. In this context, results parallel to the suggestions of Spence (2020) and Hoshi et al. (2021) regarding the auditory environment were obtained.

Cultural comparisons reveal that interior architectural responses to digital detox vary according to local contexts. In Japan, ritual simplicity stands out, in Germany, functional minimalism, in Italy, nature-human synthesis, and in Turkey, the theme of calm blended with spatial memory. This result is consistent with the findings of Hassan & Saleh (2024) and Escaso et al. (2024) explaining local design responses to digital fatigue. In this context, interior architecture serves as a bridge between universal sensitivity and local culture. The proposed visual representations not only embody the theoretical discussion, but also offer a new design language for interior architecture practice. This approach suggests a

holistic spatial design vision that takes into account psychological, emotional, and cultural layers beyond aesthetics and function. These spaces should be considered as environments that support not only the physical but also the mental and emotional well-being of the individual.

Finally, these designs have the potential to be adapted not only to individual residences but also to offices, educational institutions, health centers and public spaces. With typological flexibility, modular systems and scalable design decisions, the digital detox experience can also be carried to public spaces. This situation shows that interior designers should take a more active role in supporting healthy digital life. This study has revealed the healing potential of interior spaces against the cognitive and emotional burdens of the digital age and has made an interdisciplinary contribution to the field of interior architecture through the themes of nature, silence, simplicity and cultural awareness. It is anticipated that this approach will inspire future academic research, design studios and application projects.

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Value-Driven Concept: Achieving Architectural Innovation through Divergent and Convergent Thinking

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Abstract: This research introduces a structured educational framework specifically designed for architectural pedagogy, addressing significant methodological challenges in preserving philosophical and formal architectural concepts during the design process. Conventional architectural education often prematurely selects a singular concept, risking philosophical dilution and loss of formal integrity due to functional and contextual constraints. Alternatively, purely divergent approaches, lacking systematic convergence, frequently yield innovative yet impractical designs. To address these issues, this study proposes a structured approach emphasizing initial divergent exploration, generating multiple philosophical and formal concepts, followed by strategic convergent refinement guided by conceptual value criteria.

The methodology underwent empirical validation over a seven-year study in Architectural Design Studio 3, explicitly selected due to its emphasis on conceptual creativity, philosophical exploration, and formal innovation. Comparative outcomes against earlier pedagogical models (programmatic and metaphoric) indicate significant improvements in conceptual diversity, innovation, functional coherence, and conceptual value preservation. The proposed divergent-to-convergent framework effectively mitigates single-concept risks, producing resilient and contextually appropriate architectural solutions.

This research contributes significantly to architectural pedagogy by offering educators an empirically validated strategy for balancing conceptual innovation with practical feasibility.

Keywords: Architectural innovation, Divergent thinking, Convergent thinking, Architectural pedagogy, Value-driven design

1.Introduction

1.1 Background and Motivation

Architectural education consistently seeks effective methods to foster creative innovation, emphasizing structured frameworks that help students generate meaningful, feasible designs. However, current pedagogical strategies often struggle to balance conceptual innovation with practical constraints effectively (Hargrove & Nietfeld, 2015). Traditional methods typically impose functional limitations prematurely, resulting in superficial concepts lacking philosophical depth and originality (Al-Qemaqchi, 2022).

Philosophical and formal architectural concepts inherently carry substantial creative potential due to their theoretical richness and exploratory freedom (Plowright, 2014; Eilouti, 2018). Yet, translating abstract concepts into practical architectural outcomes without compromising their integrity remains challenging. Practical constraints, such as functional requirements and contextual demands, often necessitate iterative adjustments that significantly alter original concepts (Damadzic et al., 2022).

Reliance on a single philosophical or formal concept introduces substantial risks. Strict adherence to one concept can lead to significant deviations under practical pressures, potentially diluting or fragmenting the original concept. Therefore, architectural pedagogy benefits from structured methodologies that initially foster the exploration of diverse concepts through divergent thinking, subsequently refined via convergent processes guided by external constraints and conceptual value criteria.

1.2 Research Problem

Architectural design education faces inherent challenges due to early conceptual convergence and reliance on singular ideas without sufficient exploration. Prematurely introducing practical constraints limits creative ideation and leads to superficial outcomes. Conversely, purely divergent methods without structured convergence expose designs to unpredictable modifications, losing conceptual integrity.

Two critical issues emerge:

- **Risk of Single-Concept Reliance:** Early commitment to a single idea rarely withstands practical constraints unchanged, leading either to strengthened adaptation or significant compromise.
- **Difficulty Sustaining Conceptual Integrity:** Even multiple concept explorations struggle to maintain integrity amid external pressures without structured guidance, often resulting in diluted or fragmented outcomes.

Addressing these challenges demands a structured pedagogical method emphasizing initial divergent creativity and strategic convergent refinement to achieve mature, resilient architectural designs.

1.3 Significance of Study

This study addresses critical gaps in architectural pedagogy by proposing a structured educational framework designed to encourage divergent thinking across multiple philosophical and formal concepts. It strategically integrates selective convergent refinement guided by explicit value indicators. The research makes significant contributions by:

- **Mitigating Conceptual Risk:** Prioritizing divergent exploration reduces risks associated with single-concept dependence, fostering robust ideation resilient to external constraints.
- **Structured Constraint Integration:** Gradual, systematic convergence ensures concepts maintain philosophical depth while adapting to practical feasibility.
- **Bridging Theory and Practice:** Developed within Architectural Design Studio 3, the proposed method is pedagogically sound and empirically validated, effectively bridging educational theory and professional architectural practice.

1.4 Research Aim and Objectives

1.4.1 Aim

To develop and empirically validate a structured educational methodology emphasizing divergent thinking to mitigate single-concept risks, subsequently integrating selective convergent refinement to sustain conceptual integrity through practical development.

1.4.2 Objectives

- Identify and critically analyze the risks associated with maintaining conceptual integrity of singular philosophical and formal architectural concepts.
- Evaluate existing pedagogical frameworks and their limitations in integrating and adapting philosophical concepts in response to practical constraints.
- Formulate a structured framework emphasizing initial divergent exploration

across multiple concepts to enhance creative diversity and mitigate risks.

- Introduce selective convergent thinking systematically, guided by conceptual value criteria, progressively refining concepts through iterative interaction with external constraints.
- Empirically validate the proposed framework within Architectural Design Studio 3, assessing its effectiveness in preserving conceptual integrity, enhancing creativity, and achieving practical viability.

2. Theoretical Framework

2.1 Cognitive Roots of Divergent and Convergent Thinking (DT/CT)

Divergent and convergent thinking are central concepts in cognitive creativity research, initially articulated by Guilford (1967) and extensively developed in recent studies (Sowden et al., 2015; Ketizmen & Keleş, 2023). Divergent thinking (DT) involves generating multiple, varied, and original ideas without immediate critical evaluation, effectively broadening the conceptual phase. Convergent thinking (CT), conversely, systematically evaluates, refines, and integrates these diverse ideas based on predefined criteria, narrowing the conceptual focus toward practical feasibility (Sowden et al., 2015; Zhang et al., 2020).

These cognitive modes are not mutually exclusive but rather complementary components within the creative design cycle. Effective creativity in design contexts emerges from a continuous iterative oscillation between divergence (expansive exploration) and convergence (critical refinement). Recent neurocognitive evidence emphasizes this iterative interplay, indicating that the capacity to fluidly shift between DT and CT significantly predicts creative outcomes (Zhang et al., 2020).

Box 1: Definitions

Definitions
• **Divergent Thinking (DT)**: The cognitive process characterized by expansive, open-ended exploration aimed at generating numerous, original, and varied conceptual possibilities without immediate judgment of feasibility (Sowden et al., 2015).
• **Convergent Thinking (CT)**: The cognitive process of strategically evaluating and refining ideas, systematically integrating external constraints, and progressively narrowing the focus toward practically viable solutions (Zhang et al., 2020).

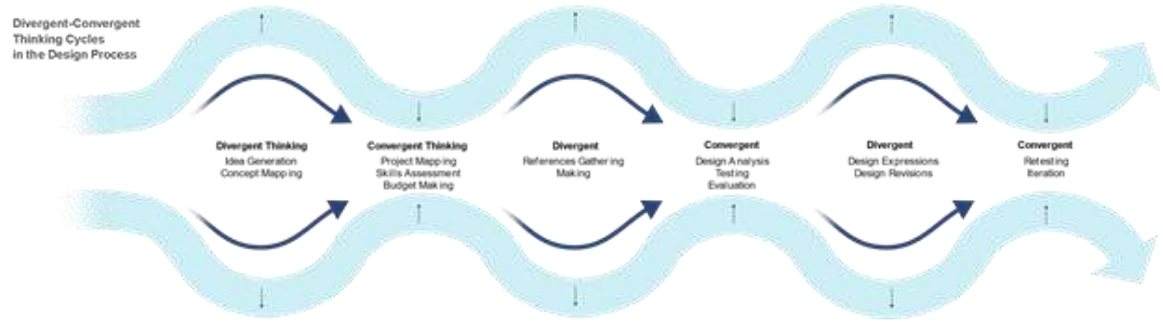

Figure 1: *Showing iterative fluctuation between DT and CT*

2.2 Translating Cognitive Theories into Value-Driven Architectural Studio Workflow

Although DT and CT originate from cognitive psychology, effectively integrating these concepts into architectural education requires contextual translation to spatial and design-specific tasks (Creative Thinking in the Architecture v design inherently involves addressing complex spatial problems requiring both expansive ideation and rigorous refinement. Divergent thinking within architecture emphasizes exploring a wide range of theoretical, philosophical, and formal ideas without early constraints, fostering creative freedom and conceptual diversity (Damadzic et al., 2022).

Convergent thinking is essential for assessing architectural feasibility. This mode strategically incorporates practical constraints such as structural demands, contextual responsiveness, environmental sustainability, and regulatory compliance systematically refining and maturing concepts. Effective architectural pedagogy thus requires structured methodologies explicitly supporting iterative cycling between DT and CT, ensuring innovative concepts remain robust, practical, and contextually integrated.

Central to bridging DT and CT in architectural education is the introduction of conceptual value as an explicit evaluative criterion (Nikander et al., 2014; Kudrowitz & Wallace, 2013). "Conceptual value" moves beyond novelty alone, encompassing broader qualitative attributes cultural relevance, aesthetic coherence, symbolic significance, and social responsiveness. These attributes reflect philosophical positions advocated by theorists like Frampton and Pérez-Gómez, who emphasize that value in architecture transcends mere functional or formal qualities, incorporating deeper ethical, cultural, and symbolic dimensions. For example, Frampton's 'critical regionalism' or Pérez-Gómez's emphasis on meaning directly influenced how students identified and evaluated conceptual values in their studio projects.

Using conceptual value as a convergence metric enables clear differentiation between superficially novel ideas and genuinely meaningful, impactful innovations. The proposed value-driven convergence model explicitly integrates this evaluative criterion within the architectural design process, guiding the systematic transition from divergent exploration to convergent refinement. Initially, students explore multiple philosophical and formal ideas freely, unrestricted by immediate practical judgments. Gradually, convergence occurs, guided by assessing each concept's intrinsic value alongside external practical constraints.

This structured methodology effectively mitigates the risks associated with premature selection of singular concepts by ensuring that the final design not only retains original philosophical depth and formal integrity but also becomes stronger and contextually enriched through rigorous value-driven evaluation.

Table 1: *Comparing Value-Driven Convergence with Programmatic and Metaphoric Approaches*

Criterion	**Programmatic Approach**	**Metaphoric Approach**	**Value-Driven Approach (Proposed)**
Initial Ideation Focus	Functional and pragmatic needs	Symbolic/metaphoric expressions	Philosophical and formal exploration
Divergent Thinking Level	Low (Early functional constraints)	Moderate (Expressive exploration)	High (Expansive concept exploration)
Conceptual Risk	Low	High	Moderate (managed via multiple explorations)

Conceptual Integrity Retention	Moderate	Low	High (through structured iterative refinement)
Innovation Potential	Low	High (but prone to weakening)	High (maintained via rigorous value criteria)
Practical Feasibility	High	Moderate to Low	High (through selective constraint integration)

The proposed framework explicitly reduces conceptual risk, enhances innovation, and maintains integrity, strategically balancing creative freedom with practical necessity.

3. Literature Review

Architectural education continuously balances creative innovation and functional practicality. Central to this task is effectively integrating various architectural concepts into pedagogical practices. This review thematically explores recent advances in concept typologies and cognitive strategies, emphasizing their implications for pedagogical practice.

3.1 DT/CT Interplay in Architectural Design Education

Recent studies increasingly emphasize the dynamic interplay between divergent (DT) and convergent thinking (CT) within architectural pedagogy. Ketizmen and Keleş (2023) demonstrated how structured integration of DT and CT significantly enhances student creativity, resulting in richer, more contextually adaptive designs. Similarly, a comprehensive analysis of architectural creativity education highlights the critical role that alternating cognitive strategies play in supporting meaningful innovation (Experiences in Architecture Creativity Education, 2022).

Such studies consistently underline the pedagogical importance of clearly delineated phases of expansive ideation (DT) followed by structured refinement (CT), effectively addressing conceptual erosion risks common in earlier single-method frameworks (Al-Qemaqchi, 2022).

Technological advancements, particularly AI-assisted tools, are reshaping architectural pedagogy by enhancing divergent exploration. Recent research highlights how platforms such as Midjourney significantly expand conceptual diversity, providing students with powerful tools for visual ideation that surpass traditional manual approaches (Midjourney to Enhance Divergent Thinking, 2024). AI tools actively support students in generating expansive visual alternatives, facilitating deeper exploration of philosophical and formal possibilities beyond initial cognitive biases (Damadzic et al., 2022). However, despite these promising advances, educators caution that AI augmentation requires carefully structured pedagogical integration. Such structured integration is crucial to ensuring concepts maintain coherence and philosophical integrity during the critical transition to convergent refinement phases (Ketizmen & Keleş, 2023). Thus, AI tools must complement rather than replace structured pedagogical frameworks to achieve meaningful architectural innovation.

3.2 Cognitive and Constraint-Based Perspectives on Architectural Creativity

Research increasingly emphasizes the productive role constraints can play in creative ideation processes. Contrary to viewing constraints merely as restrictive, recent studies demonstrate they can significantly stimulate creativity by providing clear frameworks for problem-solving (Acar et al., 2019; Generative Design Reasoning, 2023). In architectural education, strategic constraint integration enhances conceptual maturity by systematically guiding students toward feasible yet innovative solutions.

For example, Acar et al. (2019) illustrate how creatively structured constraints yield outcomes superior in innovation and practical feasibility compared to unconstrained environments.

Similarly, recent analyses of generative design reasoning further affirm constraints' capacity to foster high-quality, contextually robust architectural concepts (Generative Design Reasoning, 2023).

Emerging neurocognitive research provides deeper insights into the cognitive mechanisms underpinning creative thinking in architectural contexts. Zhang et al. (2020) presents compelling evidence linking cognitive flexibility particularly the capability to fluidly alternate between divergent and convergent modes with significantly enhanced creative outcomes. These neurocognitive insights suggest targeted pedagogical interventions that cultivate cognitive flexibility, substantially boost students' creative potential.

Complementing this research, recent studies on bilingualism indicate that individuals with multilingual capabilities display enhanced creative thinking capacities, helping architectural ideation processes by fostering richer conceptual associations (Bilingualism & Creativity, 2022). These findings suggest pedagogical benefits from fostering cognitively diverse learning environments within architectural education, encouraging more adaptive and innovative concept generation.

3.3 Critical Evaluation of Existing Pedagogical Frameworks

Despite growing awareness of DT/CT benefits and AI-assisted methodologies, existing pedagogical frameworks frequently fall short. Traditional single-concept approaches, whether programmatic, metaphoric, or formal often fail to sustainably integrate practical constraints without significant loss of conceptual integrity (Plowright, 2014; Damadzic et al., 2022). Many frameworks overlook the systematic integration of diverse concept types, risking superficial design outcomes that compromise initial philosophical depth and originality (Al-Qemaqchi, 2022).

This critical gap underscores an urgent pedagogical need: explicitly structured educational methodologies rigorously integrating divergent and convergent thinking, carefully guided by explicit evaluative criteria to ensure sustained innovation, conceptual integrity, and functional feasibility.

3.4 Literature Gap and Contribution of Current Research

This research addresses these identified gaps by presenting a structured, empirically validated pedagogical methodology. The method strategically integrates divergent exploration of multiple philosophical and formal concepts with selective, value-driven convergent refinement, ensuring robust conceptual integrity and practical adaptability.
Empirically validated through extensive longitudinal analysis within Architectural Design Studio 3 explicitly chosen due to its pedagogical emphasis on philosophical exploration, formal innovation, and conceptual creativity, the approach uniquely synthesizes theoretical cognitive frameworks with practical pedagogical applications. Thus, this study contributes robust, empirically grounded insights essential for effectively navigating diverse concept types in contemporary architectural education.

4. Methodology

4.1 Overview of Methodological Approach

This research employs a structured pedagogical framework designed to address the inherent risks associated with single philosophical or formal concept reliance in architectural education. The methodology systematically integrates divergent thinking (DT) and convergent thinking (CT), initially emphasizing expansive ideation, followed by strategic refinement guided by conceptual value criteria. The approach has undergone rigorous empirical validation through a seven-year longitudinal study within Architectural Design Studio 3.

4.2 Pedagogical Context: Architectural Design Studio 3

Architectural Design Studio 3 was intentionally selected due to its pedagogical emphasis on philosophical exploration, formal innovation, and conceptual creativity. Unlike Studios 1 and 2, which primarily focus on foundational technical skills and basic programmatic or structural constraints, Studio 3 explicitly

encourages students to engage deeply with philosophical, formal, and symbolic ideas. This studio context provides a robust environment for testing the effectiveness of the DT-to-CT approach, as students routinely engage in complex, theoretically driven architectural projects, thus making it uniquely suited to validate a methodology focused on creative innovation and philosophical integrity.

4.3 Phases of the Methodological Framework

The structured pedagogical approach comprises three interconnected phases designed to balance divergent exploration and convergent refinement:

Table 2: *Methodological Phases and Objectives*

Phase	Activity	Objective
1	Divergent Thinking – Expansive Idea Generation	Encourage expansive exploration without constraints
2	Gradual Convergent Thinking – Value-Based Refinement	Identify and refine mature, feasible concepts
3	Strategic Selection and Conceptual Refinement	Finalize a resilient, contextually appropriate concept

(a) Phase 1: Divergent Thinking – Expansive Idea Generation

This phase prioritizes extensive conceptual exploration, valuing the generation of multiple ideas over immediate judgment of feasibility.

- **Objective:** Encourage students to explore numerous philosophical and formal concepts without premature practical constraints.
- **Implementation:**
  - Students produce multiple "Concept Sheets," including sketches, abstract diagrams, inspirational imagery, and conceptual narratives.
  - Emphasis is on conceptual quantity and diversity, no evaluation of practical feasibility at this stage.
- **Assessment:** Based solely on the number and variety of generated concepts, promoting uninhibited creativity.

(b) Phase 2: Gradual Convergent Thinking – Selective Value-Based Refinement

Following broad divergent exploration, this phase introduces systematic convergence. Concepts undergo selective refinement through iterative exposure to practical constraints, explicitly guided by conceptual value assessments.

- **Objective:** Identify resilient, conceptually mature ideas capable of practical realization without compromising their initial philosophical depth.
- **Implementation:**
  - Students shortlist concepts exhibiting significant philosophical depth, formal coherence, and resilience.
  - Shortlisted concepts are iteratively refined against external constraints (e.g., environmental conditions, structural feasibility, contextual integration).
  - Structured developmental documentation tracks concept evolution, explicitly capturing changes guided by conceptual value considerations.
- **Assessment:** Evaluation emphasizes how effective concepts maintain conceptual integrity and adapt to external constraints.

(c) Phase 3: Strategic Selection and Conceptual Refinement

In this final phase, students select the most robust and mature concept, demonstrating consistent adaptability and conceptual integrity throughout previous evaluations.

- **Objective:** Finalize and develop a single concept rigorously tested against practical constraints, ensuring philosophical depth, formal coherence, and contextual adaptability.
- **Implementation:**
  - Collaborative selection involving instructors, peers, and potentially external stakeholders ensures broad evaluative perspectives.
  - Detailed refinement includes site zoning, functional analysis, spatial circulation, and conceptual detailing,

emphasizing value integration and feasibility.
    - Comprehensive documentation clearly illustrates the final concept's maturity, practical viability, and maintained philosophical/formal integrity.
- **Assessment:** Final evaluation based on conceptual depth, adaptability, innovation, and practical feasibility.

4.4 Implementation of the Conceptual Framework

The conceptual framework was practically implemented through structured stages emphasizing initial divergent ideation, followed by selective convergence guided by conceptual value criteria. Students engaged systematically, documenting conceptual explorations, iterative refinements, and collaborative evaluations throughout the process. For detailed implementation guidelines, submission formats, and evaluation criteria employed within Architectural Design Studio 3, refer to **Appendix A**.

4.5 Evaluation Methods

This study employs multiple complementary evaluative methods to rigorously validate the pedagogical effectiveness of the DT-to-CT framework:

- **Case Study Analysis:**
    - Selected case studies from Architectural Design Studio 3 document the methodology's practical implementation, clearly demonstrating the transition from divergent ideation to convergent refinement and practical realization.
- **Observational Data Collection:**
    - Systematic direct observation during studio sessions documents ideation diversity, creativity, and iterative integration of external constraints.
- **Participant Feedback (Surveys and Interviews):**
    - Structured surveys and semi-structured interviews capture qualitative feedback from students, instructors, and external reviewers regarding creativity enhancement, conceptual integrity preservation, and practical viability.
- **Comparative Thematic Analysis:**
    - Qualitative thematic analysis compares outcomes of the DT-to-CT methodology against traditional single-concept pedagogical approaches, highlighting differences in creativity, resilience, and conceptual integrity.

4.6 Data Analysis Approach

Qualitative and observational data were analyzed through rigorous thematic analysis methods, focusing specifically on:

- Recurring themes related to concept resilience and maturity.
- Effectiveness in preserving philosophical and formal integrity during practical adaptations.
- Impact on creativity, originality, and practical adaptability compared to single-concept approaches.

Analysis synthesized key findings from multiple case studies, observational data, and participant feedback, ensuring robust, evidence-based conclusions regarding the methodology's pedagogical validity.

4.7 Methodological Limitations and Considerations

While empirically successful, the methodology has several limitations:

- Effectiveness may vary due to individual student characteristics, instructor facilitation style, and specific educational contexts.
- Iterative convergence phases require careful oversight to avoid prematurely imposing constraints.
- Successful implementation depends heavily on active guidance and consistent engagement from experienced educators.

These limitations inform ongoing methodological refinement, suggesting further studies to confirm effectiveness across diverse educational contexts.

4.8 Methodology Summary

This structured pedagogical framework explicitly addresses risks associated with single-concept reliance by emphasizing initial divergent exploration of multiple philosophical and formal architectural concepts. Through

gradual selective convergence guided by explicit conceptual value criteria, the approach demonstrates significant effectiveness in cultivating robust, innovative, and practically feasible architectural concepts without compromising conceptual integrity. Empirical validation within Architectural Design Studio 3 provides rigorous evidence supporting the methodology's educational value and practical effectiveness.

5. Results

5.1 Empirical Findings from Longitudinal Analysis

The effectiveness of the proposed Divergent-to-Convergent (DT-to-CT) methodological framework was empirically evaluated over seven years within Architectural Design Studio 3, explicitly selected due to its focus on conceptual creativity, philosophical exploration, and formal innovation. Approximately 252 undergraduate students participated across three distinct pedagogical approaches:

1. **Programmatic Approach (Years 1–2):** Focused explicitly on functional constraints from the beginning.
2. **Metaphoric Approach (Years 3–4):** Emphasized symbolic and abstract conceptualization.
3. **Value-Driven DT-to-CT Approach (Years 5–7):** Integrated expansive divergence followed by systematic, value-based convergence.

Quantitative evaluations were based on rubric assessments across four key dimensions (rated on a 1-to-5 scale):

- Conceptual Quality (Functional Feasibility)
- Conceptual Diversity
- Innovation
- Conceptual Value Integrity

5.2 Summary of Comparative Results (Mean ± SD)

Table 3: *Summary of Comparative Results*

Criterion	Programmatic (n≈72)	Metaphoric (n≈72)	DT-to-CT (n≈108)
Conceptual Quality	4.09 ± 0.32	2.87 ± 0.39	4.32 ± 0.34
Conceptual Diversity	2.53 ± 0.41	3.82 ± 0.36	4.57 ± 0.27
Innovation Score	2.84 ± 0.35	4.11 ± 0.29	4.48 ± 0.31
Conceptual Value Integrity	2.69 ± 0.38	3.17 ± 0.46	4.27 ± 0.29

5.3 Key Empirical Insights

- **Conceptual Quality (Functional Feasibility)**:
  The DT-to-CT method achieved the highest conceptual quality scores (mean=4.32), significantly outperforming the metaphoric approach (mean=2.87) and slightly surpassing the programmatic approach (mean=4.09). This explicitly demonstrates the method's strength in balancing innovation and feasibility.
- **Conceptual Diversity and Innovation**:
  The DT-to-CT approach enhanced conceptual diversity (mean=4.57) and innovation scores (mean=4.48). This represents substantial improvements over the programmatic method and moderate yet significant gains compared to the metaphoric method, confirming the structured approach's ability to foster expansive yet practical creativity.
- **Conceptual Value Integrity**:
  The most substantial advantage of the DT-to-CT methodology explicitly appeared in conceptual value integrity (mean=4.27). This strongly indicates that structured iterative convergence guided by conceptual value effectively preserves original philosophical depth and formal coherence.

