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From Foundations to Frontiers: A|Z at 23

Hayriye EŞBAH TUNÇAY • *Editor*

A retrospective look at the 20+ year publishing history of A/Z – ITU Journal of the Faculty of Architecture reveals our steady progress. Since its launch in 2004, our journal has continued its publication uninterrupted, having published 22 volumes and 66 issues to date.

We honor our founding editor, Prof. Dr. Orhan Hacıhasanoğlu, who passed away last year. The first issue, titled "Housing Policy," appeared under his guidance. Issues from the early years—edited by him through Volume 9 in 2012—spanned diverse topics. These included sustainability across urban planning and cultural landscapes; technology, design, and vernacular architecture; quantitative models in planning; education; diversity, multiculturalism, and urban life quality. This broad sensitivity persists today.

From Volume 10, Issue 1 (2013) to Volume 16, Issue 3 (2019), under Chief Editor Prof. Dr. Yasin Çağatay Seçkin and acting editors Prof. Dr. Yurdanur Dülgeroğlu Yüksel, Prof. Dr. Tüzin Baycan, and Prof. Dr. Gül Koçlar Oral—supported by a robust team—the journal advanced in design, planning, technology, and education. Standout themed issues captured architecture's dynamic discourse: Sustainable Landscape Planning and Safe Environment (2013), Cities at Risk (2014), Space Syntax and Architectural Design (2015), Energy Efficiency in Buildings (2016), Urban Transformation (2017), Sustainability vs. Resilience (2018), Future Trajectories of Computation in Design (2018), and Theory (2019). Covers sparked debate with provocative titles like "We Need Designers Not Scientists" and questions such as "Is Sustainability Out, Resilience In?"

Structural upgrades ensured world-class quality. Since 2015, we've published three times yearly to meet demand. We refreshed the logo, cover, and page design for better visibility and readability. An online manuscript system and updated website boosted accessibility. Under Prof. Dr. Yasin Çağatay Seçkin's seven-year tenure, A/Z earned SCOPUS indexing and improved its impact factor.

Since 2020, we have seen the addition of globally prioritized urgent topics such as disasters, technology, and urban adaptation to the core concepts covered by the journal. Relatively recent themes emphasize contemporary challenges: Earthquake Risk Reduction (2023), Resilience (2024), Materials (2024), and Extroversion (2025), alongside special issues such as New Horizons (2025). Since taking over as editor following the onset of the pandemic, Prof. Dr. Aliye Ahu Gülümser, along with the editorial board and secretariat, has dedicated significant effort to ensuring the journal serves as a scientific platform for sharing knowledge in the context of planning, design, technology, art and theory. I would like to express my gratitude to everyone who has contributed to the journal up to this point.

As editor of our 2026 inaugural issue, supported by a new editorial board and dedicated secretariat team, I commit to elevating A/Z's impact factor, visibility, and pioneering role in architecture, planning, design, technology, art, and theory. This issue's 13 interdisciplinary articles underscore our inclusive ethos.

Climate change relentlessly impacts urban, rural, agricultural, and natural realms, fueling adaptation needs, social injustices, and economic imbalances. Effective solutions demand scientific research, interdisciplinary collaboration, solidarity, and collective action. Subsequently, this issue's articles deliver key insights on climate adaptation: self-housing policy; urban design, walkability, and stress management; resilience in historic rural settlements; conservation; and history. One explores integrated project delivery in project management. A substantial number of articles in this issue examines design education and spatial perception from various scales and disciplines.

We eagerly await reconnecting in future 2026 issues with articles on local and global priorities.

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Why self-help housing failed in urban Turkey: A policy and legislation misalignment

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Abstract
Housing low-income households in Turkey's urban areas has remained an enduring challenge. During the 1960s, growing housing shortages and economic constraints urged efforts to prevent and upgrade squatter settlements, leading Turkey to adopt self-help housing (SHH) programs for low-cost housing provision. Under the first two five-year development plans (FYDPs), government-assisted SHH initiatives were launched in major cities as part of squatter prevention zones (SPZs). However, the successful beginning of the projects did not lead to successful conclusions; the policy failed to reach its goals in urban areas of Turkey despite the extensive research support. This study investigates the legislative causes behind this failure. It draws on SHH's core characteristics to analyse its alignment—or misalignment—with Turkey's policy framework, offering a structured approach to legislative reform. The SHH model is examined across four thematic axes: (1) design process, (2) construction process, (3) actors and roles, and (4) financing mechanisms. The study maps SHH-related regulations in Turkey through a chronological inventory of housing policies, laws, and FYDP targets. Findings highlight the need to restore research-policy dialogue and rethink legislative frameworks to enable viable SHH programs. This study is the first to systematically map Turkey's legislative misalignments with SHH requirements. It contributes to scholarly debate and future policy-making by offering a novel framework linking architectural theory with policy analysis.

Keywords
Affordable housing, Housing legislation, Participatory housing, Self-help housing, Turkish housing policy.

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1. Introduction

The need for this study arose from the current lack of inclusive public housing policies to provide affordable housing in Turkey to reflect on the possibilities of the abandoned alternative model of self-help housing. In his global survey, Coupe (2021) frames the global affordability crisis and the challenging nature of universal policy models while emphasizing the necessity for country-specific policy-making. Diamond et al. (2019) also caution that policy instruments such as rent control can have unintended consequences, including supply constraints and deeper inequalities for low-income groups. Coskun's (2023) empirical analysis of Turkey reveals that affordability pressures disproportionately burden vulnerable social groups: low-income, less-educated, youth, and precarious workers. Yıldırım's (2023) recent study on housing affordability in Turkey addresses that relying solely on market forces without any intervention fails to resolve the shortage of affordable housing. These findings point to the urgent need for socially targeted housing interventions.

Building on critical urban studies, Fields and Uffer (2014) situate housing affordability within broader financialisation and urban restructuring processes, wherein market logics displace low-income communities, thereby magnifying exclusion and segregation. As Charles Abrams (1964) argued, the housing needs of the middle class can be easily and adequately met by the private sector, while government housing programs should be targeted at low-income groups. Drawing on these insights, the implicit challenges of providing housing for low-income populations struggle to overcome the mismatch between supply and demand when left alone by inadequate policy and legislation.

Historically, the interdependence of research and policy-making in the context of self-help housing highlights the period of the 1960s to 1970s when research directly influenced policy. However, for the following period, the lack of dialogue between researchers and practitioners involved in planning and policy-making is highlighted (Ward & Macoloo, 1992). The emerging deficiency of regulations from the 1970s onwards is particularly addressed and criticised by scholars (Bredenoord & van Lindert, 2014; Wakely & Riley, 2011; Ward & Macoloo, 1992) after the implementation of site-and-services projects around the world was hastily judged as ineffective. While SHH faded from policy agendas in the 1990s, academic interest persisted, with scholars like Burgess (1992) and Pugh (1997) reexamining its policy relevance. More recent studies (Durst, 2015; Gillespie, 2018; Grubbauer & Escobar, 2021) call for renewed attention to SHH frameworks, state subsidies, and regulatory instruments to support microfinance and self-organised housing initiatives.

Turkey's housing history reflects this trajectory. In the 1960