Overall, the data demonstrates robust evidence of the DT-to-CT method’s pedagogical effectiveness, clearly confirming significant advantages in maintaining conceptual integrity, innovation, and functional viability compared

explicitly to traditional pedagogical approaches.

6. Discussion

6.1 Mapping Empirical Findings to DT/CT Theory

Empirical results strongly align with cognitive theories emphasizing the iterative fluctuation between divergent and convergent thinking (Guilford, 1967; Sowden et al., 2015; Zhang et al., 2020). Specifically, the high scores in conceptual diversity and innovation confirm theoretical predictions that initial divergent exploration enriches creativity, providing diverse conceptual pathways resilient to later-stage practical constraints.

The conceptual value integrity observed under the DT-to-CT framework underscores the effectiveness of guided convergence. This aligns closely with Ketizmen and Keleş's (2023) and recent generative design reasoning studies (2023), demonstrating that carefully structured convergence significantly reduces conceptual erosion risks common in metaphoric and single-concept approaches.

6.2 Advantages over Traditional Pedagogical Methods

The empirical evidence positions the DT-to-CT framework as pedagogically superior, effectively balancing conceptual creativity with practical feasibility. In contrast to the metaphoric approach, which suffered substantial loss of conceptual integrity, and the programmatic method, which explicitly limited innovation, the DT-to-CT approach maintained high standards across all measured criteria.

These findings reinforce existing literature (Al-Qemaqchi, 2022; Damadzic et al., 2022), affirming that reliance on a single concept inherently risks significant conceptual dilution. The structured exploration of multiple concepts, guided by conceptual value criteria, effectively mitigates these risks, ensuring stronger, more resilient, and contextually adaptable architectural outcomes.

Reflecting on the process, I observed that students became more adept at articulating their conceptual intentions and demonstrated greater resilience in maintaining conceptual integrity through iterative refinement. This increased awareness not only enhanced the quality of their final projects but also contributed to a deeper understanding of the relationship between philosophical values and practical design constraints.

6.3 Methodological Limitations and Considerations

Despite its effectiveness, several limitations must be acknowledged:

- **Instructor Influence**: Variations in instructor guidance could impact student outcomes, indicating that consistent educator training is essential.
- **Student Cohort Variability**: Individual student characteristics, motivation, and prior experiences may affect the replicability of results.
- **Contextual Specificity**: Findings were obtained within a single educational context (Architectural Design Studio 3). Broader applicability across varied educational and cultural contexts requires further validation.

Addressing these limitations through future studies, potentially incorporating broader contexts and enhanced digital platforms, will further solidify the method's pedagogical value.

6.4 Practical Implications for Architectural Pedagogy

Practically, the structured DT-to-CT methodology provides educators with a clear, empirically validated strategy to effectively cultivate mature, innovative architectural concepts. Explicit iterative evaluation processes and clearly defined value-based refinement criteria enable educators to systematically balance creativity and feasibility throughout the design studio process.

Moreover, integrating AI tools for divergent thinking and structured evaluative frameworks for convergent refinement provides promising directions for further enriching the methodology. Such integration expands the approach's applicability and effectiveness,

offering significant potential advancements in architectural pedagogy.

7. Conclusion

This research proposed and empirically validated a structured educational methodology explicitly tailored to architectural design pedagogy, addressing critical challenges associated with maintaining conceptual integrity through practical design processes. Traditional single-concept pedagogical strategies, whether functional, metaphoric, or formal demonstrate significant weaknesses, notably conceptual dilution under real-world constraints. To overcome these challenges, the proposed Divergent-to-Convergent (DT-to-CT) methodology systematically integrates expansive divergent thinking initially, followed by selective convergence driven by conceptual value criteria.

Empirical evaluation over seven years within Architectural Design Studio 3, explicitly chosen due to its pedagogical emphasis on philosophical exploration, formal innovation, and conceptual creativity robustly demonstrates significant advantages of the DT-to-CT approach. Findings explicitly confirm substantial enhancements in conceptual diversity, innovation, functional feasibility, and conceptual integrity compared to previous methodologies. Specifically, the structured integration of divergent and convergent cognitive strategies effectively mitigates conceptual erosion risks, enabling students to develop resilient, contextually appropriate architectural concepts that maintain original philosophical depth and formal coherence.

Theoretically, this research significantly advances the discourse on creativity in architectural education, providing empirical evidence supporting structured iterative driving between divergent and convergent thinking. Practically, the DT-to-CT framework equips architectural educators with validated strategies for balancing creative exploration and practical constraints, fostering robust innovation without compromising feasibility.

Nevertheless, the study acknowledges certain limitations primarily instructor variability, student characteristics, and contextual specificity that suggest paths for further exploration. Future research should investigate broader applications of the methodology across diverse educational and cultural contexts and explore the potential integration of advanced AI-driven platforms to enhance divergent ideation and convergent refinement.

Ultimately, this research significantly contributes to architectural pedagogy by offering educators an innovative, empirically validated approach. By explicitly integrating cognitive creativity theories into practical educational contexts, the DT-to-CT methodology enables the development of mature, innovative, and practically viable architectural designs, bridging theoretical creativity frameworks and real-world architectural practice.

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Appendix A: Implementation of the Conceptual Framework

This appendix details the structured pedagogical process explicitly employed within Architectural Design Studio 3, supporting the effective implementation of the Divergent-to-Convergent (DT-to-CT) conceptual framework described in the main methodology.

A.1 Divergent Thinking Phase: Expansive Ideation

During the initial divergent phase, students systematically generate multiple philosophical and formal concepts, explicitly prioritizing creative exploration and quantity over immediate practical feasibility.

Submission Format: Concept Sheets

Each student submits multiple **Concept Sheets**, documenting conceptual explorations structured around the following components:

- **Concept Value:**
  Students explicitly articulate the intended conceptual value (cultural, social, aesthetic, environmental) aligned with the project goals.
- **Inspirational Imagery:**
  Multiple visual references communicate the concept's underlying philosophical or formal essence, stimulating creative imagination.
- **Philosophical Statements:**
  Brief narratives clarify conceptual intentions, underlying theories, and their alignment with project values.
- **Abstract Representations:**
  Multiple sketches, diagrams, or models illustrate diverse spatial and formal interpretations, capturing the concept's potential from various perspectives.

Evaluation Criteria:

At this stage, assessments explicitly focus on the quantity, diversity, and originality of generated ideas. Practicality and feasibility considerations are intentionally postponed maximizing creative ideation.

A.2 Convergent Thinking Phase: Selective Refinement

Following expansive divergence, selected concepts undergo iterative refinement explicitly guided by conceptual value assessments and practical constraints integration.

Shortlisting Criteria:

Concepts are evaluated against the following three explicit criteria:

- **Innovation Alignment:**
  Concepts demonstrating novel approaches aligned explicitly with the project's values, introducing innovative solutions or incorporating advanced technologies.
- **Value Integration:**
  Concepts clearly embedding project values—social, environmental, cultural, aesthetic—into their core design, evidencing meaningful and potentially impactful outcomes.
- **Feasibility and Potential Impact:**
  Assessment includes practical scalability, adaptability to future requirements, and the potential to serve as exemplary architectural solutions within the project's context.

Collaborative Evaluation:

Selections involve collaborative input from instructors, peers, and occasionally external stakeholders, ensuring broad validation, contextual relevance, and diverse evaluative perspectives.

A.3 Detailed Conceptual Refinement Phase

The final phase strategically selects the most resilient, contextually appropriate concept for detailed refinement, emphasizing practical feasibility, maintained conceptual integrity, and explicit value integration.

Developmental Analysis Components:

For each shortlisted concept, students submit structured documentation clearly addressing the following components:

- **Site Analysis:**
  Comprehensive analyses of site-specific physical, environmental, and socio-cultural characteristics.
- **Spatial Relationship Diagrams:**
  Clear diagrams visually demonstrate primary zone interactions, overall spatial logic, and conceptual coherence within the site context.
- **Zone Area Definitions:**
  Precise estimation of essential zone areas, explicitly reflecting functional needs and programmatic requirements.

Detailed Concept Refinement Activities:

Each shortlisted concept undergoes meticulous refinement:

- **Site Zoning and Placement:**
  Explicit detailing of site zoning, building orientation, spatial arrangement, and integration of environmental and contextual constraints.
- **Circulation and Floor Plan Schematics:**
  Simplified conceptual plans explicitly indicating internal and external circulation logic, ensuring functional viability without overly detailed spatial specifications at this stage.
- **Value Integration Documentation:**
  Clearly outlined strategies for embedding core conceptual values within design details, including material selections, form, spatial organization, and user experience considerations.
- **Concept Visualization Models:**
  Visual representations through refined sketches and mass models explicitly communicate conceptual form, scale, and contextual harmony, clearly demonstrating final conceptual maturity and practical adaptability.

A.4 Final Concept Selection and Iterative Flexibility

The structured methodology explicitly allows iterative flexibility, providing options to revisit earlier conceptual phases if necessary. If the initially selected concept does not fully meet project expectations or contextual suitability, previously developed alternative concepts remain readily available as viable alternatives.

Final Submission Structure:

Students submit comprehensive final presentations clearly structured around the following elements:

- **Concept Narrative:**
  Detailed descriptions clearly outline conceptual development, philosophical underpinnings, and strategic value alignment.
- **Detailed Site Integration Visualizations:**
  Clear graphical overlays explicitly illustrating site zoning and concept placement onto detailed site analysis drawings.
- **Zoning and Circulation Plans:**
  Conceptual diagrams clearly indicating spatial logic, zone distribution, estimated functional areas, and circulation strategies.
- **Integrated Value Documentation:**
  Explicit explanations and illustrations documenting conceptual value integration strategies across scales, highlighting coherence between conceptual intent and practical feasibility.
- **Final Visualization Models:**
  Comprehensive visual representations—finalized sketches and mass models—clearly communicating the architectural form, conceptual coherence, and contextual responsiveness.

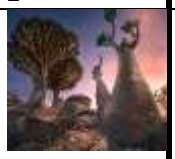
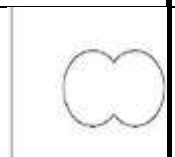
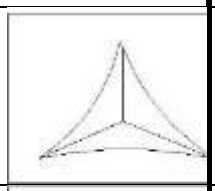
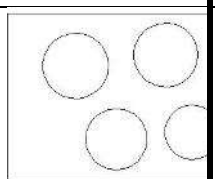
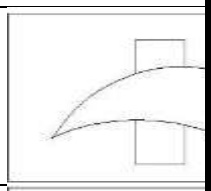
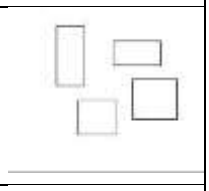
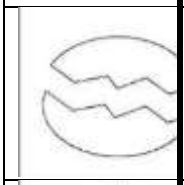
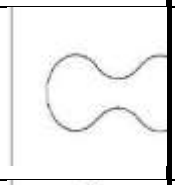
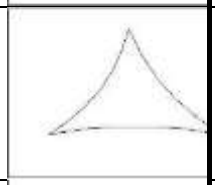
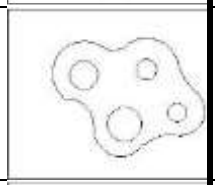
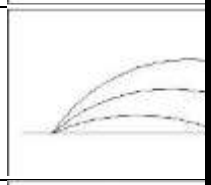
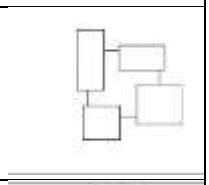
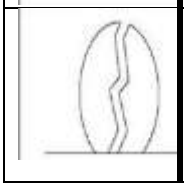
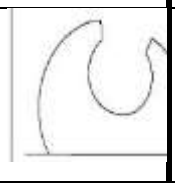
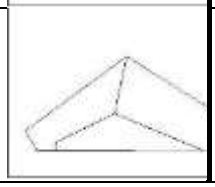
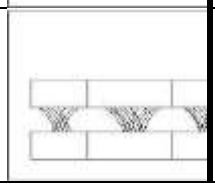
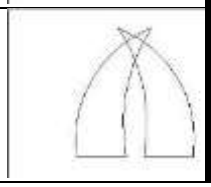
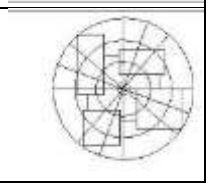
A.5 Case Example: Cultural Heritage Museum Project Implementation

To illustrate the practical effectiveness of this framework, students completed a design project for a **Cultural Heritage Museum**. This project explicitly implemented the DT-to-CT framework as follows:

- **Divergent Phase:** Students explored diverse conceptual possibilities drawn from local culture, history, and traditional architectural elements, producing extensive conceptual alternatives.

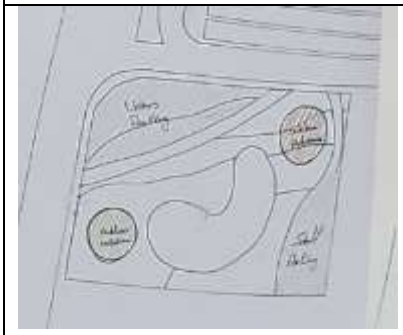
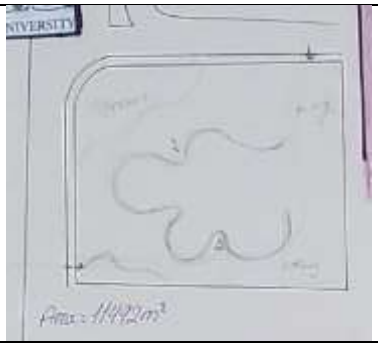
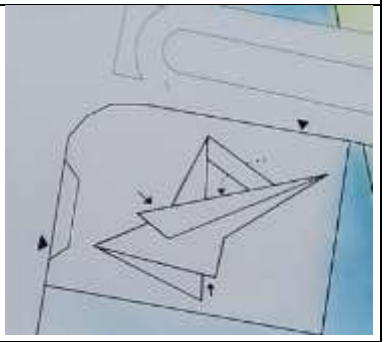
- **Convergent Phase:** Concepts underwent structured refinement informed by explicit cultural and aesthetic values and functional constraints, resulting in a mature, contextually adaptive final concept.
- **Detailed Refinement:** The final concept clearly demonstrated innovative integration of contemporary architectural strategies with traditional symbolic references, successfully maintaining conceptual integrity and practicality throughout iterative refinements.
- **Sample of stage one**

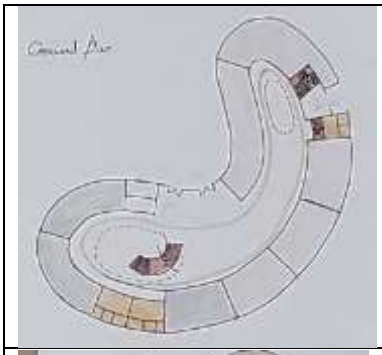
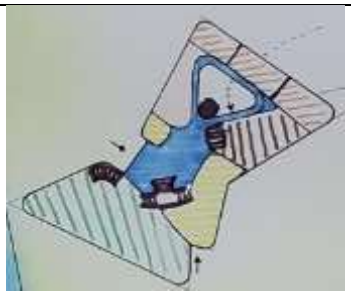
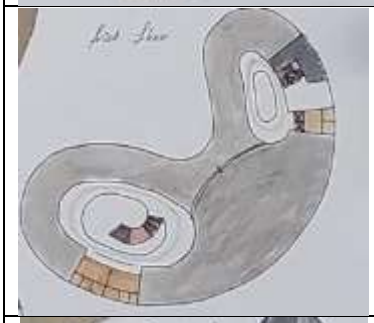
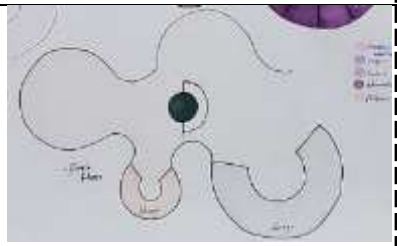
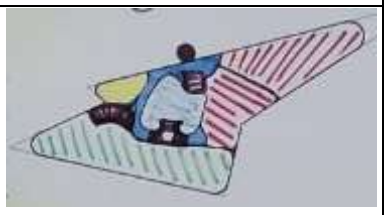
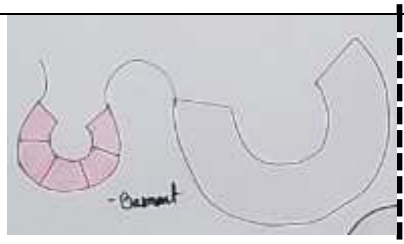
Table 1 first stage

Concept Value: Aesthetic value more specifically cultural value to be as a landmark.					
1	2	3	4	5	6
					
The concept draws from coffee bean's lifecycle, symbolizing growth, com and tradition, to shape a museum that reflects the culture's deep connectio coffee.	The Desert Rose, native Socotra, epitomizes adap and survival, mirroring the island's singular ecosyste underscoring the project's on conservation and cult depth.	Symbolizes adaptability s resilience, influencing museum's use of materi and structures that ec traditional, communal des shelters.	Represents endurance and uniqueness, guiding design elements that reflect the city's natural heritage and cultural identity.	Emblematic of honor and tradition, inspires decorative and architectural motifs that underscore the city's rich cultural narratives.	Showcases architectural ingenuity and cultura persistence, mirrored in the museum's geometric patterns and traditional building styles.
					
					
					

- **Sample of stage 2**

Table 2 second stage

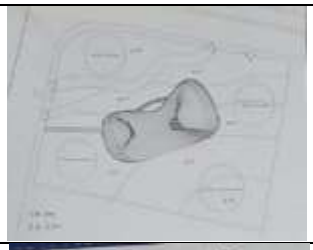
Site analysis	Relationship diagram	Spaces area
Concept one	**Concept two**	**Concept three**
		

		
		
		
 The values here where integrated by adding a pattern in the elevation which is taking from the local architecture	incorporating its structure as a central core in the museum, surrounded by a floor that serves as a landscape, embodying endurance and distinctiveness.	The acute angle of the Jambiya symbolizes dynamism and elegance, influencing architectural designs with its sharp, sweeping curves to guide visitor flow and focus attention.
Sketches+ Mass model	Sketches+ Mass model	Sketches+ Mass model

- **Sample of stage 3**

Table 3 third stage

Co**ncept development** +Philosophy of the Co**ncept**	

Underlay is Site analysis, above are Site Zoning and Concept Placement	
1 Floor plan zoning with circulation and estimated area	
2 Floor plan zoning with circulation and estimated area	
3 Floor plan zoning with circulation and estimated area	
Value integration New value here were added along with the cultural value which is natural ventilation and lighting	
Sketches + Mass model	

This exemplary project explicitly demonstrates the framework's practical effectiveness, significantly enhancing pedagogical outcomes in architectural education.

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Integrating Sustainable Design, Smart Technologies, Certification in Green Hospital Architecture

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Abstract: Healthcare facilities are among the most resource-intensive buildings, yet they must operate continuously and remain functional during emergencies. This paper presents a holistic approach to green hospital architecture that synthesizes sustainable design principles, energy-efficient smart technologies, green building certification systems, and seismic resilience strategies. A literature review of recent research and case studies is conducted to identify how these domains intersect in hospital design. Key sustainable architecture principles (energy efficiency, resource conservation, indoor environmental quality, etc.) are discussed alongside smart building systems for energy management and patient comfort. Green building certification benchmarks such as LEED are examined as frameworks to guide hospital sustainability and performance. In parallel, strategies for seismic resilience – including structural innovations and "earthquake architecture" integrating engineering and aesthetics – are analyzed given the critical importance of hospitals remaining operational after disasters. The synthesis reveals that designing a truly sustainable hospital requires an integrated approach: one that meets rigorous environmental standards, leverages intelligent systems and materials, and ensures structural safety and resilience. This integrated paradigm can yield hospitals that are not only environmentally friendly and energy efficient, but also smart, safe, and adaptive in the face of climate and seismic challenges. The paper concludes with a conceptual model and recommendations for architects and engineers to collaboratively implement sustainable, smart, certified, and resilient design in future healthcare projects.

Keywords: Sustainable Design, Smart Technologies, Green Hospital

Introduction

Hospitals and life-science buildings expend tremendous amounts of energy to operate 24/7 and maintain strict environmental controls. In fact, healthcare buildings account for about 4.4% of the world's total carbon emissions, making sustainability in hospital design a high-impact priority. At the same time, hospitals have critical infrastructure that must remain functional during and after disasters like earthquakes. Recent trends in architecture and engineering emphasize that truly sustainable design must also be resilient (Meerow et al. 2016). This convergence calls for an integrated approach to green hospital architecture – one that merges sustainable design principles, smart building technologies, green certification benchmarks, and seismic resilience strategies into a unified design framework (see Fig.1).

Modern sustainable architecture aims to reduce negative environmental impacts of buildings by minimizing energy and resource consumption and improving occupant well-being (Kats

2006). In the case of hospitals, which are among the most energy-intensive building types (with inpatient hospitals averaging nearly 193 MBtu/ft² energy use, roughly three times typical commercial buildings), efficiency gains can be especially significant . Architects are increasingly expected to incorporate renewable energy, passive design, and efficient systems to curb hospitals' greenhouse gas emissions and operational costs. Equally important is maintaining excellent indoor environmental quality (IEQ) – including air quality, lighting, acoustics, and access to daylight – as studies show these factors improve patient recovery and staff performance (Ulrich et al. 2008). Sustainable hospital design thus entails a multidisciplinary balance of energy and environmental performance with human-centered healthcare needs.

Another critical facet is the integration of smart technologies and intelligent systems in hospital buildings. Smart building design leverages sensors, automation, and data to optimize performance. Hospitals can benefit from building management systems that automatically adjust lighting, ventilation, and temperature, improving energy efficiency while maintaining stringent health requirements (Shafa 2024a). A recent study by Shafa (2024a) identified that among various smart design elements, intelligent lighting systems, advanced fire alarm systems, and environmental sensors (for temperature and humidity) were the most influential factors for improving building efficiency. This highlights how digital infrastructure and IoT-based controls can complement classical sustainable design strategies. Indeed, the concept of a smart hospital aligns with broader smart city initiatives – integrating smart environment and smart living principles to enhance both operational efficiency and occupant experience (Batty et al. 2012). By using real-time data and automation, smart hospitals can continuously adapt to reduce energy waste, respond to occupancy needs, and even anticipate maintenance issues, embodying a new paradigm of high-performance healthcare facilities.

In parallel, green building certification systems provide structured frameworks and metrics to guide sustainable design in hospitals. Rating systems like LEED (Leadership in Energy and Environmental Design) and others (e.g. Green Globes, BREEAM, WELL for health aspects) establish best practices and performance

***Figure 1**: An infographic illustrating the core components of green hospital architecture, focusing on sustainable design and smart technologies to enhance energy efficiency, resource conservation, and patient comfort.*

benchmarks across key sustainability categories. For example, LEED for Healthcare addresses site selection, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation in design. These systems encourage an integrated design process and accountability through third-party verification. Studies reviewing green building rating systems note that most certification frameworks share common principles aimed at reducing environmental harm and resource use. Over time, these systems have evolved to incorporate broader sustainability aspects – not only environmental and economic criteria but also social considerations of occupant health and community impact. In essence, the trend is towards truly sustainable buildings that balance the "triple bottom line." For hospitals, achieving certifications like LEED can signify that the facility meets rigorous standards for energy efficiency, waste reduction, healthy indoor environments, and overall environmental stewardship. Certification benchmarks thus serve as useful design targets and validation tools, ensuring that a hospital's green design goals are comprehensive and measurable.

Recent studies are pushing sustainability efforts forward by examining how smart technologies, advanced materials, and data-driven environmental analysis can be effectively integrated into architectural design. Shafa (2024a), for instance, emphasizes the role of energy-efficient systems and renewable resources in developing intelligent, responsive buildings. Her complementary research (Shafa 2024b; Shafa 2025) explores materials like ETFE and phase change materials (PCMs), illustrating their ability to enhance energy performance, indoor comfort, and environmental adaptability—key attributes of sustainable architecture. Meanwhile, incorporating machine learning-based drought classification into environmental assessments adds a layer of precision and intelligence to site analysis and geotechnical planning (Saghaei et al. 2025). Together, these contributions help transform broad sustainability goals into practical, site-specific design solutions that influence choices in materials, energy systems, and environmental strategy.

This paper synthesizes these four dimensions – sustainable architectural principles, smart energy-efficient technologies, green certification systems and explores their integration in the context of hospital architecture. The following sections review the state-of-the-art in each domain, then discuss strategies for combining them into a cohesive design approach. By drawing connections between energy performance and structural safety, between intelligent systems and environmental certification, we aim to outline a holistic framework for that protect both people and the planet.

Innovative materials like ETFE (ethylene tetrafluoroethylene) foil cushions for transparent facades/roofs and thermochromic materials that change properties with temperature – these can reduce heat gain and improve daylighting while being lightweight alternatives to glass (Shafa 2024b). Such smart materials, tailored to environmental conditions, can significantly enhance a building's sustainability by improving adaptability and lifespan of building components (Addington and Schodek 2012). In terms of waste, sustainable hospitals aim to minimize construction waste (via recycling plans and prefabrication) and plan for operational waste management (facilitating recycling of paper, plastic, as well as safe handling of medical waste). Durable materials that can withstand heavy use in hospitals (e.g., rubber flooring, high-quality wall protection) also reduce the frequency of replacement, thereby conserving resources over the building's life cycle.

Indoor Environmental Quality (IEQ): Hospitals must provide a healing environment, so IEQ is paramount. Green design for IEQ includes maximizing natural daylight and views to the outdoors for patient rooms and staff areas, as studies have linked access to daylight with improved patient recovery rates and reduced staff stress (Ulrich et al. 2008). High-efficiency air filtration and ventilation systems ensure excellent indoor air quality by removing

contaminants – this overlaps with infection control, a unique requirement in hospitals. Using low-VOC interior finishes (paints, adhesives, flooring) prevents harmful off-gassing that could affect occupants, aligning with the health mission of healthcare facilities. Acoustic design is another factor: controlling noise through sound-absorptive materials and strategic space planning (to keep loud equipment or activities away from patient resting areas) contributes to a more healing environment. Thermal comfort is addressed through zoned climate control to adapt to different occupants' needs (patients, who may be sedentary, versus staff moving around). By designing for superior IEQ, green hospitals not only reduce energy (through daylight use and efficient ventilation) but also improve patient outcomes – a synergy between sustainability and healthcare quality.

It is important to note that implementing these sustainable design strategies can face practical challenges. Architects often must balance the initial costs and regulatory constraints with long-term benefits. Sustainable features can sometimes increase upfront construction costs (for example, adding a solar energy system or advanced wastewater treatment), which hospital clients might be hesitant to bear without clear ROI. However, many studies show life-cycle cost benefits via energy and water savings (Kats 2006). Shafa (2025) found in a survey of architects that economic and environmental factors were considered the most important drivers for applying sustainable design principles in projects – indicating that cost-effectiveness and environmental impact are top of mind. Lack of familiarity or training in green design can also hinder adoption; gaps in professional knowledge and perceived risks can create a disconnect between sustainability aspirations and execution. Overcoming these barriers requires education, stronger sustainability mandates, and showcasing successful precedents of green hospitals. In summary, sustainable architecture principles provide a foundation for green hospitals, establishing the design strategies and goals needed to reduce the ecological footprint of healthcare facilities while enhancing human wellness.

Energy-Efficient and Smart Technologies in Hospitals

Technological advancements play a pivotal role in achieving and maintaining sustainability goals in modern hospitals. Smart building systems and controls enable continuous monitoring and optimization of a hospital's performance, which is crucial given the complex, round-the-clock operations of healthcare facilities. Key aspects of smart and energy-efficient technology integration include:

•Building Management Systems (BMS) and Automation: A centralized BMS in a hospital monitors all major energy-consuming systems – HVAC, lighting, medical equipment loads, etc. Through automation, the BMS can adjust ventilation rates, temperatures, and lighting levels based on occupancy or time of day, ensuring energy is not wasted in unoccupied areas (like unused operating rooms at night) while always meeting critical minimum requirements. Sensors placed throughout the building (temperature sensors, CO_2 sensors for air quality, occupancy sensors, light sensors near windows) feed data to the BMS. Advanced controls use this data to, for instance, dim artificial lights when ample daylight is available or reduce airflow in areas with lower occupancy, thereby saving energy. According to a recent ranking study of smart building design factors, effective lighting control was one of the most impactful features for energy efficiency, alongside smart safety systems and climate sensors . In a hospital context, automated lighting and climate control not only save energy but also allow more precise environmental conditions tailored to patient comfort and medical needs.

•IoT and Connected Medical Systems: The Internet of Things (IoT) extends beyond traditional building services. Smart hospitals increasingly connect medical devices, nurse call systems, asset tracking, and even patient wearable devices into the hospital's digital network. While these primarily serve clinical and operational efficiency, they can intersect with building sustainability. For example,

occupancy data from IoT (knowing which rooms/beds are occupied) can inform HVAC zoning in real- time. Smart beds or tags can report when a patient room becomes vacant, prompting the BMS to set back the conditioning in that room until it is cleaned and reused. Such integration ensures energy is used only where and when needed, aligning with the efficient use principle. Additionally, predictive maintenance systems – where sensors on equipment like chillers or air handlers predict faults – help maintain optimal performance and prevent energy wastage due to poorly functioning equipment. The overarching idea is a hospital that self-optimizes and learns usage patterns to continually minimize resource consumption.

•Renewable Energy and Energy Storage: Smart technologies also encompass how hospitals generate, store, and manage energy. Given their critical role, hospitals require uninterruptible power – traditionally provided by backup generators. In a green hospital, renewable energy sources (solar panels, wind turbines if feasible, geothermal systems) are integrated to supply a portion of the power. Smart inverters and microgrid controllers can manage these renewable sources alongside batteries and the grid, ensuring the hospital can island itself during outages and optimizing when to use stored energy. This can dramatically cut peak demand and improve resilience. Some hospitals have adopted large battery storage or thermal storage (ice storage for cooling) to shift loads and better utilize renewable generation. These technologies are managed by intelligent controllers that respond to weather forecasts (for solar output) or grid signals. As an example, a hospital might use a smart microgrid to prioritize solar energy usage on a sunny day and charge batteries, then draw from those batteries in the evening peak hours – thereby reducing grid dependence and costs. The incorporation of renewables aligns with sustainable goals, and the smart control ensures reliability is not compromised, which is vital in healthcare settings.

•Smart Materials and Adaptive Systems: Beyond the conventional "hard" technologies, even architectural materials can be imbued with smart features. As noted earlier, materials such as phase change materials (PCMs) can be integrated in walls or ceilings to absorb excess heat and release it later, effectively leveling out temperature swings and reducing HVAC loads. Electrochromic or thermochromic glazing can dynamically tint or change properties to control solar gain. These systems can be automated or sensor-triggered – effectively acting as a building's "skin" that responds to climate conditions. For instance, a thermochromic window might be clear on a cloudy cool day (to admit heat and light) but turn opaque on a hot sunny day to block heat, all without user intervention. Shafa (2024b) emphasizes that using such intelligent materials significantly enhances compatibility with the environment and the building's adaptability to weather changes. In hospitals, where lighting and temperature control are critical, these adaptive solutions can maintain comfort while easing mechanical system demands.

Crucially, the integration of smart tech must maintain the safety and reliability standards of hospitals. All automated systems need manual overrides and fail-safes, given that patient health and safety are paramount. Cybersecurity of IoT devices is also a concern in connected hospitals. Nonetheless, when implemented thoughtfully, smart technologies are powerful enablers of sustainability: they continuously fine-tune building operations and uncover efficiencies that static designs cannot. As Saghaei et al. (2025) demonstrate, even at the urban planning level, integrating environmental intelligence (e.g., using machine learning on meteorological data) can inform better site decisions. In the context of a hospital, this suggests that data-driven approaches – from site selection (considering climate and hazards) to real-time building management – contribute to a smarter and more sustainable facility. By embracing automation and data, green hospitals can achieve high-performance targets and adapt over time to changing conditions or demands.

Green Building Certification Systems and Benchmarks

Green building certification systems (see Fig.2) provide a comprehensive set of criteria to

evaluate and recognize sustainable design and operations. For hospital projects, certification not only signifies environmental responsibility but also often correlates with improved patient environments and reduced operating costs. Several certification systems and guidelines can apply to hospitals:

•LEED for Healthcare (Leadership in Energy and Environmental Design): Developed by the U.S. Green Building Council, LEED is one of the most widely adopted rating systems globally. LEED for Healthcare is tailored to the 24/7, intensive-use nature of hospitals and healthcare facilities. It includes prerequisites and credits across categories such as Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, Indoor Environmental Quality, Innovation, and Regional Priority. Each credit has specific measurable targets (e.g. percentage energy cost reduction, water use reduction, use of certified wood, low VOC materials, daylighting for certain interior spaces, etc.), and projects earn points toward different certification levels (Certified, Silver, Gold, Platinum). Achieving LEED certification for a hospital can be challenging due to stringent healthcare requirements (for instance, high ventilation rates for infection control can conflict with energy efficiency). Yet many hospitals pursue it for the long-term benefits. According to the USGBC, LEED- certified healthcare facilities exemplify the "triple bottom line" by benefiting people (patients and staff health), planet (reduced emissions and waste), and profit (lower operating costs). Notably, certified hospitals often implement measures like healing gardens and enhanced ventilation beyond code minimums, which improve patient satisfaction – showing that sustainability and healthcare quality go hand in hand.

•BREEAM and Other International Systems: In other regions, hospitals may use certification systems like BREEAM (Building Research Establishment Environmental Assessment Method) from the UK, Green Star (Australia), CASBEE (Japan), and others. These systems have similar broad criteria covering energy, water, materials, etc., with some regional differences in emphasis. For example, BREEAM has credits for impact on ecology and public transport access, which are highly relevant for a hospital's site planning (ensuring good access via transit, minimizing disturbance to ecosystems). A review of global rating systems notes that despite differences in weighting, "most of the GBRSs have similarities in common more than differences" since all aim to create buildings that reduce environmental harm. Over time, many systems have converged towards including all three pillars of sustainability. The inclusion of credits for social aspects (like occupant health/comfort, or community impact) is a trend – for instance, a system initially called "Green Building Tool" was renamed to "Sustainable Building Tool" (SBTool) after adding social sustainability criteria. In essence, green certifications are evolving to sustainable building certifications that holistically assess environmental, economic, and social performance.

•Healthcare Specific Guidelines: Apart from general sustainability ratings, hospitals often follow guidelines focused on health and wellness. The WELL Building Standard, while not healthcare- specific, emphasizes indoor health factors (air, water quality, nutrition, light, fitness, comfort, mind) and could complement LEED for a hospital by ensuring a people-centered design. Additionally, tools like the Green Guide for Health Care (GGHC) provided an early framework specifically for healthcare facilities, which informed the development of LEED for Healthcare. Some countries also have energy or green building mandates for public hospital projects, effectively requiring a certification or equivalent compliance.

***Figure 2**: An infographic showcasing key green building certification systems—LEED for Healthcare, BREEAM, Green Star, and CASBEE—used to evaluate and guide sustainable design in healthcare facilities worldwide.*

One benefit of pursuing certification in hospital projects is the structured integrated design process it encourages. Achieving credits across categories requires collaboration between architects, engineers, hospital administrators, and clinicians from early stages – exactly the kind of multidisciplinary approach needed for a complex building like a hospital. This process can yield innovative solutions; for example, to get high scores in both energy and indoor quality, teams have experimented with technologies like displacement ventilation in patient rooms (which uses stratified airflow to both save energy and improve air quality for patients). Certification frameworks also push for commissioning and performance verification – a critical step in hospitals to ensure that all systems (HVAC, emergency systems, etc.) function as intended.

However, it is worth noting that typical green certifications have not historically included resilience (e.g., seismic resilience) as a scored category. They focus on sustainability during normal operation. There are emerging rating systems like RELi (which is oriented towards resilience) and some pilot credits in LEED for resilience, but these are new. Emerging frameworks such as RELi (Resilience Action List and Credit System) and PEER (Performance Excellence in Electricity Renewal) have begun addressing these gaps by explicitly incorporating resilience and grid reliability, but their application in healthcare contexts remains limited. Their evolving presence suggests a growing awareness of the need to bridge sustainability and disaster preparedness in future certifications. Thus, a hospital could be LEED Platinum yet still need separate verification that it meets seismic safety standards. In recognition of this, some researchers and practitioners argue for integrating resilience metrics into sustainability certifications for critical buildings. Overall, green certification systems remain a valuable tool for benchmarking hospital sustainability. They ensure a hospital project meets a broad set of environmental performance criteria and can provide public recognition which is beneficial for institutions focused on community trust. By following certification guidelines, project teams are less likely to neglect any key aspect of sustainability – from site ecology to patient wellness – thus producing a more balanced green design.

Integrated Approach: Toward Green, and Smart Hospitals

The domains of green design, smart technology, certification, and resilience should not be

viewed in isolation when it comes to hospital architecture. The ultimate goal is to create healthcare facilities that are sustainable in the broadest sense – environmentally, socially, and structurally. An integrated design approach recognizes interdependencies among these domains and seeks synergies where one strategy can serve multiple goals.

One useful concept is to think of a hospital as an ecosystem with various subsystems (energy, water, waste, safety, etc.) that can be optimized together. For example, consider the interplay between energy efficiency and resilience: a highly energy-efficient hospital (through insulation, efficient systems, on-site generation) not only lowers carbon footprint but is also easier to keep running on backup power during grid outages. In essence, efficiency enhances emergency resilience. A hospital that requires half the energy to operate can run twice as long on the same generator fuel or battery backup. This is a strong argument for sustainability measures from a resilience perspective. Conversely, adding resilience features like on-site solar and energy storage contributes to sustainability by reducing reliance on the grid and fossil fuels. Thus, strategies like solar PV with battery storage satisfy both LEED energy credits and provide critical infrastructure for disaster scenarios – a win-win.

Another synergy is between smart technologies and green operations. Smart building analytics can continuously commission and improve building performance, ensuring the hospital not only achieves but maintains its LEED or green targets over time. Machine learning models might predict how to adjust operations for an incoming heatwave or how to pre-cool certain areas to avoid peak demand charges, effectively marrying sustainability with advanced technology. Saghaei et al. (2025) illustrate the power of such data-driven models in environmental planning; in a hospital, similar models could integrate meteorological forecasts, real-time occupancy, and even patient care schedules to optimize energy and resource use dynamically. Moreover, smart systems aid in monitoring compliance with certification or regulatory standards – for instance, continuously tracking indoor air quality (a factor in both LEED and WELL) and alerting if levels deviate from the target, thereby ensuring the hospital's indoor environment remains healthy.

Green building certification frameworks can serve as a common language or checklist to align the many stakeholders in a hospital project. However, one must integrate additional criteria for resilience. A proposed integrated framework for a green, smart, resilient hospital could overlay sustainability targets with resilience targets. For example, in design charrettes, the team can simultaneously address: "How does this design decision impact energy performance, and how does it impact post-disaster functionality?" Some decisions might involve trade-offs: a large atrium might improve daylight (good for LEED and patients) but could be a seismic risk if not engineered properly – here, advanced structural design (perhaps base- isolating the atrium roof or using moment frames around it) can resolve the conflict. Integrative design is about finding solutions that satisfy multiple objectives. Table 1 already hints at such overlaps (e.g., the redundancy of power supply is both a resilience measure and aligns with "green" reliable operations).

In conclusion of this discussion, the integrated approach is not just a theoretical ideal but a practical necessity. The challenges of climate change and increasing natural disasters mean hospitals must reduce their environmental impact and be prepared for extreme events. By combining green architecture, smart systems, certification frameworks, and seismic design, we can create hospital buildings that are future-proof – minimizing harm to the environment while maximizing safety and resilience for the community. This holistic vision transforms hospitals into beacons of sustainability and security, showcasing how the built environment can rise to meet global health and climate challenges.

Conclusion

Designing a green hospital in the 21st century goes beyond simply adding solar panels or

meeting energy benchmarks – it requires a comprehensive approach that interweaves sustainability, technology, and resilience from the ground up. This paper has presented an integrated perspective on hospital architecture, drawing together sustainable design principles, energy-efficient smart technologies, green certification systems, and seismic resilience strategies. Through synthesis of literature and examples, several key conclusions emerge:

•Sustainable Design as a Foundation: Fundamental green architecture practices (efficient energy and water use, sustainable materials, healthy indoor environments) form the baseline of a green hospital. These measures yield significant environmental benefits and also improve patient outcomes and staff productivity. The case of Shiraz architects showed that environmental and economic factors are paramount considerations, reinforcing that green design can align with cost-effectiveness in healthcare projects.

•Smart Technologies Magnify Efficiency: Intelligent building systems and IoT innovations act as force-multipliers for sustainability. They ensure that a hospital's performance is continuously optimized, bridging the gap between design intent and actual operation. Smart hospitals can dynamically respond to changing conditions – saving energy, maintaining comfort, and even informing broader decisions like site suitability through environmental data modeling. Embracing these technologies is crucial to manage the complexity of modern hospitals without incurring resource waste.

•Certification Provides Comprehensive Targets: Green building rating systems like LEED for Healthcare offer a useful roadmap and accountability mechanism for achieving sustainability across a wide spectrum of criteria. They encourage integrated thinking and help institutionalize sustainability goals within the project. However, certifications should be complemented with explicit resilience planning, as current systems only partially address disaster preparedness. The trend towards including social and health factors in certifications is positive and particularly relevant to hospitals

For architects, engineers, healthcare administrators, and policymakers, the implications are clear. We must champion design approaches that break down traditional silos and address sustainability and safety in tandem. Future research could develop integrated assessment metrics for green and resilient hospitals, or document post-occupancy performance of such facilities to inform best practices. Machine learning and big data analysis (as seen in environmental modeling research) may also play a role in continuously improving hospital design guidelines as more performance data becomes available.

In closing, the green hospitals of tomorrow will likely be defined by their interdisciplinary excellence. They will harness cutting-edge materials and smart systems, fulfill rigorous sustainability certifications, and embody structural resilience that protects their mission under duress. These hospitals will not only heal patients but also heal the environment by drastically cutting emissions and resource use. They will stand as resilient community pillars in the face of climate change and natural disasters. The integrated design approach outlined in this paper is a step toward that vision – one where healthcare architecture becomes a model of how to build sustainably and safely in an increasingly uncertain world.

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Author Contributions: The author confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.
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AI-Guided Concept to Design Output: A Comparative Visual Analysis Based on SSIM, Histogram, and LBP in an Interior Architecture Studio

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Abstract: Artificial intelligence (AI) has rapidly become a transformative force in design disciplines, including interior architecture. With the increasing integration of AI tools into the design process, interior architecture education faces new pedagogical opportunities and challenges. This study examines how second-year interior architecture students utilized artificial intelligence (AI)-supported visual generation tools during the conceptualization and development of their design projects, and investigates the impact of these tools on creative processes within the context of the 'Interior Architecture Project I' design studio conducted at Istanbul Sabahattin Zaim University.

Ten second-year interior architecture students participated in a semester-long project focusing on the adaptive reuse of the historic Kibrithane Building, redesigned as a restaurant interior. At the beginning of the course, students generated concept visuals using AI tools such as Midjourney, Canva and Bing, etc. These images were based on their self-authored prompts and were intended not as final design templates but as visual stimuli to encourage reflective engagement and conceptual development. Students developed functional layouts, material, color strategies, and 3D models based on their AI-inspired concepts throughout the semester.

A comparative analysis was conducted between the AI-generated images and the final student designs using qualitative observations and quantitative image analysis methods: Structural Similarity Index (SSIM), Histogram Comparison, and Local Phase Descriptor (LPD). The evaluation focused on four key criteria: form, material, color, and spatial organization. The findings emphasize that AI tools, when used reflectively, act as creative catalysts rather than prescriptive design solutions. The study concludes that AI integration in design studios can support conceptual exploration, foster critical thinking, and maintain students' creative autonomy. It also recommends that educators guide students in interpreting and transforming AI outputs through aesthetic, functional, and contextual reasoning rather than applying them directly. This research contributes to the evolving discourse on AI in design education by highlighting its pedagogical potential and offering a framework for structured, critical integration within interior architecture curricula.

Keywords: Artificial intelligence, Interior architecture studio, AI-generated concepts, Creative process, Artificial intelligence in design education

1. Introduction

Interior architecture education is a field where technical knowledge and aesthetic skills are acquired and a process in which students' creative thinking, problem-solving, and multidimensional design development skills are supported. Historically, interior architecture education in Türkiye started in 1925 at the Sanayi-i Nefise Mekteb-i Alisi. However, the practical training of professionals dates back to the 1970s [Kaptan, 1998]. Interior architecture education has shaped two main approaches during this process: The first is decoration-oriented programs; the second is programs with a more holistic approach that associates interior architecture with disciplines such as architecture, industrial design, and landscape architecture [Çetin, 2021].

Educational programs have undergone significant changes with the impact of digital transformation on a global scale. Particularly since the 1980s, integrating computer-aided design (CAD) software into education has enabled the development of new means of expression in interior architecture studios. This digital transformation has recently gained a new dimension by integrating artificial intelligence (AI) supported tools into the design process. Interior architecture students now have the opportunity to guide decisions about the design object and the design process with AI-supported data and visualization tools.

Design studios are one of the most critical areas of interior architecture education, where students transform creative thoughts into concrete outputs. The studio structure covers a multidimensional process from conceptual research to technical drawings, from material selection and spatial organization to presentation skills. Especially in the early stages of the studio, students often utilize visual references (e.g., Pinterest, Google Images, etc.) in the concept development process. However, this method can sometimes lead to repetitive design patterns that are far from original. Artificial intelligence-based visual production tools have the potential to break this cycle by enabling students to produce original visual outputs with scenarios and keywords of their choice.

This study was produced from the paper "The Effect of Artificial Intelligence on Interior Architecture Design Studio," presented at the ICMEK 5th International Congress on Interior Architecture Education held in 2024. This analysis examines the effects of artificial intelligence-supported tools in interior architecture studios on students' design process. The study evaluated the contribution of artificial intelligence to the design process through a project studio conducted with 2nd-year students of Istanbul Sabahattin Zaim University Department of Interior Architecture. The conceptual visuals produced by the students with artificial intelligence and the three-dimensional (3D) designs they created at the end of the semester were compared and analyzed in terms of visual similarity, design principles, and spatial atmosphere.

This research is grounded in two interrelated pedagogical frameworks: Donald Schön's concept of the "reflective practitioner" and David Kolb's experiential learning theory. Schön (1983) argues that professional knowledge is not merely applied but constructed through action and reflection. In the design studio, students engage in reflection-in-action as they critically respond to complex design challenges during the process and in reflection-on-action as they assess their decisions retrospectively. The introduction of AI-generated visual inputs in this study catalyzed both types of reflection, enabling students to interpret, modify, or contest the initial data based on design intentions and user needs.

In design pedagogy, Donald Schön's concept of the 'reflective practitioner' emphasizes learning through action and reflection rather than through the passive transmission of knowledge. According to Schön (1983), design is an inherently reflective process in which professionals engage in reflection-in-action—thinking and making decisions while designing—and reflection-on-action, which

involves evaluating and learning from one's design outcomes retrospectively. In this study, integrating AI-generated visual inputs into the design process is positioned not as a shortcut to solutions but as a stimulus for reflective thinking. Students were encouraged to critically interpret and transform the AI outputs based on contextual needs, user scenarios, and spatial constraints. This reflective engagement with AI tools aligns with Schön's framework, suggesting that the design studio can serve as a dynamic space for constructing knowledge through iterative thinking, making, and evaluating.

Kolb's experiential learning model (1984), which consists of a cyclical process—concrete experience, reflective observation, abstract conceptualization, and active experimentation—complements Schön's approach by emphasizing how learners transform experience into knowledge (Figure 1). Within this framework, AI tools functioned as mediators that facilitated iterative exploration: students generated visual content (concrete experience), critically reviewed AI outputs (reflective observation), redefined design ideas (abstract conceptualization), and applied them in their final studio projects (active experimentation). The interplay of these pedagogical models underscores the studio not as a site of passive instruction, but as a dynamic environment for reflective inquiry, experimentation, and creative authorship—particularly when augmented by emerging technologies such as artificial intelligence.

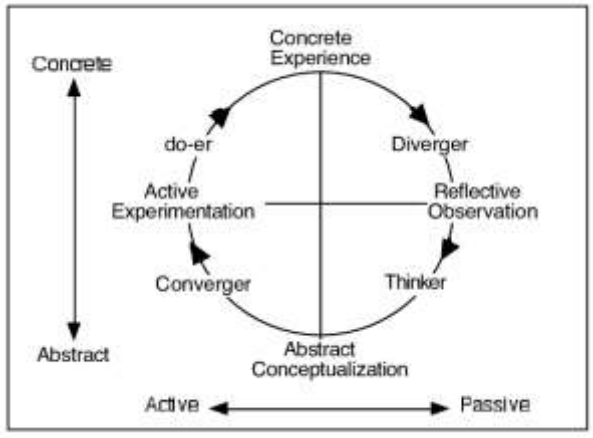

Figure 1: *Kolb's experiential learning model (Smulders, 2011)*

Students were encouraged to engage with the AI-generated images not as fixed templates but as fictional design experiments. In line with Schön's (1983) reflective practitioner model, students were guided to question, reinterpret, and adapt AI outputs through iterative critique and personal design logic—an approach fostering reflection-in-action.

Moreover, the learning cycle proposed by Kolb (1984) provided an implicit pedagogical structure throughout the design process. The AI-generated image was a concrete experience, prompting students to engage in reflective observation as they analyzed and critiqued the outputs. Through this, they entered the phase of abstract conceptualization, developing personalized design ideas, which were later tested through active experimentation in spatial modeling and rendering. The entire studio process was thus intentionally aligned with these pedagogical theories, ensuring that the integration of AI technologies did not replace creative thinking but instead supported it through structured, reflective engagement.

In this context, form, material, color, and space criteria were determined based on the basic design elements and principles (Ching, 2007; Güngör, 2005; Aydınlı, 1992, 1993) widely accepted in the design literature. The form criterion was defined through components such as point, line, plane, volume, and direction, while the material was evaluated in terms of texture and surface quality. The color criterion included tone, value, and harmony, whereas space was considered with interior atmosphere, the balance of void and mass, and the use of light. These four criteria were selected to enable a multidimensional analysis of how and to what extent AI-generated concept visuals influenced students. Therefore, it aims to evaluate how effective artificial intelligence can be in terms of originality, creativity, and process management in interior architecture education.

This study employed a comparative visual analysis to examine the relationship between each student's AI-generated concept image and their final 3D studio design. The researcher, who also served as the studio instructor,

conducted the evaluation and observed each student's design development throughout the semester. A structured rubric—developed in alignment with the predefined criteria—was used to assess the design outcomes based on four key dimensions: volumetric composition (form), surface and material texture (material), color scheme and visual contrast (color), and spatial organization and experiential quality (space). Although a single evaluator carried out the assessment, the use of standardized definitions, consistent evaluation procedures, and visual documentation helped reduce subjectivity and maintain analytical rigor. This approach allowed for a context-sensitive and pedagogically informed interpretation of each student's creative engagement with AI tools.

2. Literature Review

Artificial intelligence (AI) has increasingly emerged in design disciplines in recent years. AI technologies integrated into the design process enable visualization of design outputs and influence multidimensional areas such as data analysis, decision-making, form creation, user experience, and sustainability. Architecture and interior architecture have also been significantly affected by the transformation.

Generally, studies on the use of AI in architecture are categorized under two main headings. The first group focuses on integrating artificial intelligence into the usage phases of the building. In these approaches, AI is used to optimize building performance with sensors, systems that analyze user movements, and automation-based scenarios. Examples in this field are generally developed on smart building and smart housing systems [Tomaş, 2019; Uzunali, 2003; Yalkı, 2001]. In addition, researchers such as Üstün [2020] examined the contribution of these systems to sustainability, energy efficiency, and user comfort.

The second group of studies are approaches where AI is used directly in the design process. The studies focus on using AI algorithms in early design stages such as planning, form development, and layout. Researchers such as Baydoğan [2013] and Kayış [2019] have developed models for creating site plans with the help of artificial intelligence. Özkan [2022), Çerçi [2022], Akçan [2022], and Sanalan [2022] evaluated the impact of AI on architectural form, especially visual production, design proposal diversity, and integration with parametric approaches.

Kahraman et al. [2024] evaluated AI integration in interior design education by comparing student projects that used different levels of prompt quality in generating concept images. The study found no significant difference in creativity scores but highlighted that effective adaptation of AI-generated content to design context is key. The authors conclude that AI supports rather than replaces design thinking and recommend further exploration of hybrid AI approaches in education.

Recent studies have also begun to explore how interior architecture students perceive and interact with AI technologies. Cao, Aziz, and Arshard [2023] examined the attitudes of interior architecture students in China toward artificial intelligence technologies using the Technology Acceptance Model (TAM). The research revealed limited awareness of advanced AI tools yet a notable openness to adopting them for enhanced productivity and creativity. The findings emphasize the need for educational institutions to strengthen AI literacy among design students. Similarly, Aboushall [2024] investigated the impact of artificial intelligence on interior design processes and emphasized that while AI cannot fully replace human creativity, it can effectively support design and implementation. The study highlighted the role of machine learning and digital fabrication in enhancing design performance, suggesting that AI should be viewed as a supportive tool rather than a substitute for designers.

Ismail [2024] explored the integration of artificial intelligence technologies into interior architecture education by focusing on applied student experiences. It emphasized the importance of introducing students to AI tools and proposed the creation of structured yet adaptable frameworks to guide AI integration

into design studios. In addition, Carroll [2024] examined how generative AI tools—specifically Stable Diffusion—can be integrated into conceptual design processes in interior architecture. The research explored using multimodal inputs, such as physical models and text prompts, to generate design visuals aligned with designers' intentions. The study emphasized the creative potential of using AI in early design phase. It contributes to understanding how AI can augment ideation rather than merely automate routine tasks.

Despite the growing literature on AI integration in architecture, studies on interior architecture education are relatively limited. Considering that interior architecture differs from architecture in its unique components, such as material, color, texture, atmosphere, furniture, and user experience, the pedagogical and methodological effects of using AI should be evaluated separately. In this context, Arisha (2023) emphasizes the transformative potential of AI-driven design tools in interior design education, highlighting how spatial scenarios grounded in art and design culture can be generated through AI programs and integrated into curricular frameworks. The study proposes an interdisciplinary pedagogical model that incorporates coding, prompt-based visual production, and AI-assisted design processes tailored to the specific needs of interior design education. Similarly, Almaz et al. (2024) emphasize that AI contributes to efficiency and sustainability and significantly enhances creativity; their study shows that AI-supported design tools enable students to explore diverse design scenarios rapidly and effectively within an integrated learning environment.

The interaction between AI and space design was addressed in a study by Bayrak [2022], and it was concluded that students generally approached these new production tools positively. However, the study does not include in-depth analyses of how students use AI in the design process, how decision-making mechanisms are shaped, or to what extent design outputs are affected.

The existing literature lacks comprehensive investigations into how interior architecture students engage with concept development processes through the use of artificial intelligence. The impact of AI on design originality and creativity remains controversial, and qualitative observations on how AI transforms the relationship between students and the design process are largely missing from the literature.

Regarding design education, Charles Eames' statement in 1954, "Design will be done with new technological tools in the future and the more prepared the designer is for these tools, the more successful he will be", is still valid today. Technological tools should be considered not only as instrumental but also as a pedagogical element. Currently, technology integration in education is considered not only an instrumental add-on but also a structure that transforms ways of designing.

Especially in disciplines where visuality and representation are prominent, such as interior architecture, AI-based tools offer an experimental environment where students can develop unique design language. However, the way in which this experimental environment is aligned with design pedagogy is still open to research.

3. Methodology

This study was conducted as part of the course "Interior Architecture Project I," offered during the Spring semester of the 2023–2024 academic year in the Department of Interior Architecture and Environmental Design at Istanbul Sabahattin Zaim University. The course aimed to equip students to evaluate context, materials, user needs, and aesthetic decisions holistically when designing a functional interior space. The

study involved ten second-year students enrolled in this studio course and voluntarily participated in the research.

The project subject focused on the adaptive reuse of the Kibrithane building, a registered cultural heritage site located in the Küçükçekmece district of Istanbul. Students were tasked with developing an interior design proposal for a restaurant function within a maximum area of 850 m² in the existing structure.

The implementation process was structured around four main stages to systematically examine how students integrated AI-supported tools into their design workflow and how these tools influenced the final outcomes. First, students conducted structural and environmental analyses by researching the historical building and its surroundings, focusing on functional, historical, and spatial context. In the next stage, they generated site-specific concept visuals using AI-assisted tools such as Midjourney, Bing Image Creator and DALL·E, guided by a predefined user profile and functional requirements; the originality and adequacy of the prompts varied across participants. In this work, AI-generated images are not treated as fixed templates or final design proposals but are positioned as inspiration boards, visual trigger stimuli that aim to encourage reflective and creative engagement throughout the design process.

Students developed interior design solutions based on these visuals, including functional layouts, furniture arrangements, and material proposals. Finally, their 3D models were compared with the initial AI-generated visuals through quantitative and qualitative methods, enabling an evaluation of the extent and nature of AI's influence on the final design outputs.

3.1. Research Process and Stages

The research process was structured in four stages to investigate the influence of artificial intelligence (AI) tools on interior architecture design studio practices. As the first step, students were asked to develop a concept shaped by a user and scenario of their choosing, to be situated within a designated part of the historical Kibrithane Building. Each student prepared stroyboard showing the process of the restaurant with the visuals they created with artificial intelligence using AI tools such as Midjourney and DALL·E. The prompts, written freely by the students, included keywords and spatial descriptions reflecting their design intentions and varied in clarity and detail, allowing for comparative analysis. The AI-generated visuals served as conceptual references, providing initial insights about form, material, atmosphere, and spatial qualities. Although some outputs were unrealistic or functionally inconsistent, they significantly stimulated students' design thinking. The students then developed interior design solutions based on these visuals, producing spatial layouts, functional schemes, material and color strategies, and three-dimensional models with explanatory renderings. In the final stage, the AI-generated concept images and the students' final 3D

Figure 2: *Comparative student project produced by AI and 3D design programmes*

design outputs were analyzed using qualitative and quantitative methods (Figure 2). This included content analysis and visual similarity assessments based on SSIM, histogram comparison, and Local Phase Descriptor (LPD) analysis. These evaluations provided insights into how AI-supported tools influenced the design process and the specific design criteria—such as form, material, color, and spatial organization—where this impact was most apparent.

3.2. Evaluation Criteria

This study examined the impact of AI-supported tools on the interior architecture design process at both formal and conceptual levels by analyzing students' project outcomes. Accordingly, the evaluation process was based on four main criteria: form, material, color, and spatial atmosphere. These criteria were selected not only because they represent the fundamental components of interior design but also because they are the primary visual domains most affected by AI-generated outputs.

In particular, formal composition and spatial atmosphere are areas where students express their creativity most clearly. In contrast, AI tools often automatically produce material and color and may appear disconnected from the design context or overly hyper-realistic. Therefore, the comparative analysis based on these four criteria provides a meaningful framework for assessing both the divergences between AI-generated concepts and student interpretations and the extent of the students' original contributions. These criteria are also widely recognized in the interior architecture literature as fundamental components used in design evaluation and analysis (Ching, 2007; Güngör, 2005; Aydınlı, 1992, 1993).

The criteria were applied as follows:

Form was assessed regarding volumetric coherence, geometric balance, proportion, and spatial organization.

Material was evaluated based on texture, surface quality, and material authenticity.

Color was analyzed through color palette selection, contrast, and tonal harmony.

Space was examined concerning the balance of solid and void, light and shadow effects, spatial openness, and the overall sense of spatial experience.

3.3. Visual Comparison Tools

Within the scope of the study, the AI-generated concept visuals were visually compared with the students' final interior design proposals developed at the end of the semester. Three pixel-based image analysis methods were employed to obtain more objective and measurable data beyond qualitative observations: Structural Similarity Index (SSIM), Histogram Comparison, and Local Phase Descriptor (LPD).

SSIM is an algorithm that measures the structural similarity between two images (Wang et al., 2004). It evaluates parameters such as brightness, contrast, and texture, producing a similarity score between 0 and 1—where 1 indicates perfect similarity and 0 indicates complete dissimilarity. This study normalized both AI-generated visuals and student designs to the exact resolution (256×256 pixels), and an SSIM score was calculated for each paired image set. This method was used primarily to evaluate the form and spatial criteria.

Histogram comparison assesses the distribution of colors in images to evaluate similarity in terms of color harmony and tonal transitions. RGB color space histograms were created for each image and compared accordingly. Since AI-generated visuals often involve hyper-realistic or highly stylized color usage, this method analyzed how students transformed these color suggestions in their design decisions. Histogram comparison served as the primary analysis tool for the color criterion.

LPD is an image comparison method that analyzes edge, texture, and micro-pattern variations (Figure 3). Considering the image's local phase information enables highly accurate texture analysis. It is particularly suitable for examining details related to material and surface quality. This method determined how and to what extent students incorporated and transformed material and texture suggestions from the AI-generated visuals into their designs.

All visual similarity analyses (SSIM, Histogram, and LPD) were conducted using open-source Python libraries with the assistance of ChatGPT, which provided support in coding

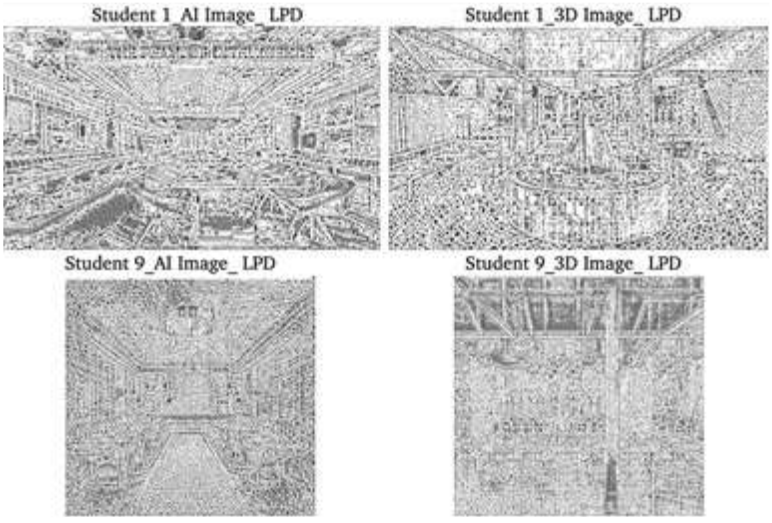

Figure 3: *Local Phase Descriptor (LPD) analysis of Students 1 and 9*

and implementing the comparative analysis methods. This is disclosed in accordance with ethical transparency principles regarding AI-assisted research. In this process, images were resized at the exact resolution, color balances and light intensity levels were equalized, and analysis conditions were standardized. The similarity percentages obtained for each project were transferred to the table, and the total average similarity ratio was determined (Table 1).

The CAIDC (Creativity Assessment in the Interior Design Classroom) framework, which provides a structured rubric for assessing creative performance in design education, was adopted in this study to evaluate the creativity levels of student projects. The rubric includes four main criteria: originality, functionality, aesthetic quality, and design process management, each rated on a 5-point Likert scale (1 = very weak, 5 = very strong). The researcher conducted the evaluation, acted as the studio instructor, and was familiar with the students' design development throughout the semester. Although this introduces the potential for subjective bias, a predefined rubric and consistent scoring protocol were applied to ensure reliability and transparency. The scoring was supported by visual comparisons and reflective documentation provided by the students, allowing for a comprehensive and context-sensitive assessment of creativity in the AI-assisted design process.

In the study, creative impact was not measured directly. Still, it was evaluated through the degree of transformation in sub-criteria such as form, material, color, and space atmosphere, and the capacity to move away from the AI output/reinterpret it. In particular, the students' designs who developed their own contextual decisions instead of adhering to the AI visual received higher scores in terms of creative interpretation. Thus, creativity could be evaluated qualitatively through the transformation skills in the design process instead of a single score.

4. Findings

In this section, the students compare the concept visuals they generated using AI-supported production tools with the 3D design visuals they created at the end of the semester, evaluating them based on four main design criteria: form, material, color, and space. Visual analysis measured each criterion, and pixel-based comparisons calculated percentage similarity ratios.

The AI-generated visual produced by Student 1 at the beginning of the semester was compared with their final 3D design using the Structural Similarity Index (SSIM) method (Fig. 4). The structural similarity was calculated as 8.01%. The student significantly altered the AI output's volumetric arrangement and spatial layout, introducing notable differences in the central table composition, ceiling design, and overall symmetry. This indicates that the AI-generated image was not directly transferred into the final design but reinterpreted through a contextual and simplified design approach.

Figure 4: *Student 1's AI concept drawing (left), final 3D drawing (center) and visual difference analysis (SSIM) (right)*

Histogram analysis revealed 22.13% similarity. The warm and flashy tones in the AI image were transformed into light and natural material tones in the student's design. This shows that individual and contextual preferences are effective in color decisions. LPD analysis revealed 99.44% similarity. It is understood that the student has largely preserved the surface and material representations suggested by AI. This indicates that the creative intervention is concentrated on the scale of form and space and is limited in the textural dimension. The overall similarity rate was calculated as 43.19% when the three analyses were averaged.

As a result of the SSIM analysis of the AI and 3D works of Student 2, a structural similarity of 12.13% was determined (Figure 5). The student transformed the historical-mystical atmosphere in the AI image into a simpler language that combines local, modern, and traditional motifs in its context. The histogram analysis result is 67.96%. The color palette was reconstructed with a similar temperature balance without being utterly dependent on the AI visual. This points to the student's ability to be inspired by the visual and transform it by their context. The LPD analysis resulted in 99.64% high similarity. Although there are some differences in form and structure, a high level of similarity with the artificial intelligence image was maintained in surface details and aesthetic details. This shows the student adhered to the AI visual in material and texture preferences.

The SSIM analysis of the AI and 3D visuals of Student 3 was calculated as 17.86%, the Histogram analysis as 33.46%, and the LPD analysis as 95.65% (Figure 6). According to these results, the student developed a different design identity based on the atmosphere offered by the AI image rather than imitating it exactly. While the AI visual provides a unique color atmosphere with its open-air effect and natural elements, the student design tends towards a more controlled, closed, and fictional understanding of color within the defined boundaries of the interior space. The surfaces are clear and complete in both the AI and the student visuals, and prominent textures are

Figure 5: *Student 2's AI concept drawing (left), final 3D drawing (center) and visual difference analysis (SSIM) (right)*

Figure 6: *Student 3's AI concept drawing (left), final 3D drawing (center) and visual difference analysis (SSIM) (right)*

Figure 7: *Student 4's AI concept drawing (left), final 3D drawing (center) and visual difference analysis (SSIM) (right)*

used, especially in the background. Although presenting a different spatial construct, the student uses the surface effect with similar intensity.

When Student 4's AI and 3D works were analyzed using the SSIM method (Figure 7), a structural similarity of 18.93% was found between the two images. The student abandoned the characteristics such as "openness, naturalness, lightness" offered by AI and presented an abstract formal expression and different functional analysis. This shows a creative approach independent of the AI proposal. Histogram analysis of the two images yielded a similarity rate of 48.33%. The AI image is all-natural light and creates a feeling of lightness, while the student design creates a dramatic stage atmosphere with obvious artificial lights and reflective surfaces. The similarity of texture and surface (LPD) was 99.77%. Although the space organization and light are different, the materials' surface effects and textural character are strongly similar.

SSIM analysis of Student 5's images shows a low structural similarity rate of 16.86%. Both images have Japanese/Asian aesthetics (e.g., screens, tea ceremony elements, murals). Still, they are applied in very different ways (Figure 8). The AI design is characterized by warm light and an atmosphere typical of a traditional Japanese interior. In contrast, the student design produces a different perception with daylight from the outside and stagelike tones in the interior. This was supported by the histogram analysis with a rate of 19.18%. The 98.80% high level of similarity obtained from LPD analysis shows that the student design is largely faithful to the AI visual regarding surface and material textures.

Figure 8: *Student 5's AI concept drawing (left), final 3D drawing (center) and visual difference analysis (SSIM) (right)*

Figure 9: *Student 6's AI concept drawing (left), final 3D drawing (center) and visual difference analysis (SSIM) (right)*

Student 6 a very low structural similarity rate of 9.05% was obtained between the AI and 3D images (Figure 9). The student has simplified the rich form character of the AI image in a more contemporary language. The Histogram analysis with a rate of 70.23% shows that the color palette of the AI image was largely adhered to. While the AI image is a historical space illuminated with natural light, the student design is designed as a more contemporary interior space. However, the color choices and emphasized materials are similar. Both images feature rich texture combinations that create visual interest. Texture and surface similarity (LPD) was measured as 95.63%. This situation created similar pattern density and transitions in surface analysis.

As a result of the SSIM analysis of the AI and 3D works of Student 7, a low structural similarity of 6.85% was found (Figure 10). The student did not adopt the dense formal language proposed by AI; instead, he constructed the space as simple, casual, and accessible with his design analysis. On the other hand, he achieved a high rate of 60.90% in the Histogram analysis. Although the two images are quite different in form, there is a general harmony between the color spectrum. In the LPD analysis, a very high similarity rate was reached. A 99.57% similarity rate shows that although the volumetric construction of the space is different, it is strongly influenced by the AI visual in terms of the richness of surface details and the way it is organized.

Figure 10: *Student 7's AI concept drawing (left), final 3D drawing (center) and visual difference analysis (SSIM) (right)*

Figure 11: *Student 8's AI concept drawing (left), final 3D drawing (center) and visual difference analysis (SSIM) (right)*

When the AI and 3D works of Student 8 were analyzed with the SSIM method, a structural similarity of 14.21% was found between the two images (Figure 11). The dense texture, symmetrical arrangement, and material diversity in the AI image were solved with minimal, simple, and homogeneous surfaces in the student image. In histogram analysis, the similarity rate was measured as 16.26%. The student has formally interpreted the elements inspired by AI but shows that he has built a very different world regarding color and atmosphere. The LPD analysis rate is relatively high, with 99.77%. A parallelism exists between the linear textures observed, especially on the walls and furniture surfaces, floor coverings, and furniture borders in terms of LPD analysis.

The structural similarity (SSIM) between the Student 9 images is 17.02%. While the student design has a more simplified and modern style, the AI image uses a language of textured walls, ornamented ceilings, and rich details (Figure 12). Histogram correlation was measured at 27.25%. The color difference transformed the aesthetic and perception of the space: The AI image was more luxurious, classical, and theatrical, while the student design produced a more contemporary and casual interpretation. LPD analysis was detected 99.39% of the time. Although the space is more open and linear in the student visual, it is observed that the surface materials are faithful to the AI visual.

Figure 12: *Student 10's AI concept drawing (left), final 3D drawing (center) and visual difference analysis (SSIM) (right)*

Figure 13: *Student 9's AI concept drawing (left), final 3D drawing (center) and visual difference analysis (SSIM) (right)*

When we analyzed the AI and final 3D visuals of Student 10 with the structural similarity method, 10.80% similarity was obtained. The student has redesigned the spatial scale, functional organization, and architectural language according to his style (Fig. 13). The histogram analysis result is 25.25%. The change of colors is an essential factor that directly affects user perception. In this context, the student has reinterpreted the AI visual on the axis of functional simplicity. Finally, when we examined the surface and material textures with LPD analysis, 99.61% similarity was found. Although the volumetric and structural constructions differ, the student has developed a close aesthetic understanding of texture arrangements.

In the study, comparative analyses of the artificial intelligence-supported concept visuals of 10 students and their final designs, according to form, material, color, and space criteria,

Table 1: *Similarity ratios between artificial intelligence and 3D design visuals.*

Project number	Form (SSIM)[1]	Material (LPD)	Color (Histogram)	Space (SSIM)	Total Similarity Rate
01	%8.01	%99.44	%22.13	%8.01	**% 34,39**
02	%12.13	%99.64	%67.96	%12.13	**%47,96**
03	%17.86	%95.65	%33.46	%17.86	**%41,20**
04	%18.93	%99.77	%48.33	%18.93	**%46,49**
05	%16.86	%98.80	%19.18	%16.86	**%37,92**
06	%9.05	%95.63	%70.23	%9.05	**%45,99**
07	%6.85	. %99.57	%60.90	%6.85	**%43,54**
08	%14.21	%99.77	%16.26	%14.21	**%36,11**
09	%17.02	%99.39	%27.25	%17.02	**%40,17**
10	%10.80	%99.61	%25.25	%10.80	**%36,61**
Total Average	**%13,17**	**%98,72**	**%39,09**	**%13,17**	**%41,03**

quantitatively revealed the similarity rates of each project (Table 1). The data obtained shows a high material/texture similarity level, averaging 98.72%. This indicates that the artificial intelligence visuals significantly influenced the students regarding material character, surface texture, and aesthetic atmosphere. On the other hand, low similarity rates were found in form (13.17%) and space (13.17%) criteria. This shows that the students developed original design strategies in spatial organization, mass placement, and formal decisions and put forward formal interpretations independent of artificial intelligence. The use of color (39.09%), on the other hand, shows a moderate level of diversity, with some students being more faithful to AI visuals while others adopted completely different color schemes. In total, the average of the four criteria was 41.03%. This rate shows that AI tools do not have a limiting effect on students; on the contrary, they have an inspiring and guiding impact on students and that students maintain their creative interpretation skills.

5. Conclusion and Recommendations

This study has several limitations that should be acknowledged when interpreting the findings. First, the varying levels of students' rendering proficiency and software literacy may have influenced their ability to translate design intentions into digital outputs. As a result, some students may have remained visually closer to the AI-generated concept due to technical constraints rather than intentional design decisions. Second, the time limitations inherent in the academic calendar—especially within a tightly scheduled studio—may have restricted iterative exploration and refinement opportunities. These factors introduce variability that cannot be entirely controlled and may affect the consistency of the comparative analysis. Therefore, the results should be viewed not as definitive measures of creativity or originality but as reflections shaped by a combination of pedagogical experimentation, technological mediation, and practical studio conditions.

This study explored the integration of AI-supported visual generation tools within an interior architecture design studio. It focused on how second-year students utilized these tools during conceptualizing and developing their design projects. Through a structured methodology combining AI-based concept generation, design development, and visual analysis, the study revealed that students actively engaged with AI outputs but did not adopt them directly. Instead, they reinterpreted these visuals by incorporating contextual, functional, and aesthetic judgments, transforming AI suggestions into original, coherent design solutions.

The comparative analysis using SSIM, histogram comparison, and LPD methods demonstrated that the students differed from the AI-generated visuals regarding form, material, color, and spatial atmosphere. These findings highlight the potential of AI as a creative catalyst rather than a deterministic design tool, supporting critical thinking and iterative design development when used reflectively.

- AI tools should be used as supportive instruments that encourage conceptual exploration. These tools can allow students to enhance creative thinking and explore diverse design scenarios.
- Educators should promote a critical and contextual engagement with AI outputs rather than direct implementation. This approach enables students to develop conscious and original design decisions.
- Integrating AI-supported tools in interior design education should go beyond technical proficiency and include aesthetic, cultural, and user-centered evaluations.
- AI tools used in design studios should be structured in a way that guides students, helping them develop skills in prompt writing, interpretation, and synthesis.
- Future studies are encouraged to apply this approach across user profiles, design scales, and AI models. This would allow a broader evaluation of AI's influence on design pedagogy.

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

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

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

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

Introduction

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

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

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

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

Method

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

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

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

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

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

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

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

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

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

Sustainability Goals and Cycling Infrastructure of Universities

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

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

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

Study Area and Field Data

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

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

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

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

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

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

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

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

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

Table 2: *Design Studio processes and student achievements*

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

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

Design Decisions of Student Projects

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

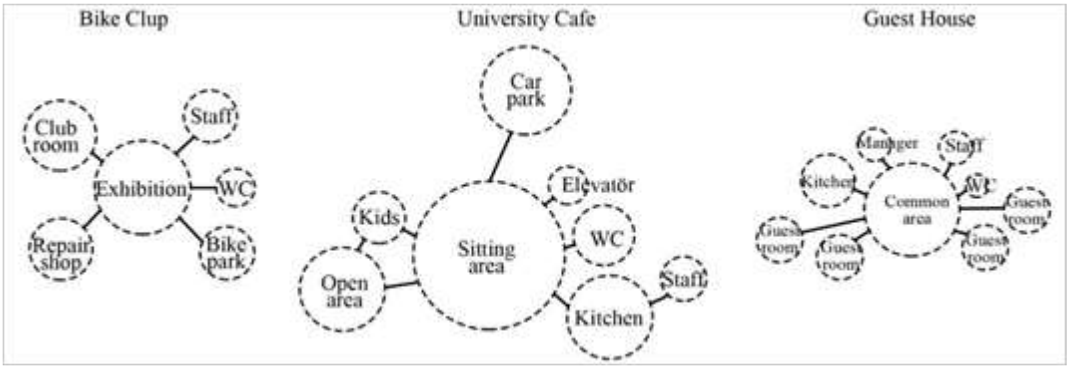

Figure 4: *Bubble diagram (Adopted from İsmail Tekeli's drawing)*

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

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

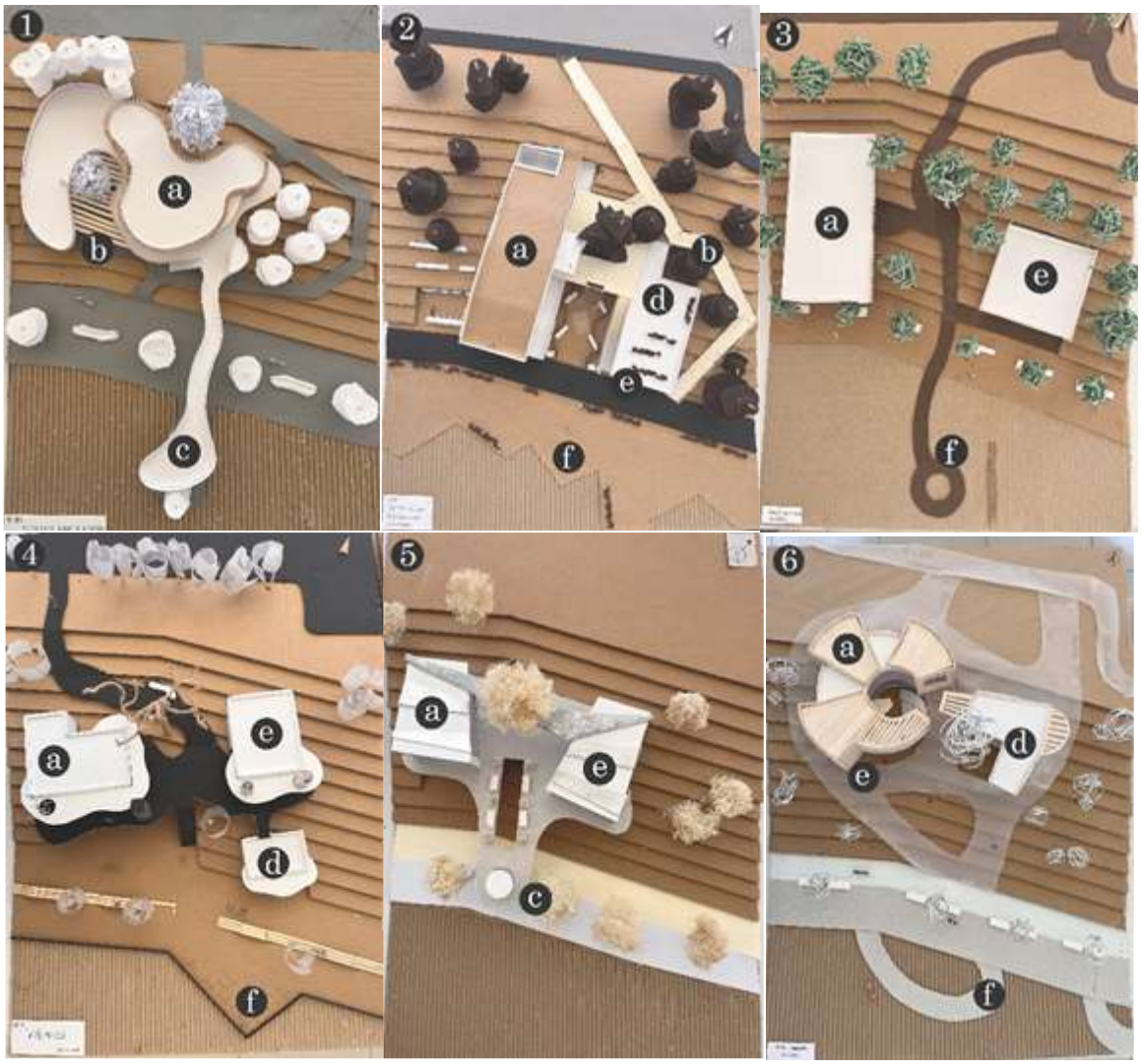

Figure 5: *Design decisions and locations of units on the project site*
(1: Altynbek Mamyrov, 2: Özlem Merve Büyükakkaş, 3: Shams Dheyaa Mahmood Almarawee, 4: İsmail Tekeli, 5: Münire Battal, 6: Seyedeh Asmae Alboshokeh)
a: cafe b: inner garden c: observation terrace d: guest room e: bike club f: wharf

Street sections and bicycle-friendly urban furniture designs

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

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

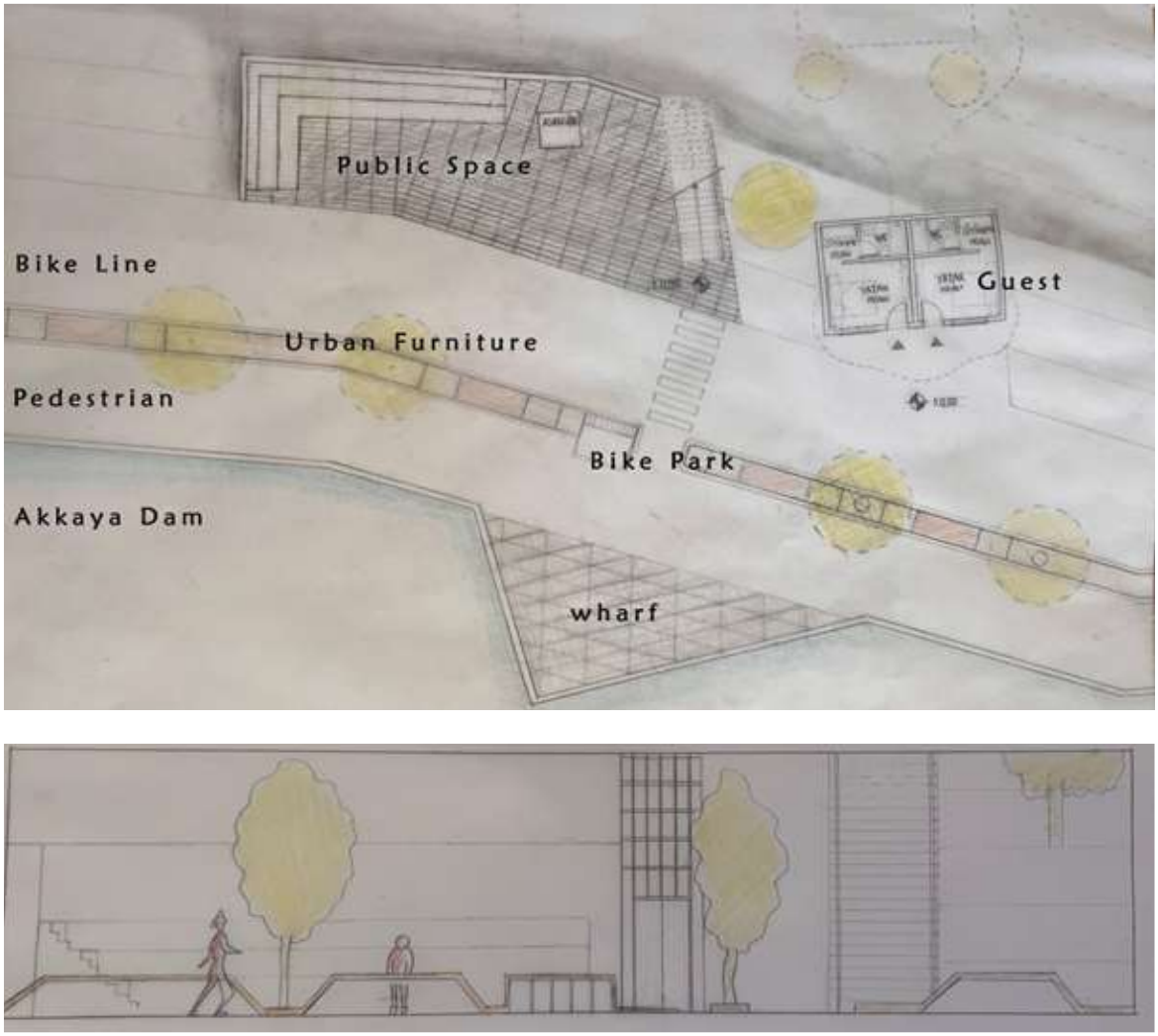

Figure 6: *Street section and its relationship with water (İsmail Tekeli)*

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

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

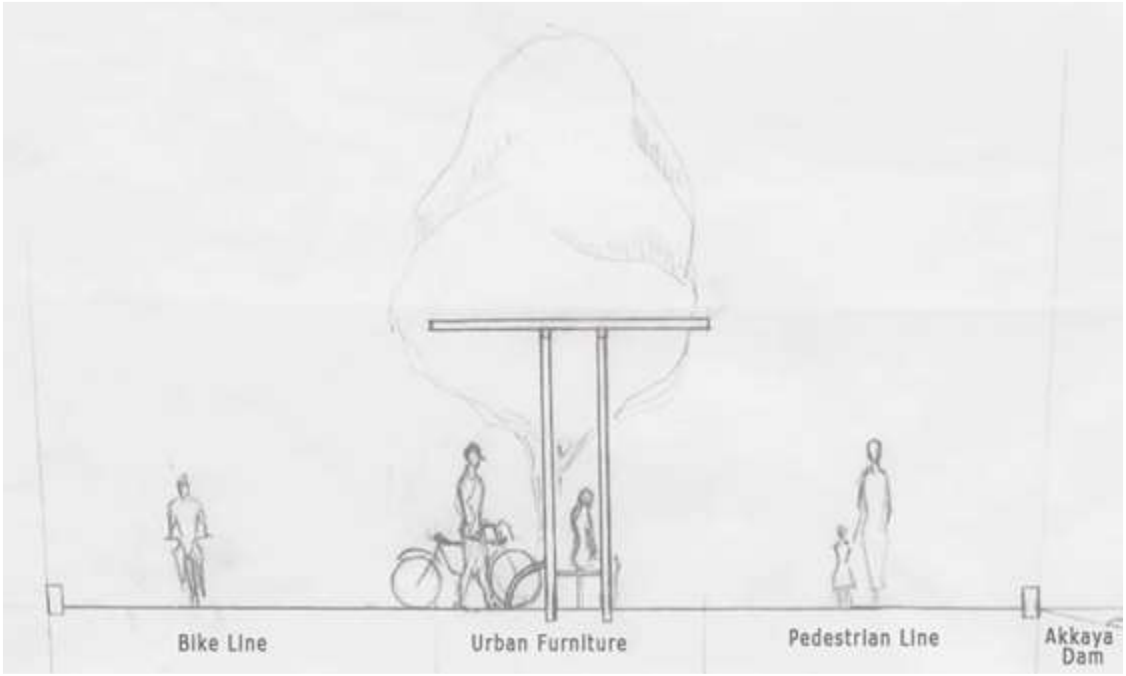

Figure 7: *Design of bicycle and pedestrian paths around the dam (Altynbek Mamyrov)*

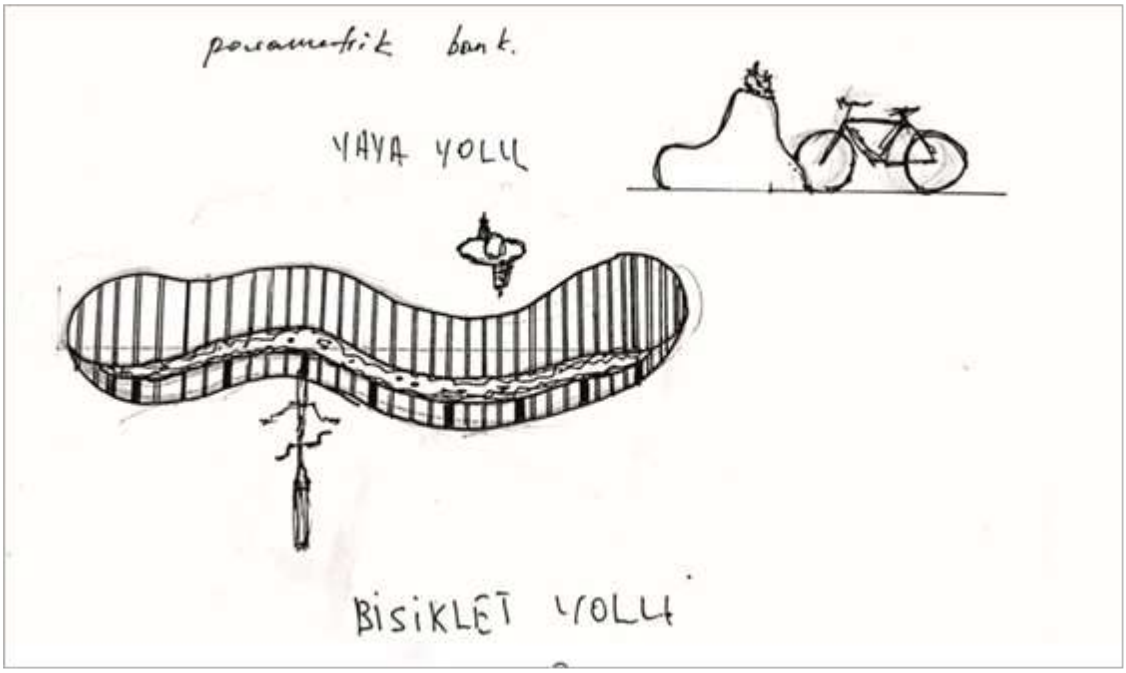

Figure 8: *Bicycle-friendly urban furniture designs (Altynbek Mamyrov)*

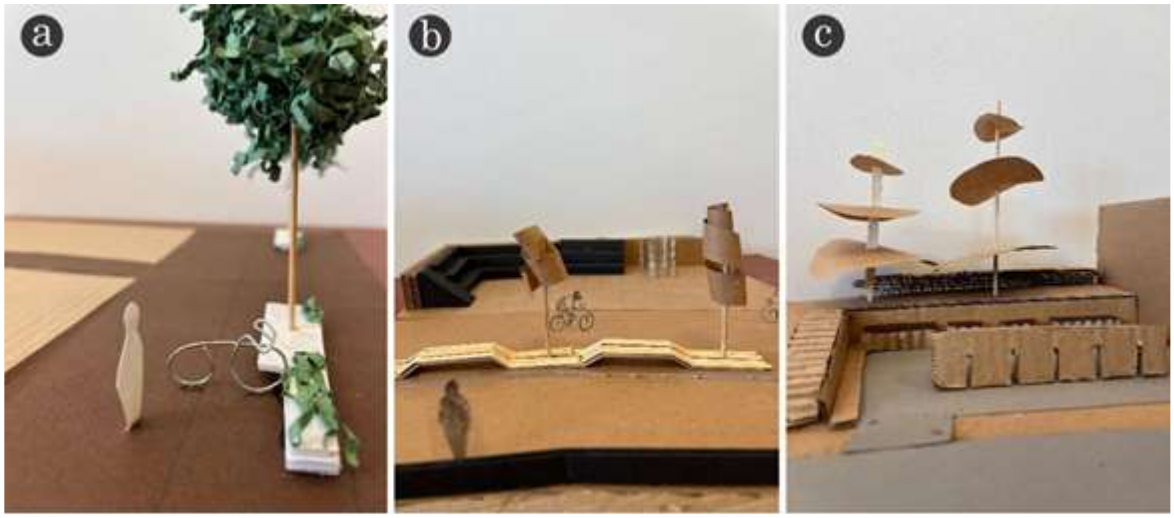

Figure 9: *Model examples (a: Shams Dheyaa Mahmood Almarawee, b: İsmail Tekeli, c: Özlem Merve Büyükakkaş)*

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

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

Evaluation of Architectural Design Studio Stages

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

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

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

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

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

Table 3: *Survey results*

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

Conclusion and Recommendations

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

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

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

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

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An Innovative and Sustainable Design Approach in Contemporary Architectural Education: Parasitic Architecture

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Abstract: This paper investigates parasitic architecture as an innovative and sustainable approach in contemporary architectural education. Parasitic architecture, which establishes symbiotic relationships with existing structures, is explored as a design strategy for creating new spaces within constrained urban environments. The study's methodology includes a multi-phase process beginning with a literature review and discussions on parasitic architecture, sustainability, flexibility, and innovation. Students then proposed structures based on their urban experiences and developed scenarios linked to architectural programs. The final phase involved a design studio at Bingöl University, where students applied parasitic architecture principles to real-world scenarios. The results demonstrate that this approach significantly fosters creative problem-solving skills, refunctionalizes spaces, and enhances environmental awareness. The study highlights the potential of parasitic architecture in addressing post-disaster challenges in urban environments like Bingöl, contributing to the reactivation of underutilized spaces and enhancing the social and cultural vitality of urban areas. This positions parasitic architecture as an effective strategy in both architectural education and practice.

Keywords: Contemporary architectural education, Environmental impact and sustainability, Urban context, Adaptive reuse of existing structures, Parasitic architecture.

Introduction

Architecture education must continuously evolve to keep pace with the ever-changing societal, technological, and environmental dynamics. Traditional methods employed in architectural design education can often be static and repetitive, which may inadvertently confine students to predefined patterns of thinking, thereby limiting the development of innovative ideas (Lökçe, 2002; Varolgüneş et al., 2024). While traditional methods and theories might have fulfilled the needs of a specific era, they increasingly fall short in addressing the rapidly changing technological, social, and environmental conditions of today (Şensoy&Üstün, 2018). In contemporary practice, architects are required not only to consider aesthetics and functionality but also to prioritize sustainability, energy efficiency, and social responsibility (Özdemir&Varolgüneş, 2024). Consequently, educational programs must offer innovative and interdisciplinary approaches to equip students with the skills to tackle these complex and multidimensional challenges (Casakin&Wodehouse, 2021). Additionally, the growing integration of digital

technologies in architecture necessitates that students become proficient in these tools, further underscoring the importance of contemporary approaches in education. Parasitic architecture emerges as a significant contemporary approach within this context. By attaching to or integrating with existing structures, parasitic architectures foster a symbiotic relationship with the existing architectural fabric, enabling students to rethink architecture and push its boundaries (Letzter, 2023). This approach is particularly effective in offering creative solutions to pressing issues such as urbanization and sustainability. Parasitic architecture enhances students' abilities to transform existing structures and develop new typologies. Adopting innovative and experimental approaches like parasitic architecture in architectural education empowers students to move beyond traditional practices and generate creative solutions that are responsive to future architectural challenges (Yorgancıoğlu&Güray, 2018).

This paper explores the concept of parasitic architecture as an alternative space design strategy and its application in architectural education. Parasitic architecture aims to create new spaces by establishing symbiotic relationships with existing structures, encouraging students to approach these structures from different perspectives. This paper discusses the potential benefits of parasitic architecture in the educational process and examines how this strategy can be effectively implemented in architecture education. In this context, a study was conducted within the third-semester studio course at Bingöl University's Department of Architecture, focusing on the theme of "parasitic architecture". The study offers suggestions through a design studio that seeks solutions to real-world problems (Caglar&Uludag, 2006). Design studios, where students articulate ideas, evaluate alternatives, and experiment with new approaches, must be properly guided to prepare them for the profession of architecture (Roberts, 2004). The selection of this topic was influenced by the need to develop innovative solutions to the increasingly complex urban and environmental problems of today. As population growth and the continuous expansion of cities increase the demand for new housing and living spaces, interventions in the natural environment have also escalated. In this context, parasitic architecture aims to challenge the limits of existing structures, providing both space-saving solutions in dense urban areas and contributing to the preservation of the natural environment. This approach offers sustainability-focused solutions by maximizing benefits with limited resources and introducing new functions to existing structures with minimal interventions. Parasitic architecture reduces pressure on the natural environment by offering innovative and sustainable designs that can integrate with existing urban fabrics. The selection of this project topic emphasized the potential of such architectural approaches to both transform existing structures and minimize environmental footprints. The goal was for students to develop creative solutions that are responsive to global issues such as urban density, spatial scarcity, and environmental sustainability.

The key contributions of this study are as follows:

- The application of parasitic architecture in architectural education enhanced students' abilities to interact with existing structures, repurpose spaces, and develop innovative solutions in limited urban areas.
- By examining how parasitic architecture aligns with sustainability principles, the study emphasized the importance of creating living spaces with minimal environmental impact and contributed to promoting environmentally sensitive architectural practices.
- The study focused on the design process of structures that could be integrated into the existing urban fabric, thereby improving students' abilities to optimize space in urban areas and unlock the potential of existing structures.

- The educational benefits of addressing real-world problems and data in student projects were highlighted.
- Parasitic architecture-focused projects enhanced students' creative problem-solving abilities, increasing their confidence in addressing complex urban and environmental issues and strengthening their innovative thinking skills.

This paper is structured into four main sections. The first section introduces the concept of parasitic architecture and provides a theoretical framework derived from the literature. The second section outlines the methodology of the study, including the structure of the 14-week design studio and the evaluation criteria. The third section presents and analyzes selected student projects, focusing on how parasitic architecture strategies were applied in urban contexts. The final section summarizes the key findings and educational implications of the study. The organizational flow of the article is illustrated in Figure 1.

Parasitic Architecture as a Design Strategy in the Architectural Design Studio

The term "parasite" in biology refers to the ecological relationship where the host organism supports the parasite, which benefits from the connection without providing anything in return (Gültekin&Birer, 2019). Similarly, parasitic architecture integrates with existing structures, creating a symbiotic relationship akin to biological parasitism (Kavut&Selçuk, 2022). This design strategy aims to create new spaces by repurposing existing buildings, deviating from traditional paradigms and addressing contemporary challenges such as sustainability, flexibility, and innovation (Arabulan&Lank, 2023; Mehan&Mostafavi, 2023). First discussed by Ungers in 1966, parasitic architecture refers to structures that attach to existing buildings or urban spaces, relying on the host for support while providing unique benefits in return (Given, 2021; Šijaković&Perić, 2018). This approach involves temporary, modular designs that extend the life of existing buildings, reduce material consumption, and lower the carbon footprint (Pratama et al., 2023; Bardzinska-Bonenberg, 2018). It offers an important solution to sustainable urban development by minimizing the need for new construction and promoting energy-efficient designs (Mehan&Mostafavi, 2023). Parasitic architecture mimics biological strategies such as attachment, climbing, and anchoring to existing structures, drawing inspiration from natural parasitism (Kachri&Hanna, 2014). It should be viewed not as an appendage, but as a

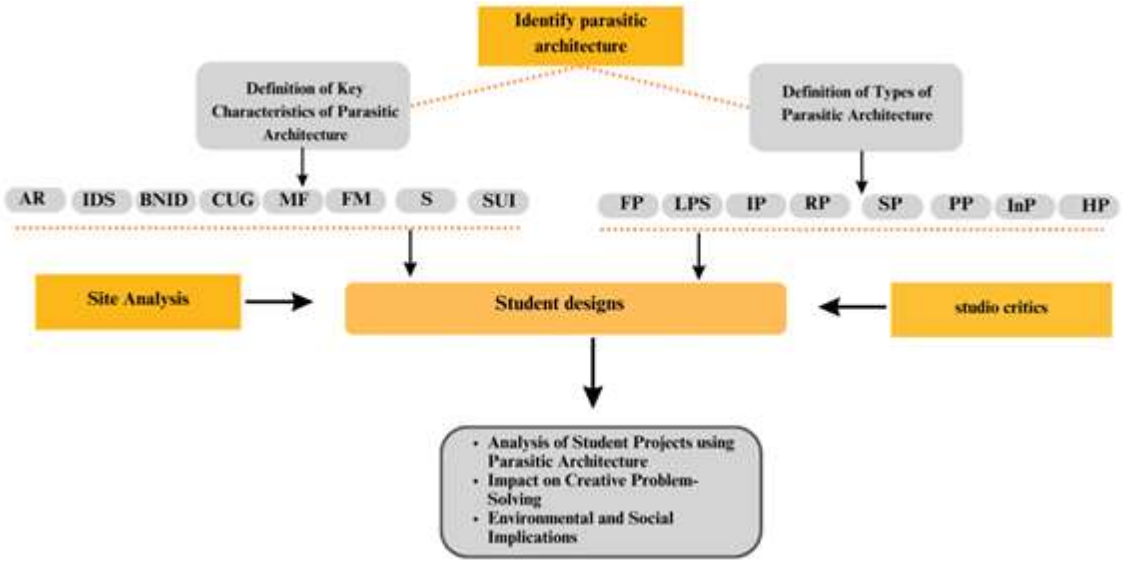

Figure 1: *Conceptual framework of the research*

growth mechanism within the urban context, contributing to the sustainable and organic development of cities (Šijaković&Perić, 2018). This approach is being explored in architectural studios, encouraging innovative and adaptable design solutions. It helps optimize underutilized spaces, promotes urban growth, and fosters speculative design to address contemporary challenges (Karacalı & Polat, 2022; Christenson, 2014). Parasitic architecture also addresses urban issues such as space constraints, homelessness, and the need for flexible growth. Students have transformed disused walls into public spaces and developed strategies for infiltrating and parasitizing existing structures (Karacalı & Polat, 2022; Christenson, 2014). Through biomimicry, this approach provides new perspectives on contemporary architectural challenges, contributing to the development of flexible, sustainable urban environments (Baroš & Katunský, 2020; Watanabe et al., 2014; Sara, 2007).

Methodology

This study examines the concept of parasitic architecture and evaluates the architectural design strategies developed through this approach. It covers the 14-week studio process and its outcomes (as detailed in Table 1), along with the authors' research and studio-based educational experiences. The architectural design studio was conducted during the fall semester with the participation of 18 students. At the end of the term, students submitted their final design projects individually. Among these, projects that focused on Bingöl Province as a common intervention area were selected for detailed analysis. The selection criteria included: the diversity in the students' interpretations of parasitic architectural strategies, the variety of urban and structural contexts they engaged with, and the clarity with which they applied key characteristics and typologies derived from the literature. The selected projects represented a range of parasitic interventions (such as rooftop, façade-attached, suspended, and interstitial structures) allowing for a rich comparative analysis.

In the initial phase of the studio, instructors and students collaboratively examined academic literature on parasitic architecture, sustainability, flexibility, and innovation. These discussions helped students comprehend the core concepts, historical development, built examples, and associated design strategies. In the second phase, students proposed parasitic architectural interventions based on their own urban observations, aligning these with specific architectural programs and user scenarios. This stage encouraged critical spatial analysis and the identification of design opportunities within the existing built environment. In the final phase, students developed their design proposals using parasitic architecture strategies. The projects were evaluated based on a rubric derived from the literature, which included criteria such as integration with existing structures, use of sustainable and modular materials, contextual harmony, and spatial adaptability. This study offers a comprehensive analysis of how student projects interact with the urban fabric on structural, aesthetic, and functional levels. Focusing on the post-disaster urban context of Bingöl, the research demonstrates the potential of parasitic architecture to revitalize underused spaces and enhance socio-cultural urban vitality. It also highlights the pedagogical value of this approach in fostering creative problem-solving and sustainable design thinking within architectural education.

During the evaluation process, student projects were assessed by the studio instructor based on a set of criteria derived from the literature. These criteria included integration with existing structures, use of sustainable and modular materials, contextual harmony, spatial flexibility, and conceptual clarity. No external jury was involved in the evaluation. The development of students' creative problem-solving skills was qualitatively observed through the progression of their design revisions, mid-term reviews, and final presentations. Throughout the project phases, it was noted that students were able to generate more diverse, functional, and sustainable solutions to complex urban problems. These observations, although not supported by quantitative data, were considered as indicative of the pedagogical contribution of the studio.

Table 1: *The 14-week course process and outcomes (Edited by author, 2024)*

Week	Topic	Description	Outcomes
1	Introduction and General Conceptual Framework	Introduction to the concept of parasitic architecture and explanation of fundamental principles.	Conceptual understanding, literature review.
2	Historical Buildings and Parasitic Structures	Examination of parasitic structures attached to historical buildings.	Case study analyses, discussion, and presentation.
3	Material Selection in Parasitic Architecture	Investigation of innovative and sustainable materials used in parasitic structures.	Material research, report on selected materials.
4	Biomimicry Applications in Parasitic Structures	Application of nature-inspired design strategies in parasitic architecture.	Biomimicry examples, conceptual sketches.
5	Urban Context and Parasitic Structures	Integration of parasitic structures into urban areas and their relationship with the city.	Urban analysis and mapping studies.
6	Flexibility and Modularity	Examination of flexibility and modular design approaches in parasitic structures.	Modular design examples, conceptual model.
7	Community and Social Sustainability	Examination of the social benefits and impacts of parasitic structures on social sustainability.	Social needs analysis, discussion, and presentation.
8	Midterm Jury: Initial Design Studies	Students present their initial design drafts and receive feedback.	Design presentation and jury evaluation.
9	Temporary and Portable Parasitic Structures	Examination of temporary and portable parasitic structures and their advantages.	Proposals for portable parasitic structures, draft plans.
10	Innovative Design Solutions in Parasitic Structures	Integration of innovative technologies and design solutions into parasitic architecture projects.	Innovative design solutions, prototype proposals.
11	Environmental Impact and Sustainability	Analysis of the environmental impacts of parasitic structures and the integration of sustainability principles into projects.	Sustainability analysis, material and energy strategies.
12	Implementation and Feasibility in Parasitic Architecture	Evaluation of the implementation processes and practical feasibility of parasitic structures.	Implementation scenarios, construction techniques report.
13	Final Design Studies and Preparation	Finalization of students' design projects and preparation for presentations.	Final design plans and model studies.
14	Final Jury: Final Design Presentation	Students present their final designs to the jury for evaluation.	Final presentation, jury feedback, and final report.

Table 2: *An overview of key characteristics of parasitic architecture and their explanations. (AR: Adaptive Reuse, (IDS): Innovative Design Solutions, BNID: Biomimicry and Nature-Inspired Design, CUG: Community and Urban Growth, MF: Minimal Footprint, FM: Flexibility and Modularity, S: Sustainability, SUI: Social and Urban Impact)*

Key Characteristics of Parasitic Architecture	Explanation	References
Adaptive Reuse (AR)	Parasitic architecture often involves reusing and repurposing existing structures, breathing new life into underutilized or obsolete buildings.	Kavut & Selçuk (2022) Letzter (2023) Arabulan & Lank (2023)

Innovative Design Solutions (IDS)	Parasitic architecture transforms idle or underused spaces into productive public areas, fostering diverse and functional design ideas. This approach encourages flexible structures that adapt to various spatial and environmental constraints, enhancing architectural versatility.	Christenson (2014) Casakin & Wodehouse (2021) Karacalı & Polat (2022)
Biomimicry and Nature-Inspired Design (BNID)	Utilizing biomimicry, parasitic architecture leads to self-designing, self-growing structures inspired by natural processes like fungal colonies. This approach mimics natural parasitism, using "sticking," "climbing," and "holding" mechanisms to attach to host structures, reflecting symbiotic relationships.	Speck et al. (2022) Baroš & Katunský (2020, 2021) Kachri & Hanna (2014)
Community and Urban Growth (CUG)	Parasitic architecture can drive urban growth by creating new spaces in dense areas, optimizing city space while adhering to planning regulations.	Gültekin & Birer (2019) Mehan & Mostafavi (2023) Šijaković & Perić (2018)
Minimal Footprint (MF)	Parasitic structures minimize environmental impact by being added to existing buildings, using modular and recyclable materials, making them ideal for dense urban environments with limited space.	Bardzinska-Bonenberg (2018) Speck et al. (2022) Pratama et al. (2023)
Flexibility and Modularity (FM)	Parasitic structures are designed to be flexible, modular, and adaptable, allowing them to meet various spatial and environmental needs while offering long-term sustainability by being repurposable rather than demolished.	Given (2021) Karacalı & Polat (2022) Sara (2007)
Sustainability (S)	Parasitic architecture, inspired by biological concepts like modularity and zero waste, promotes sustainable urban development by reusing existing infrastructure and reducing the environmental impact of new construction.	Speck et al. (2022) Šijaković & Perić (2018) Yorgancıoğlu & Güray (2018)
Social and Urban Impact (SUI)	Parasitic architecture provides practical solutions to urban challenges like homelessness and density by adding functional spaces to existing buildings, evolving from artistic expressions to effective social interventions.	Arabulan & Lank (2023) Gültekin & Birer (2019) Bardzinska-Bonenberg (2018)

Table 3: *An overview of different types of parasitic architecture and their applications (FP: Façade Parasites, LPS: Layered Parasite Structures, IP: Infill Parasites, RP: Rooftop Parasites, SP: Suspended Parasites, PP: Plug-in Parasites, InP: Interstitial Parasites (InP), HP: Hybrid Parasites)*

Type	Description	
Façade Parasites (FP)	Structures added to the facades of existing buildings. They typically provide additional space or functions and integrate with the facade.	Karacalı & Polat (2022) Letzter (2023) Alborghetti & Erioli (2015)
Layered Parasite Structures (LPS)	Structures added in a layered or modular fashion on top of existing buildings. These structures often offer various functions.	Sara (2007) Bardzinska-Bonenberg (2018) Arabulan & Lank (2023)
Infill Parasites (IP)	Structures placed in empty spaces or between existing buildings. They are typically used to address urban voids.	Gültekin & Birer (2019) Baroš & Katunský (2020) Šijaković & Perić (2018)
Rooftop Parasites (RP)	Structures added to rooftops. They often make efficient use of roof space and provide additional functions.	Given (2021) Pratama et al. (2023) Bardzinska-Bonenberg (2018)

Suspended Parasites (SP)	Structures suspended or supported above existing buildings. They usually extend outward from the existing structures.	Baroš & Katunský (2021) Karacalı & Polat (2022) Kachri & Hanna (2014)
Plug-in Parasites (PP)	Modular structures that can be added or removed from existing buildings. They are designed for easy installation and removal.	Christenson (2014) Arabulan & Lank (2023) Casakin & Wodehouse (2021)
Interstitial Parasites (InP)	Structures integrated into the gaps between two existing buildings. These structures utilize the voids between buildings.	Baroš & Katunský (2020) Karacalı & Polat (2022) Yorgancıoğlu & Güray (2018)
Hybrid Parasites (HP)	Structures that combine multiple parasite types. They typically incorporate various functions and design strategies.	Watanabe et al. (2014) Mehan & Mostafavi (2023) Alborghetti & Erioli (2015)

Findings and Discussion

This study analyses student projects from the Architectural Design 3 studio at Bingöl University, focusing on how parasitic architecture strategies were applied. The evaluation considers site and program selection, structural integration with existing buildings or infrastructure, and the experiential scenarios created within urban contexts. Student designs were examined in relation to key concepts and typologies of parasitic architecture derived from the literature, illustrating its educational and design impact. The study also aims to raise awareness of the potential to repurpose underused urban spaces in Bingöl through parasitic approaches. Students were encouraged to produce innovative, context-sensitive designs emphasizing reuse, sustainability, modularity, and social impact. One example, Design 1, reimagines an abandoned city center site to provide temporary housing for homeless individuals (Figure 2). The project demonstrates how parasitic architecture can support both shelter provision and social integration. Its modular, portable units were adaptable to various urban settings and enabled rapid transformation of space (Figure 3), offering not only shelter but access to essential services. The design also aligns with sustainability principles by reusing urban space and minimizing resource waste, contributing to long-term social benefits. Overall, the study concludes that parasitic architecture offers a sustainable and effective framework for

Figure 2: *Selected study area for design 1 in the city centre*

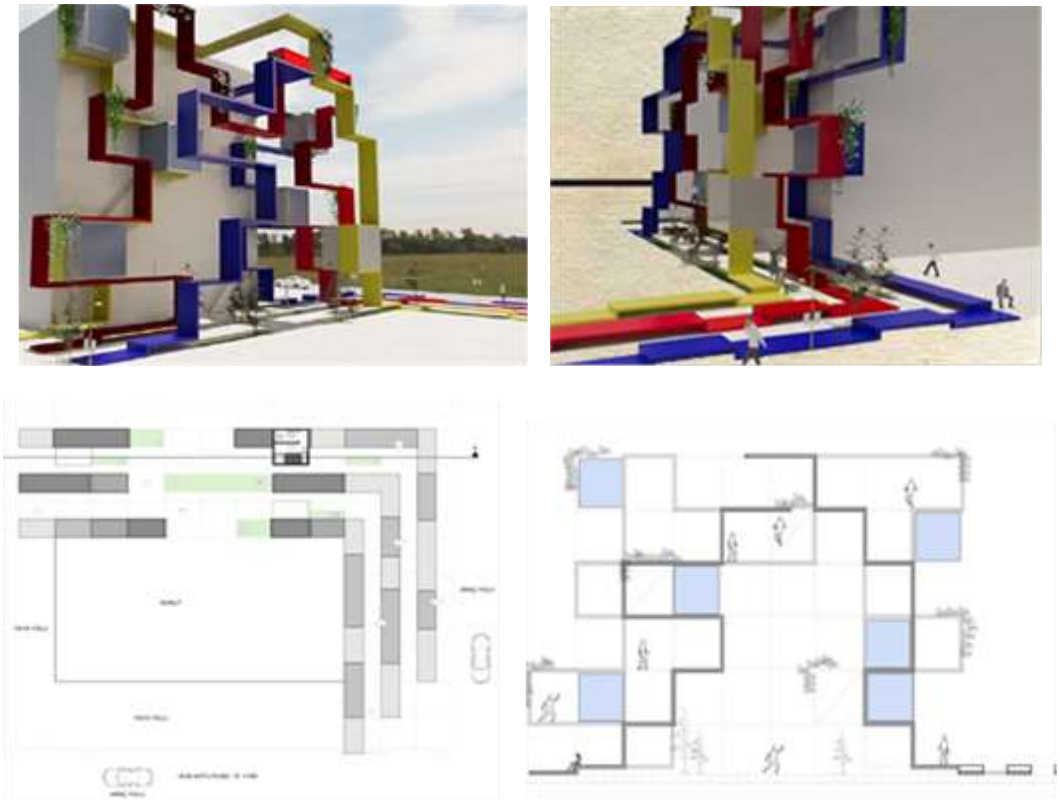

Figure 3: *Parasitic architecture proposal for design*

temporary housing, helping to address social and environmental challenges in urban design.

Design 1 is associated with the key characteristics of parasitic architecture, specifically IDS, CUG, FM, and S, and is linked to the types of parasitic architecture such as FP, LPS, PP, InP, and HP. These associations demonstrate that Design 1 has a significant impact not only in terms of aesthetics and

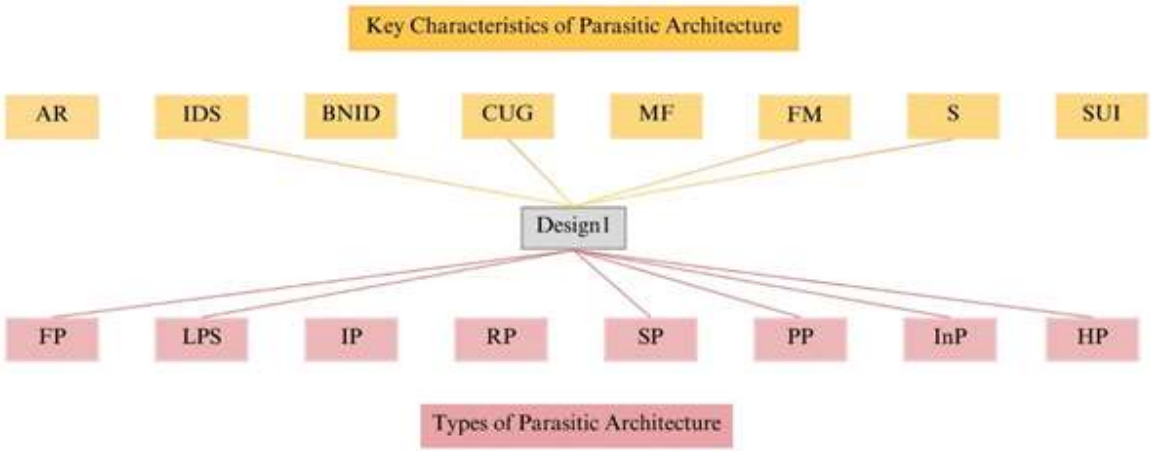

Figure 4: *The relationship of design 1 with the "key characteristics of parasitic architecture" and "types of parasitic architecture"*

functionality but also in the broader context of social growth, urban development, and sustainability. This indicates that the design approach taken highlights the innovative potential of parasitic architecture. The connection of Design 1 with various types of parasitic architecture such as FP, LPS, PP, InP, and HP reveals its capacity to integrate with existing structures by employing diverse spatial strategies and construction techniques. For instance, FP and LPS add new functions to the surfaces and layers of existing buildings, while PP and InP create innovative connections between existing structures and new spaces. HP further enhance flexibility and modularity by combining these strategies.

Design 2 is a project that aims to transform an abandoned water tank owned by a public institution into a residential and living space (Figure 5). This work stands out as a unique example that highlights the transformative capacity of parasitic architecture on existing structures. The student prioritised preserving the existing structural features of the water tank during the design process, aiming to add new functions to the structure through additions and interior modifications. In this context, the

Figure 5: *The selected abandoned water tank area for design 2 and the proposed parasitic architecture for design2*

design process required meticulous consideration of both the physical and social contexts. The student's design sought to create a functional and aesthetic living space for the community surrounding the water tank, establishing a new dialogue between the structure and its environment while adhering to the core principles of parasitic architecture. This dialogue aimed to reassess the potentials of the existing space and utilise these potentials sustainably. Within the project, the spatial organisation of the water tank's conversion into a residential area was carefully planned; the existing voids within the tank were reorganised to accommodate new functions. The horizontal and vertical spaces of the water tank were redesigned to suit the necessary functions of a living space, and these adjustments ensured the structure's integration with the street level. Considering the user profile, the project aimed to repurpose the water tank as a social and cultural interaction centre for the surrounding community. This work showcases the innovative approaches of parasitic architecture in transforming existing structures and the creative solutions it brings to urban spaces. The student's water tank project not only maximised the structure's potential in both functional and aesthetic terms but also successfully established a strong and sustainable relationship with the urban context. These findings underscore the flexibility and creativity that parasitic architecture offers in education, serving as a significant indicator of its potential in architectural practice.

Design 2, transforming an abandoned water tank into a residential and living space, reflects key characteristics of parasitic architecture, including AR, MF, FM, S, and SUI. The AR principle is emphasized by preserving the tank's existing structural features while refunctioning the space. Minimal interventions align with MF, minimizing environmental impact and demonstrating sustainability (S). FM allows for adaptable, modular spatial solutions, enabling the tank to serve various functions. The project's new relationship with the community enhances its SUI, highlighting the social significance of the transformation (Figure 6). Parasitic architecture typologies such as FP, LPS, PP, and HP further enhance the design's innovation. The FP concept adds to the exterior, enriching the structure functionally and aesthetically, while LPS reorganizes spatial arrangements by incorporating new layers. PP supports modular flexibility, and HP combines multiple parasitic strategies to create a versatile space.

Design 3 is a notable example of parasitic architecture's ability to integrate with existing structures. Located between the 12.00 and

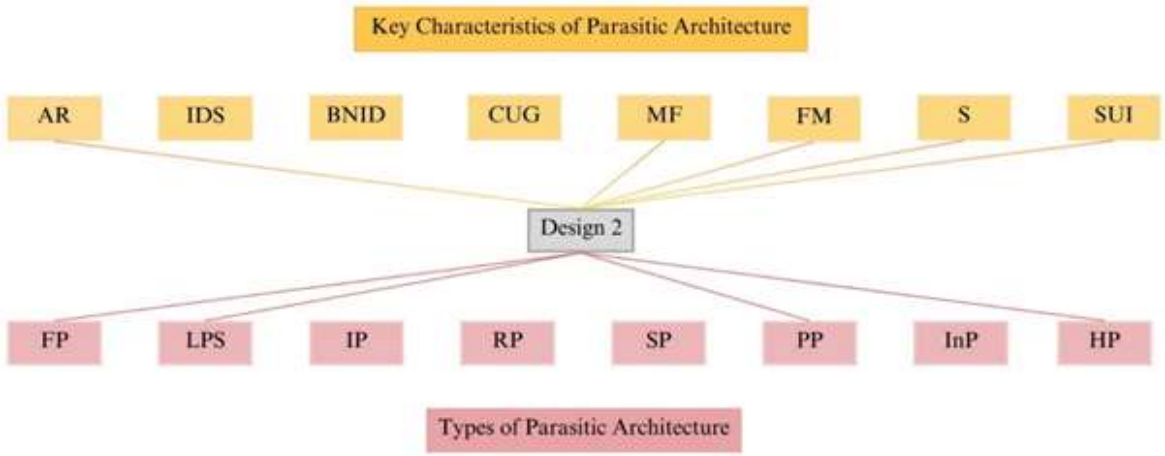

Figure 6: *The relationship of design 2 with the "key characteristics of parasitic architecture" and "types of parasitic architecture"*

Figure 7: *The viaduct selected for design 3 is located within the city*

Figure 8: *Parasitic architecture proposal for design 3*

16.00 levels of the Çapakçur Viaduct, which connects the two sides of Bingöl, the project introduces new spatial functions while maintaining harmony with the viaduct's structure (Figure 7). It includes various functional units such as accommodation spaces,

event venues, glass terraces, cafés, and walking paths, created through modular voids between the levels. This design maintains spatial continuity with the viaduct and allows for its re-evaluation in both physical and social contexts. The project demonstrates parasitic architecture's potential to refunction abandoned spaces and integrate them into the urban fabric (Figure 8). A key success is the preservation of vehicle circulation on the +24.00 level, ensuring functional integration with the existing structure. Design 3 highlights how parasitic architecture can contribute to spatial renewal, introducing new functions aligned with the urban context. It also serves as a strong example of how parasitic architecture can enhance creative problem-solving skills in architectural education, transforming neglected areas into valuable urban spaces.

Design 3, associated with key concepts of parasitic architecture such as IDS, BNID, CUG, MF, FM, S, and SUI, has achieved an environmentally conscious spatial transformation that benefits the community (Figure 9). The intervention carried out between the 12.00 and 16.00 levels of the viaduct merges the potential of the existing structure with innovative functions while aligning with the urban context through nature-inspired design approaches and modular solutions. The use of LPS, IP, SP, PP, and HP has enhanced the functional capacity of the structure, reinforcing spatial diversity and creativity (Figure 9). This project exemplifies the ability of parasitic

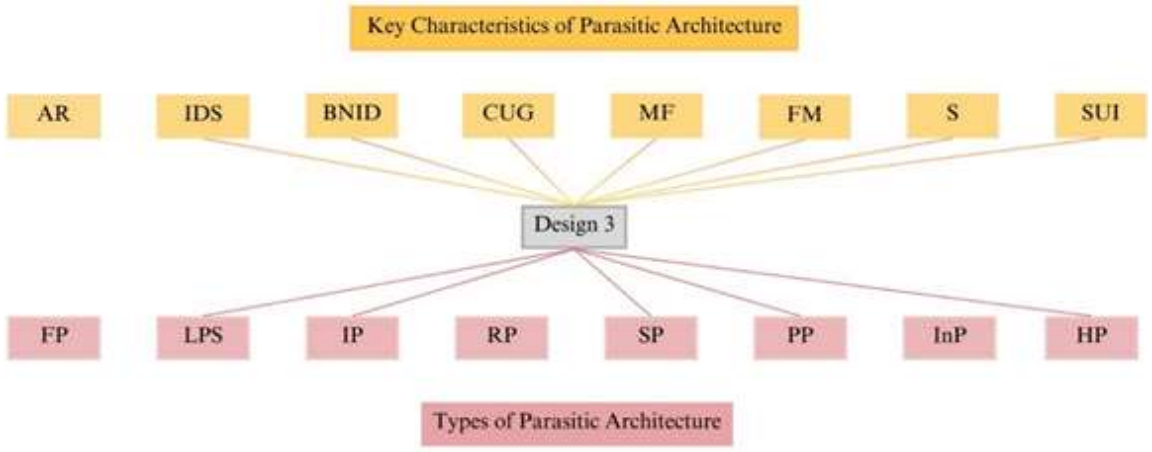

Figure 9: *The relationship of design 3 with the "key characteristics of parasitic architecture" and "types of parasitic architecture"*

Figure 10: *Selected study area for design 4 in the city centre*

architecture to generate innovative, sustainable, and socially responsive solutions in urban areas and stands out as a significant application for developing creative problem-solving skills in architectural education.

Design 4 presents an innovative reinterpretation of a blank façade in the city centre, applying parasitic architecture principles (Figure 10). The project transforms the adjacent neglected area into day-use accommodation and public spaces, harmoniously integrating with the nearby green park. Featuring a modular mixed-use system of residential and commercial units, the design enhances both functionality and aesthetics (Figure 11). Its adaptability ensures responsiveness to future urban needs. Emphasis was placed on the balance between solid and void, with sustainable materials supporting durability. Each of the three façades was uniquely designed to strengthen the building's relationship with its surroundings, while a central atrium introduces natural light, improving spatial quality and connecting interior with exterior. Overall, Design 4 exemplifies how parasitic architecture can successfully integrate with existing structures to revitalize urban spaces.

Figure 11: *Parasitic architecture proposal for design 3*

Design 4 is associated with the key characteristics of parasitic architecture, including IDS, BNID, CUG, MF, FM, S, and SUI (Figure 12). The project aims to transform the neglected and dilapidated area adjacent to the blank façade of a building in the city centre, creating day-use accommodation units and public spaces that meet contemporary needs. The design integrates with the existing green park using a BNID approach, adopting sustainable materials and a MF strategy to minimise environmental impact. Additionally, the project's flexible and modular structure FM enhances its capacity to adapt to future urban needs. From the perspective of parasitic architecture types, Design 4 is closely related to FP, LPS, IP, SP, PP, and HP, reinforcing the project's spatial diversity and innovative nature (Figure 12). The FP type has transformed the previously blank façade into a functional element, while LPS and IP have established spatial continuity through layered and infill structures added to the dilapidated area. SP and PP types, through suspended and modular structures added to the façade, have facilitated the building's multi-faceted integration with the urban context. The HP type, by combining various parasitic architecture types, has resulted in a versatile and flexible structure capable of meeting diverse user needs. These findings strongly demonstrate that Design 4 showcases the potential of parasitic architecture to offer innovative, sustainable, and socially responsive spatial solutions.

Design 5 aims to reimagine a vacant space nestled within the dense and monotonous development of the city's market district, in line with parasitic architecture principles (Figure 14). This project seeks to break the monotony of the urban fabric by creating a focal point that stands out amidst the surrounding homogeneous structures. Situated between two blank façades, the structure is designed as a public gathering space, offering a new perspective within the existing urban environment. The design underscores the capacity of parasitic architecture to repurpose unused or overlooked spaces within the city, bringing them into the urban context. The student's effort to create a public space while working within the constraints of existing structures highlights the potential of parasitic architecture to deliver innovative solutions in

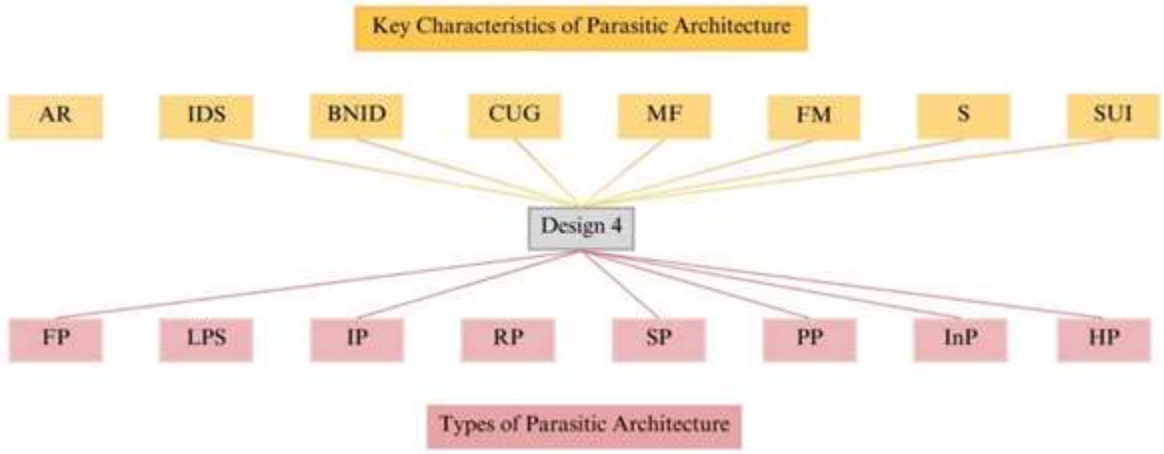

Figure 12: *The relationship of design 4 with the "key characteristics of parasitic architecture" and "types of parasitic architecture"*

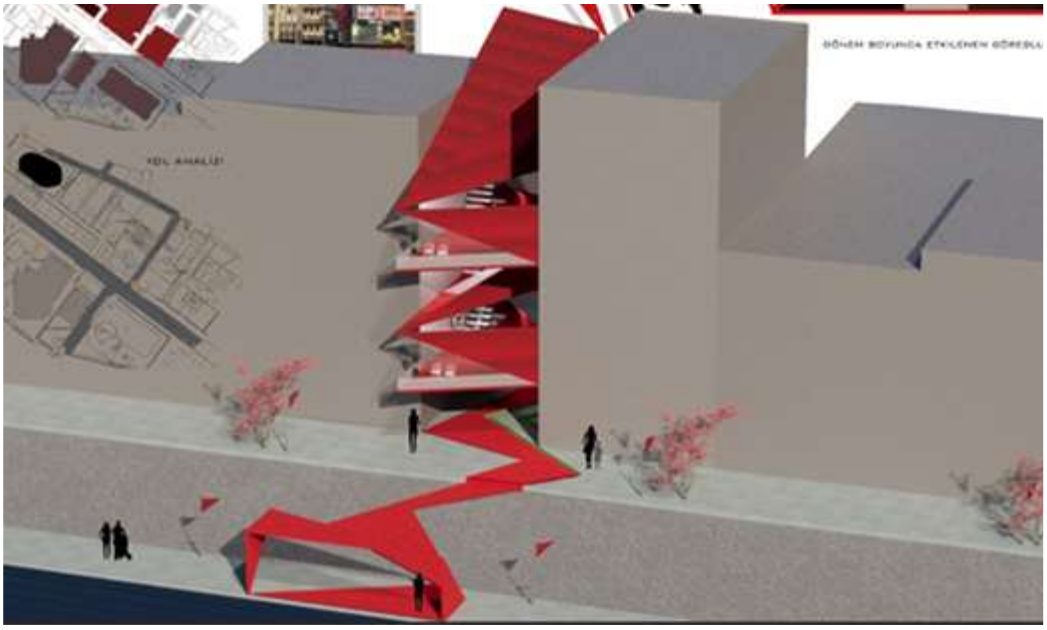

Figure 13: *Parasitic architecture proposal for design 5*

urban settings (Figure 13). Design 5 exemplifies the student's ability to transform spatial perceptions and make a significant impact within the existing built environment, both in terms of architectural design and parasitic architecture. The project successfully applies the core principles of parasitic architecture: integrating with existing structures, reclaiming unused spaces, and creating new opportunities for urban use. In this context, Design 5 stands out as a rich urban intervention, both aesthetically and functionally, through the creation of a public gathering space in the city's market district. The project is seen as a significant example of how parasitic architecture can challenge the city's monotonous landscape, offering new spaces for social interaction and demonstrating its importance and potential in architectural education.

Design 5 incorporates key principles of parasitic architecture, including IDS, BNID, CUG, MF, FM, S, and SUI, with the goal of transforming a vacant space in the city's densely built market centre into a public gathering area. By doing so, it disrupts the monotony of the urban fabric and creates new social interaction zones. The IDS approach demonstrates the ability to work within the constraints of existing structures, repurposing unused spaces to serve urban needs. The BNID method, inspired by nature, contributes to the project's sustainable design, minimizing environmental impact. Furthermore, Design 5 exemplifies the MF approach by promoting compact, eco-friendly urban development, while the FM strategy allows the project to remain adaptable to future urban needs. The integration of new social spaces aligns with CUG and SUI, enhancing social and urban development in the city center. Various types of parasitic architecture are applied: FP enhances building exteriors, LPS

Figure 14: *Selected study area for design 5 in the city centre*

and IP utilize vacant spaces in dense developments, RP adds rooftop spaces, SP extends public areas, and PP and InP offer modular flexibility. HP combines these strategies, creating a diverse and innovative design. Design 5 effectively showcases the potential of parasitic architecture to revitalize vacant urban spaces, foster social interaction, and promote sustainability, making it a valuable example for both educational and urban transformation purposes.

Design 6 stands out as a compelling example of how parasitic architecture can create functional and aesthetic transformations in structures that have left their mark on a particular era but are now in a state of disuse. For this design, a historic bridge built in 1952 in the Genç District of Bingöl was selected (Figure 16). The project demonstrates that it is possible to add a modern parasitic extension to a historical structure without compromising its integrity, by incorporating a modular group of structures onto the existing bridge. The student's choice of transparent materials and lightweight steel construction has been integrated into the bridge, preserving its architectural integrity (Figure 17). This approach successfully bridges the past and present with a modern design language, without altering the historic fabric of the structure. The parasitic structure creates a living space within the bridge, extending its use beyond a mere point of passage and providing both aesthetic and functional value. The parasitic addition not only enhances the durability and functionality of the bridge but also succeeds in creating a natural atmosphere in line with sustainability principles. In this

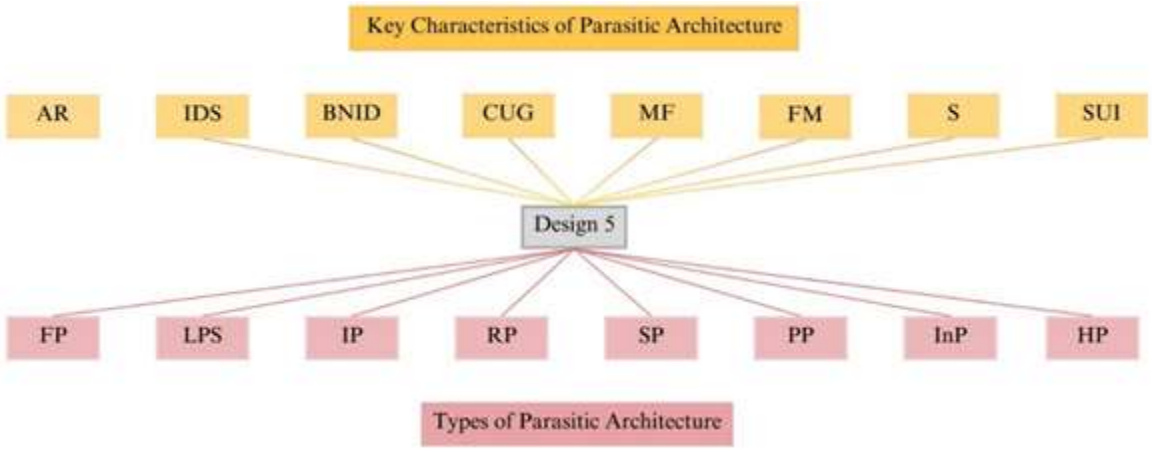

Figure 15: *The relationship of design 5 with the "key characteristics of parasitic architecture" and "types of parasitic architecture"*

context, the project offers significant insights into how parasitic structures can be integrated into the preservation and renovation of historical buildings. In conclusion, Design 6 technically demonstrates how parasitic architecture can offer innovative solutions for both the aesthetic and functional transformation of historical structures. The project clearly highlights the importance and potential of parasitic architecture in architectural education, especially in the process of preserving and enriching historical buildings with new functions. These findings provide important clues on how existing structures can be sustainably transformed through parasitic additions.

Figure 16: *The selected abandoned historical Genç bridge, built in 1952*

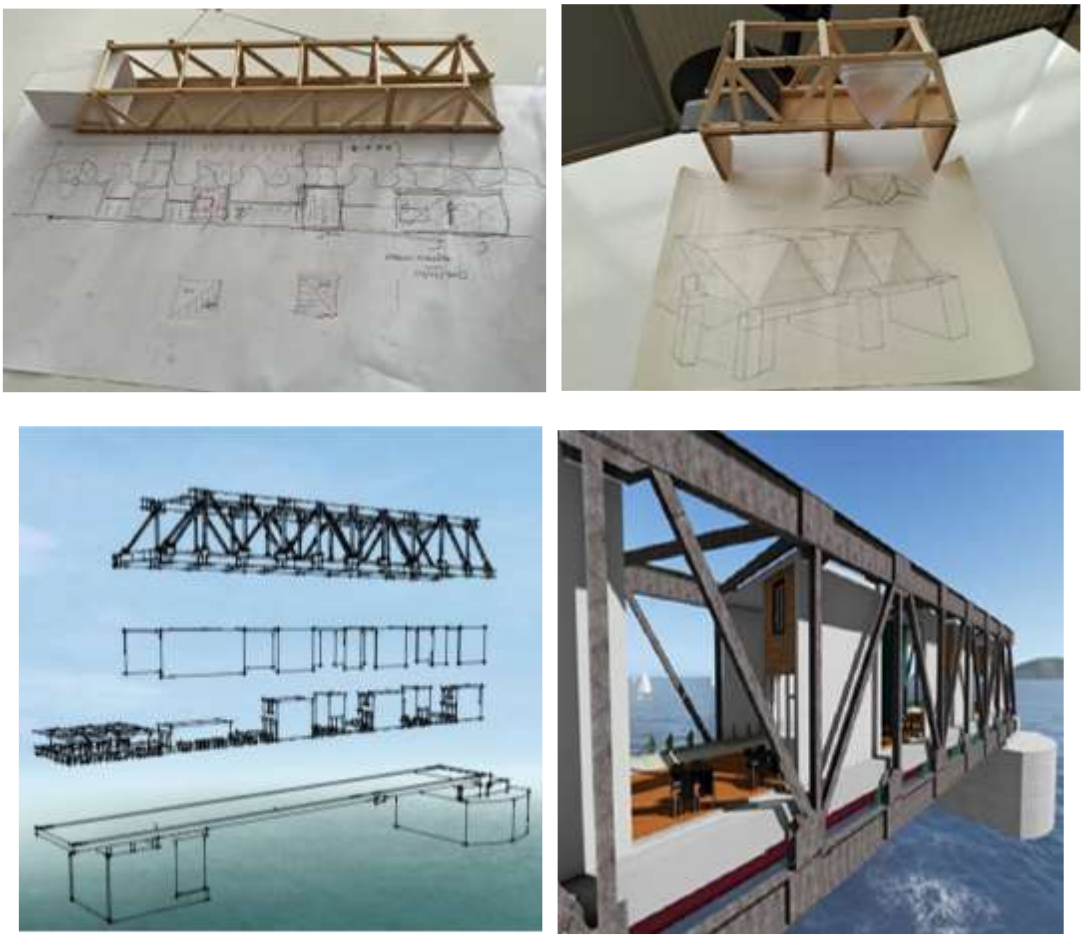

Figure 17: *Parasitic architecture proposal for design 6*

Design 6 exemplifies key aspects of parasitic architecture, such as AR, CUG, MF, FM, S, and SUI. The project involves the transformation of a historic bridge through parasitic additions, demonstrating how existing structures can be enhanced without compromising their historical value. The Adaptive Reuse approach integrates modern, innovative structures with the bridge, preserving its cultural significance while introducing new functions. The project enhances the bridge's role in the urban fabric by creating new social and public spaces, addressing urban density and community needs. Parasitic structures are designed with Minimal Footprint and Sustainability principles, using environmentally friendly materials and modular systems to ensure longevity and adaptability. The concepts of Flexibility and Modularity allow the additions to be integrated seamlessly and adapted for future needs. Design 6 incorporates various parasitic architecture types: LPS create multiple functional areas within the bridge; SP utilize previously unused spaces beneath the bridge; PP add modular, portable elements; and HP combine these approaches to maintain the bridge's historical integrity while introducing modern functionality. Overall, Design 6 illustrates the effectiveness of parasitic architecture in transforming historical structures into functional, aesthetic, and sustainable urban elements, highlighting its potential for educational purposes and urban renewal.

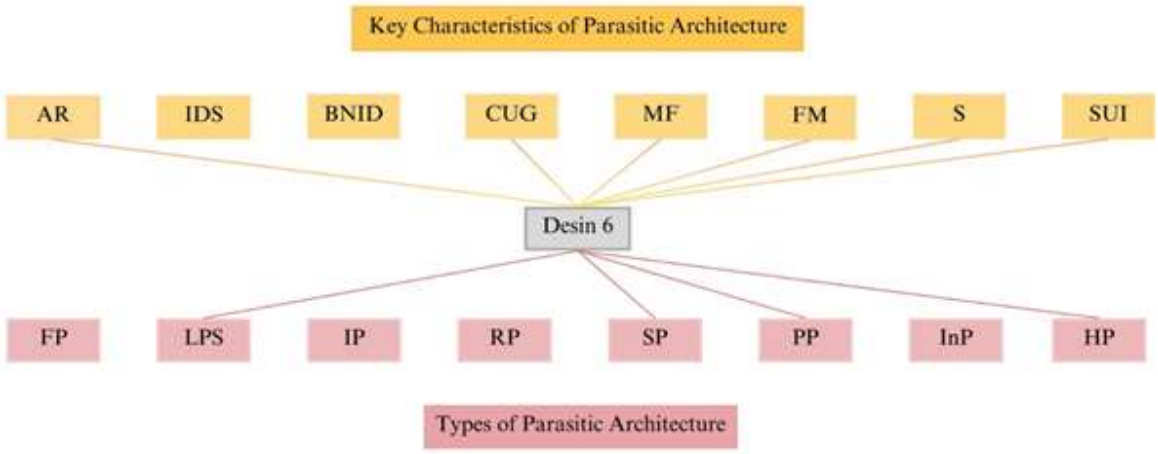

Figure 18: *The relationship of design 6 with the "key characteristics of parasitic architecture" and "types of parasitic architecture"*

The comparative analysis of the six student projects (summarized in the evaluation matrix presented in Table 4) demonstrates a consistent prioritization of Minimal Footprint (MF), Flexibility and Modularity (FM), and Sustainability (S) as core design criteria. These three key characteristics were incorporated into all six projects, revealing a strong collective orientation toward environmentally conscious and adaptable architectural thinking. Additionally, the widespread use of Hybrid Parasites (HP), Layered Parasite Structures (LPS), and Plug-in Parasites (PP) across the majority of the projects reflects a preference for multifunctional, modular, and innovative design strategies. Conversely, typologies such as Infill Parasites (IP), Rooftop Parasites (RP), and Adaptive Reuse (AR) were used less frequently, indicating that themes such as reuse of historical structures require further emphasis in future studios. These patterns, derived directly from the comparative table, underscore students' growing awareness of sustainable urban transformation and their ability to critically interpret parasitic architecture not only as a formal intervention, but as a socially and ecologically responsive design strategy.

Table 4: *Comparative Matrix of Student Projects Based on Key Characteristics and Typologies of Parasitic Architecture*

	AR	IDS	BNID	CUG	MF	FM	S	SUI	FP	LPS	IP	RP	SP	PP	InP	HP
Design 1	—	✓	—	✓	✓	✓	✓	—	✓	✓	—	—	✓	✓	✓	✓
Design 2	✓	—	—	—	✓	✓	✓	✓	✓	✓	—	—	—	✓	—	✓

	AR	IDS	BNID	CUG	MF	FM	S	SUI	FP	LPS	IP	RP	SP	PP	InP	HP
Design 3	—	✓	✓	✓	✓	✓	✓	✓	—	✓	✓	—	✓	✓	—	✓
Design 4	—	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	—	✓	✓	—	✓
Design 5	—	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Design 6	✓	—	—	✓	✓	✓	✓	✓	—	✓	—	—	✓	✓	—	✓

Conclusion and Recommendations

In this study, conducted as part of the Architectural Design course at Bingöl University's Department of Architecture, proposals were developed for underutilised areas in the city of Bingöl, considering parasitic architectural approaches. The students reimagined various spaces such as the blind facades of buildings, an unused water tank, an old bridge, and the viaduct piers connecting the city, redesigning them as day-use accommodations, social event spaces, public areas, and community gathering spots. Special emphasis was placed on sustainability, nature conservation, and reducing the carbon footprint in these projects. For instance, innovative interventions such as the transformation of a water tank into a functional living space and the addition of a new living space attached to a city bridge demonstrate that parasitic architecture can not only revitalise neglected areas but also enhance ecological sustainability.

The findings reveal how parasitic architecture can support urban development in Bingöl in a more sustainable and ecologically sensitive manner while also enhancing the social and cultural vibrancy of urban spaces. Moreover, as clearly illustrated in the comparative evaluation matrix (Table X), certain criteria were consistently prioritized across all six student projects. Minimal Footprint (MF), Flexibility and Modularity (FM), and Sustainability (S) were the three key characteristics that appeared in every project, demonstrating a shared commitment to environmentally conscious and adaptable design thinking. Typologies such as Hybrid Parasites (HP), Plug-in Parasites (PP), and Layered Parasite Structures (LPS) were also highly favored, pointing to a collective interest in multifunctional and modular spatial strategies.

On the other hand, Adaptive Reuse (AR) and Rooftop Parasites (RP) appeared less frequently, indicating that themes related to the reuse of historical or existing structures may require further emphasis in future studios. These gaps suggest the need for more diverse site selection and targeted discussions around heritage transformation in architectural education. Interdisciplinary input (particularly from urban planning, sociology, or environmental engineering) may help students understand the broader implications of parasitic interventions and their relevance to social equity and policy.

The general conclusions of the study are as follows:

- The application of parasitic architectural approaches in architectural education significantly enhanced students' abilities to interact with existing structures, repurpose spaces, and develop innovative solutions within constrained urban areas. The creative interventions

developed by the students in response to current issues such as urban density and space scarcity are considered a major step in their professional preparation process.

- The study emphasised the importance of creating living spaces with minimal environmental impact by exploring how parasitic architecture aligns with sustainability principles. This process increased students' awareness of environmentally sensitive architectural practices and strengthened their knowledge and understanding in this area.
- The process of designing structures that could be integrated into the existing urban fabric improved students' abilities to conserve space and uncover the potential of existing buildings. This approach equipped architecture students with the skills to produce functional and aesthetic solutions in dense urban environments.
- Addressing real-world problems and data in student projects contributed significantly to the learning process. This experience helped students bridge theory and practice, making them better prepared to face real-world challenges in the architectural profession.
- Projects focused on parasitic architecture enhanced students' creative problem-solving skills, boosting their confidence in tackling complex urban and environmental issues. These projects also strengthened students' ability to think innovatively, making them more equipped to handle the challenges they will encounter in architectural practice.
- The use of parasitic architecture in architectural education effectively fosters students' creative thinking and problem-solving skills. Integrated with project-based learning, this approach encourages students to question existing urban spaces and propose innovative interventions for their transformation. It promotes deeper engagement with built environments and supports an experimental, forward-thinking design perspective.

The study explored the transformations that parasitic architecture can create on existing structures, encouraging students to investigate strategies of dissection, infiltration, and parasitisation in relation to these structures. These strategies enhance students' capacities to introduce new functions to urban spaces, ensure the continuity of architectural structures, and develop innovative solutions that can be integrated into existing urban fabrics. The socially focused aspect of parasitic architecture highlights its potential to raise awareness on issues such as homelessness and immigration. In this context, architecture students can gain a deeper understanding of architectural design as a process that not only involves aesthetics but also has social implications.

Furthermore, the evaluation shows that parasitic structures hold significant potential to diversify and revitalize urban environments through minimal yet impactful interventions. They provide flexible frameworks that can accommodate temporary or permanent, legal or informal additions making them suitable for future collaboration with municipalities or NGOs interested in urban regeneration. Future research could explore how parasitic strategies evolve in different institutional settings or over multiple semesters, offering insights into their long-term educational value.

The findings from this study clearly demonstrate the significance and potential of parasitic architecture in architectural education. This educational model holds great value in not only providing students with theoretical knowledge but also in enhancing their ability to apply this knowledge in practice and offer creative solutions to real-world problems. The integration of parasitic architecture into architectural education fosters a deeper and more critical engagement between students and both existing structures and urban spaces. As a result, architectural education provides an experience that strengthens students'

independent thinking abilities, boosts their confidence, and prepares them for the challenges they will face in future architectural practice.

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Urban Design Frameworks: From Traditional Paradigms to Contemporary Landscape and Ecological Approaches

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Abstract: This paper explores the evolution of urban design frameworks, tracing the shift from traditional models focused on spatial order and architectural form to contemporary approaches that prioritize ecological integration and sustainability. It highlights the rise of landscape urbanism, green infrastructure, and ecological design as key frameworks that treat natural systems as essential components of urban form. The study compares traditional paradigms—such as modernism and New Urbanism—with ecological frameworks that emphasize adaptability, multifunctionality, and resilience. It also examines the incorporation of smart materials, intelligent systems, and data-driven environmental analysis in sustainable architecture. The paper concludes by discussing how these contemporary frameworks are being localized in the Persian context, where traditional practices like qanats and Persian gardens align with modern ecological principles. Through comparative analysis and regional application, the research advocates for a synthesis of form, function, and ecology in urban design, offering strategic guidance for building more livable and resilient cities.

Keywords: Urban design frameworks, Landscape urbanism, Green infrastructure, Ecological design

Introduction

Urban design frameworks (see Figure.1) provide structured approaches and guiding principles for shaping cities and settlements. A clear framework helps planners and designers address complex urban challenges by integrating various disciplines – architecture, landscape, infrastructure, ecology, and sociology – into a coherent vision. In recent decades, rapid urbanization and environmental pressures (from climate change to resource scarcity) have underscored the importance of robust urban design frameworks that can create sustainable, livable cities. Traditional urban design models often focused on physical form and aesthetics, but contemporary approaches increasingly emphasize ecological processes, green networks, and resilience. This paper explores the evolution of urban design frameworks, comparing traditional and contemporary models, and delves into key emerging concepts such as landscape urbanism, green infrastructure, and ecological design. The discussion also integrates the Persian urban planning context, highlighting how these frameworks are being interpreted and applied in Iran's urban design and landscape architecture discourse. Ultimately, understanding these frameworks is crucial, as they shape how we envision the future of cities and the balance between built form and natural systems (Ellis, 2015).

Figure 1: *An infographic contrasting traditional urban design paradigms focused on physical form with contemporary ecological frameworks that emphasize sustainability, green networks, and resilience in shaping future cities.*

Traditional Urban Design Frameworks: An Overview

In the 20th century, urban design was heavily influenced by modernist and neo-traditional paradigms. Modernist approaches (exemplified by architects like Le Corbusier) emphasized rational planning, zoning, and the primacy of architecture – cities were often conceived as compositions of buildings and objects arranged in orderly patterns. Nature in these schemes was frequently treated as a separate element (e.g. parks, green belts) rather than an integrated system. By the mid-20th century, critiques of modernism's sterility and environmental indifference grew. Thinkers like Jane Jacobs (1961) argued for human-scaled, organic urbanism, though her focus was social/ecological in a broad sense rather than a formal framework. This led to New Urbanism in the 1980s–1990s, a movement often seen as a return to traditional town planning principles. New Urbanism advocates walkable, mixed-use neighborhoods, transit-oriented development, and classical community forms as an antidote to sprawl. It prioritizes pedestrian-friendly streets, defined public spaces, and architectural vernacular, aiming to recreate the social cohesion of traditional towns (Forman,2014) . However, while New Urbanism addresses social and aesthetic issues of post-war sprawl, its emphasis remained on urban form (street grids, plazas, etc.) with nature often confined to parks and green boulevards. Critics have noted that New Urbanism, despite its humane scale, did not fully engage with ecological sustainability – this perceived shortcoming opened the door for new frameworks that put landscape and ecology at the forefront (McHarg, 1969) .

Traditional frameworks tended to be blueprint-driven – planners produced master plans dictating land uses, block layouts, and building forms. These frameworks sought order and beauty (e.g. City Beautiful movement's grand axial plans) or efficiency and separation of uses (modernist functional zoning). While they yielded iconic designs, they often overlooked natural processes (water flows, biodiversity) and sometimes led to inflexible urban forms unable to adapt to environmental change. In contrast, contemporary frameworks emerged to rectify these gaps, introducing more dynamic, systems-oriented thinking. Before turning to those, Table 1 summarizes key differences between the traditional approaches and the newer landscape/ecology-driven models.

Table 1: *Key Differences between Traditional and Contemporary Urban Design Frameworks*

Primary Focus	Physical form and spatial order (buildings, streets, blocks)	Natural systems and processes as foundational infrastructure
Role of Nature	Treated as aesthetic or recreational add-on (parks, vistas)	Integrated as a framework for urban structure (green networks, ecology)
Design Paradigm	Master planning, static layouts, zoning separation	Systems thinking, flexible/adaptive planning, mixed land uses integrated with ecology
Key Principles	Human-scale public spaces (New Urbanism), functional separation (Modernism), visual order, walkability (in NU)	Sustainability, resilience, multi-functionality, ecosystem services, landscape performance
Examples	Radburn superblocks, *Charter of New Urbanism* developments, Garden City layouts	Landscape urbanism projects (e.g. urban waterfront parks), green infrastructure plans (urban greenways, bioswales networks), eco-districts

As Table 1 suggests, contemporary models expand the scope of urban design beyond architecture and human use, to include environmental processes and "green" networks as essential city infrastructure. We now discuss three influential frameworks – landscape urbanism, green infrastructure, and ecological design – that exemplify this paradigm shift.

Landscape Urbanism: Merging Landscape and Urban Design

Landscape urbanism is a theory of urban design that emerged in the mid-1990s, proposing that landscape (the interconnected matrix of natural and open spaces) should replace architecture as the structuring medium of the city . In contrast to viewing cities as compositions of buildings, landscape urbanism argues that the city is fundamentally composed of "interconnected and ecologically rich horizontal field conditions" – in other words, networks of green spaces, water, topography, and infrastructure that form the groundwork on which urbanization occurs (Waldheim,2012) . This framework emphasizes performance over aesthetics: the ecological and social functions provided by landscape (stormwater management, habitat connectivity, recreation, climate moderation) take precedence over formal architectural beauty. Designers like Charles Waldheim and James Corner, who popularized landscape urbanism, advocate for systems-based thinking – designing cities via the logic of natural systems and flows rather than rigid master plans.

Recent research continues to advance sustainability goals by exploring how smart systems, innovative materials, and data-driven environmental analysis can be integrated into building design. For example, Shafa (2024a) highlights the importance of efficient energy management and the use of renewable resources in creating intelligent and adaptable building environments. In her related studies (Shafa, 2024b; 2025), she investigates advanced materials such as ETFE and phase change materials (PCMs), demonstrating their potential to improve energy efficiency, occupant comfort, and environmental responsiveness—core principles of sustainable architecture. Additionally, the application of machine learning-based drought classification models to environmental assessments introduces a new dimension of intelligence in site planning and geotechnical evaluations (Saghaei, 2025). Collectively, these efforts translate broad sustainability concepts into actionable, context-

sensitive design strategies that guide material selection, energy systems, and environmental planning in sustainable construction.

Projects often focus on transforming derelict or underutilized areas (e.g. waterfronts, brownfields) into multi-functional landscapes that evolve over time. For example, many post-industrial cities such as Detroit saw landscape urbanist strategies using green space to restructure vacant land and manage urban shrinkage (Van der Ryn ,2013). By the 2000s, landscape urbanism was also applied in Europe as a "highly flexible way of integrating large-scale infrastructure, housing and open space" , and became associated with signature projects like large urban parks (the regeneration for the London Olympic Park, for instance, is often cited as influenced by landscape urbanism).

Importantly, landscape urbanism arose as a critique of New Urbanism and modernist planning. Waldheim (2006) and others described it as a postmodern or post-postmodern response to the perceived failings of New Urbanism's approach . While New Urbanism promotes traditional town morphology and often idealizes historical forms, landscape urbanism proponents argue this can lead to formulaic designs that ignore ecological context. Instead, landscape urbanism embraces complexity and change: cities are seen as open- ended ecological processes rather than fixed end-states. This approach often welcomes indeterminacy – for instance, allowing natural succession in certain areas or designing parks that can adapt to flooding. It also overlaps with other contemporary ideas like infrastructural urbanism (viewing infrastructure as a driver of urban form) and ecological urbanism (integrating ecology and urban design thinking) . A hallmark example of landscape urbanist thinking is James Corner's work on New York's High Line and Fresh Kills Park, where derelict infrastructural corridors were reconceived as green spines for urban activity and ecological regeneration.
In summary, landscape urbanism reframes the urban design framework by treating landscape as the primary infrastructure. It advocates designing cities in harmony with natural processes, yielding outcomes that are often more resilient and sustainable. By replacing the old paradigm of the city-as-building-fabric with city-as-landscape, this framework broadens what urban design encompasses. It also set the stage for related concepts like green infrastructure and ecological design, which we explore next. While landscape urbanism provides the theoretical foundation—emphasizing systems thinking and ecological flows—green infrastructure often translates these ideas into actionable policy and design tools. In this way, landscape urbanism can be seen as a vision-setting framework, whereas green infrastructure offers the operational means to realize that vision through regulations, investments, and measurable ecological performance targets.

Green Infrastructure: Integrating Ecology into Urban Systems

Green infrastructure (GI) is a planning and design framework that focuses on creating an interconnected network of natural and semi-natural areas in urban regions to provide ecological services and enhance quality of life. In simple terms, green infrastructure is a network of multi-functional green space (and water bodies) – ranging from parks, wetlands and forests to green roofs, street trees and bioswales – that is strategically planned and managed to perform various functions. Unlike grey infrastructure (traditional engineered systems like roads, sewers, concrete flood controls), green infrastructure uses vegetation, soil, and natural processes to tackle urban challenges such as stormwater management, air pollution, heat island effects, and biodiversity loss. For example, a citywide green infrastructure plan might include preserving river floodplains as parks (for flood control and recreation), installing rain gardens and permeable pavements in neighborhoods (for stormwater absorption), and developing green corridors that connect habitat patches (to support wildlife and provide linear parks for people). The key idea is that by connecting these elements into a coherent network, they deliver multiple benefits simultaneously

The concept of green infrastructure gained prominence in the late 1990s and 2000s as urban planners and environmental organizations recognized that isolated parks were not enough – networks are needed to sustain ecological functions. Benedict (Benedict, 2012) and McMahon's seminal 2006 book Green Infrastructure: Linking Landscapes and Communities helped formalize GI as a framework, highlighting principles such as connectivity, multi-functionality, and strategic planning at different scales (site, city, region). A key principle is multifunctionality: a green infrastructure element should ideally provide several services at once. For instance, an urban wetland can treat stormwater, provide wildlife habitat, sequester carbon, cool the air, and offer educational recreation space. This aligns with sustainable design goals by getting "multiple outcomes for one investment." Another principle is connectivity: individual green spaces are more valuable when linked into networks (a continuous greenway allows animal movement and bike transportation, whereas isolated parks do not). Thus, GI planning often involves mapping existing green assets and identifying opportunities to connect them (through green corridors or stepping-stone habitats).

Green infrastructure frameworks also stress working with natural systems rather than against them. Instead of piping away rainwater (which can cause sewer overflows), GI techniques like swales, rain gardens, and green roofs absorb water where it falls, restoring a more natural hydrology in cities. This not only reduces flooding but also recharges aquifers and filters pollutants. Urban trees and parks mimic the cooling effect of natural forests, mitigating heat waves. Importantly, GI is seen as complementary to traditional infrastructure: many cities now implement "blue-green" infrastructure where natural elements augment or replace concrete infrastructure for water management and climate adaptation. For example, the city of Copenhagen has integrated green streets and retention basins to manage cloudbursts, and Singapore's "City in a Garden" approach has woven green and blue elements throughout its urban fabric to improve resilience.

The rise of green infrastructure marks a shift in urban design frameworks from seeing ecology as an amenity to treating it as fundamental infrastructure. It represents an operational way to implement landscape urbanism principles at multiple scales – often, landscape urbanism provides the theory and vision, while green infrastructure offers practical tools and policies to realize that vision across a city. Many municipalities and regional governments now have green infrastructure plans or policies, demonstrating its importance. In sum, GI embeds ecological design into everyday urban planning by ensuring that natural processes (like infiltration, evapotranspiration, habitat provision) are deliberately designed into the city. As one definition aptly puts it, green infrastructure is "a network of integrated spaces and features… 'multi- functional' – providing multiple benefits simultaneously" , from healthier environments to social well-being.

Ecological Design in Urbanism

Ecological design is a broad concept that predates and underpins frameworks like landscape urbanism and green infrastructure. It refers to designing human environments in alignment with ecological principles, so that instead of degrading natural systems, our buildings, landscapes, and cities participate in and enhance those systems. The roots of ecological design in urbanism can be traced to the late 1960s and 1970s, notably with landscape architect Ian McHarg's pioneering work. McHarg's 1969 book Design with Nature revolutionized planning by arguing that the best designs are those that work with, rather than against, nature . He introduced methods for analyzing layers of a site's ecology (soils, vegetation, hydrology, etc.) and overlaying them to determine suitable locations for development versus conservation. This "layer-cake" method laid the groundwork for modern GIS-based environmental planning and embodies ecological design – making design decisions based on ecological opportunities and constraints. McHarg's philosophy was essentially an early urban design framework

focused on ecology: before building anything, understand the "fitness of the land" and let nature inform the plan. His approach has had lasting influence on regional planning, landscape architecture, and environmental impact assessment.

In the 1990s, Sim Van der Ryn and Stuart Cowan further defined ecological design as "any form of design that minimizes environmentally destructive impacts by integrating itself with living processes." This means that a city or project should be conceived as an ecosystem – with closed-loop waste cycles, energy from renewable sources, and respect for carrying capacity. In practical terms, ecological urban design promotes techniques like using local materials, designing for passive solar and ventilation, incorporating green roofs and urban agriculture, and restoring urban watersheds and habitats. The goal is to reconcile human needs with the health of ecosystems. One succinct definition states that ecological design is "intentional design of landscapes and products to achieve and protect ecosystem services" . In urban design, this might translate to, for example, shaping the city's form to preserve a floodplain's water storage service, or planning a network of small wetlands to treat wastewater naturally (an approach popularized by ecological designer John Todd with his "living machines").

Ecological design also implies interdisciplinary collaboration: architects, engineers, ecologists, and planners working together so that engineering solutions and design aesthetics reinforce natural outcomes. This systems approach appeared in movements like permaculture and biophilic design as well, which share an emphasis on learning from nature's patterns. Notably, the concept of "urban ecology" has emerged as a scientific field studying cities as ecosystems. It has been formalizes the understanding of how ecological processes function in urban settings – providing evidence and principles that urban designers can use to create greener, more sustainable cities. For instance, urban ecology research might inform how large a patch of urban forest should be to sustain certain bird species, or how connectivity of tree canopy affects urban heat. This knowledge becomes part of the ecological design framework: design decisions are guided by ecological science to ensure the city contributes to biodiversity and environmental health rather than diminishes it . In recent years, Ecological Urbanism has been coined as a theory expanding on these ideas, merging architecture and landscape with sustainability and ethics. It calls for an urbanism that is creative, multi-scalar, and rooted in ecological thinking, extending beyond mere technical fixes to also reshape the culture and experience of the city. While more theoretical, it complements the practice- oriented approaches by asking designers to envision cities in the context of the planet's ecology and resource limits. Whether termed ecological design, eco-urbanism, or sustainable urban design, the common thread of these contemporary frameworks is a holistic integration of natural and human systems.

Comparative Analysis: Traditional vs. Contemporary Models

Bringing the discussion together, we can compare how traditional urban design models differ from contemporary frameworks in key dimensions. Traditional models (including modernist and early postmodern approaches like New Urbanism) were form-driven and often static. They aimed to impose a lasting order on cities – think of master plans with fixed layouts and architectural styles. The success of a design was typically judged by its immediate functionality and aesthetic coherence. Environmental considerations were secondary; for example, in a Garden City plan, greenbelts existed but primarily to provide fresh air and recreation, not as active ecological systems. Contemporary models, by contrast, are process-driven and dynamic. They conceive of the city as an evolving organism. Success is measured not just by aesthetics or efficient land use, but by performance over time – does the urban landscape manage water, reduce heat, support biodiversity, adapt to climate change? Landscape urbanism explicitly values the temporal dimension, allowing landscapes to mature and change and letting urban form be more fluid. Green infrastructure requires continuous networks – implying that design

must transcend individual sites and look at the whole city metabolism. Ecological design demands feedback loops, where a design is monitored and adjusted based on environmental performance (an adaptive management approach).

Another difference lies in interdisciplinarity and scope. Traditional urban design was often dominated by architects or physical planners, focusing on spatial form at the neighborhood or city scale. Contemporary frameworks necessitate collaboration across ecology, engineering, and community planning, and often operate at multiple scales simultaneously (from site micro-habitats to regional greenway systems). For instance, a landscape urbanist might work with ecologists to determine which native plant communities to establish in a park that also functions as flood protection. A green infrastructure plan may involve city planners, utility engineers, landscape architects, and public health experts (recognizing, for example, the mental health benefits of green space).

It is also instructive to consider the goals and values underpinning each. Traditional models valued order, beauty, and often social order (in the case of New Urbanism, creating a sense of community via design). Contemporary models value resilience, sustainability, and inclusivity of natural processes. This doesn't mean traditional approaches ignored human comfort – indeed New Urbanism is very much about human-scale urbanism – but they largely worked within a paradigm of human dominance over nature (nature was something to be contained or ornamentally added). In contrast, landscape and ecological urbanism treat human habitats as a subset of nature, not apart from it. This aligns with the ethos of the Anthropocene era, where design acknowledges humans must consciously harmonize with earth systems.

One concrete comparison can be drawn between New Urbanism and Landscape Urbanism, often portrayed as competing paradigms. New Urbanism (NU) focuses on urban form – compact walkable blocks, mixed-use neighborhoods, and traditional architectural vernacular. Landscape Urbanism (LU) focuses on urban process – flows of water, energy, biodiversity through a city, and creating flexible open-ended spaces. NU's toolkit includes form-based codes and street network designs; LU's toolkit includes ecological restoration and adaptive landscapes. The two emerged as responses to modernist planning, but with different strategies: NU looked backward to pre-automobile urban patterns (hence "new" urbanism reviving old urbanism), whereas LU looked outward to landscape and ecology as a way to reinvent urbanism for the future. Critics of New Urbanism argue that its idealism about traditional form doesn't necessarily solve environmental issues (a beautiful neighborhood could still be resource-inefficient), while critics of Landscape Urbanism argue that it can be too abstract and fails to generate a sense of place or community in the way good traditional design can. Increasingly, some planners seek common ground between these approaches – for instance, incorporating green infrastructure into New Urbanist developments, or ensuring landscape-driven plans also foster walkable urbanity. In practice, the best contemporary projects often blend insights from both: they use ecologically rich landscapes as a framework, while also creating human-scaled urban places.

Persian Urban Planning Context and Application

In Iran and the Persian context, urban design frameworks have also been evolving under global influences and local traditions. Historically, Persian cities and gardens exemplified an integration of architecture with nature – the Persian garden (e.g., Fin Garden in Kashan or Eram Garden in Shiraz) is a classical template where water and vegetation were meticulously arranged to create microclimates and aesthetic order. These gardens and green spaces in traditional Persian design were not only for beauty but also served practical purposes like cooling and managing water. Studies indicate that up until the late 19th century, Iranian urban design employed sustainable features in response to climate and resource limits, and these historical models could inform contemporary sustainable design strategies. For example, the use of qanats (underground water channels) and garden

layouts in desert cities was an early form of green infrastructure, ensuring water supply and evaporative cooling. Such precedents resonate with today's emphasis on working with climate and hydrology. These time-tested strategies are not merely historical artifacts—they offer viable solutions to current challenges such as Tehran's air pollution, water scarcity in Yazd, and the increasing demand for heat-resilient public spaces. By adapting ancient systems like qanats and garden layouts, planners can address pressing issues with culturally embedded, ecologically sound tools.

In modern times, Iranian urban planners and scholars have begun to explicitly adopt and localize concepts like green infrastructure and landscape urbanism. A study by Hakimian and Lak (2017) highlighted green infrastructure as a common concept bridging the disciplines of urban design and landscape architecture in Iran's academic programs, suggesting that both fields are moving toward a shared ecological approach. Their research, focused on Shahid Beheshti University in Tehran, reviewed design studio projects and theses and found that many urban design students were incorporating ecological networks and many landscape architecture students were addressing urban issues – with green infrastructure being a meeting point. The findings showed that although the two disciplines might initially emphasize different scales or aspects of green infrastructure, they ultimately shared goals of improving environmental performance and urban quality of life. This implies that the next generation of Iranian designers is being trained to think beyond the old dichotomy of "urban vs. landscape" and instead approach city design holistically.

There have been tangible projects and proposals in Iran reflecting these contemporary frameworks. For instance, graduate theses have proposed urban design frameworks based on ecological corridors in Iranian cities. One such project developed a framework for Tehran's Evin neighborhood focusing on linking ecological networks at the neighborhood scale. Another study looked at Isfahan's District 9, formulating a "green urban design" guided by the area's natural corridors. These efforts mirror global trends, yet respond to local context – Isfahan's dry climate and historic gardens, for example, require adapting green infrastructure practices to ensure drought-tolerant planting and use of traditional irrigation knowledge. Additionally, Iranian cities like Mashhad and Tehran have started implementing green belts, urban parks, and restoring river-valley ecosystems (such as the restoration of the Zarjub and Gohar Rood riversides in Rasht as green promenades). These can be seen as initial steps toward a broader green infrastructure network.

It's also worth noting that the cultural and aesthetic dimensions of landscape are very strong in Persian tradition, which could enrich the application of frameworks like landscape urbanism. The notion of "bagh" (garden) is ingrained as a Persian ideal of paradise on earth; contemporary designers can leverage this cultural affinity for gardens to garner public support for green infrastructure projects (for example, framing new urban parks or greenways as extensions of the Persian garden legacy). Meanwhile, challenges specific to Iran – such as water scarcity, air pollution in cities like Tehran, and rapid urban growth – make ecological design approaches not just desirable but essential. For instance, urban ecological design can help mitigate Tehran's notorious air pollution by creating urban forests and biofilters, and green infrastructure can assist with water management in a country where every drop counts. The blending of modern science with traditional wisdom (like using wind towers and gardens for cooling) is a promising direction Iranian urban design is beginning to explore.

In summary, the Persian context demonstrates both a rich heritage of integrated design and a growing contemporary movement to align with global best practices in landscape and ecological urbanism. As Iran's cities continue to grow and face environmental pressures, these frameworks provide valuable tools to create more sustainable and livable urban environments.

Conclusion

Urban design frameworks have significantly expanded in scope from the early 20th century to today. Traditional approaches gave us the foundation of orderly, human-centric urban form, but often at the expense of ecological considerations. Contemporary frameworks like landscape urbanism, green infrastructure planning, and ecological urban design represent a paradigm shift – they treat cities as living systems and position nature as an equal partner in design. This shift is crucial in an era when cities must address climate change, biodiversity loss, and resource limitations. The integration of landscape and ecology into urban planning leads to designs that are inherently more adaptive and resilient: a city with wetlands, urban forests, and permeable surfaces will better withstand floods and heat waves than one of concrete and asphalt. Likewise, a city that designs with nature in mind can enhance its citizens' well-being – providing cleaner air, accessible green space for recreation, and a stronger connection to place and history.

Comparatively, we see that no single framework is a silver bullet. New Urbanism contributed lessons about walkability and human-scale design, which remain important even as we green our cities. Landscape urbanism taught designers to value processes and think long-term, but it must still create places people love. Green infrastructure offers practical strategies to implement ecological ideas, yet it requires policy support and maintenance commitment to be effective. Ecological design imbues a value system of sustainability, but it needs community engagement to succeed (cities are social-ecological systems, after all). The future of urban design likely lies in synthesizing these frameworks – creating hybrid approaches that draw on the strengths of each. Already we see terms like "sustainable urban design," "resilient urbanism," or "regenerative design" that essentially bundle together the human, ecological, and infrastructural aspects into unified strategies.

The Persian urban planning experience underscores that applying these frameworks will have unique local expressions. By learning from Iran's own sustainable traditions and embracing contemporary science, Persian cities can develop models suited to their environment and culture – potentially offering lessons back to the global community (for example, how to design green infrastructure in arid climates, or how to incorporate millennia-old landscape wisdom into modern urbanism). In the end, the importance of urban design frameworks is that they guide practitioners in making countless decisions – from where to site a new neighborhood to how wide to make a sidewalk bioswale. A framework rooted in sound principles ensures those decisions collectively lead toward a vision of a thriving urban ecosystem. As this research has shown, moving from traditional to contemporary frameworks is not about discarding the past, but about enriching urban design with new dimensions of knowledge. Landscape urbanism, green infrastructure, and ecological design expand our toolkit and imagination, helping cities become not only more beautiful and functional, but also more sustainable, equitable, and resilient for future generations.

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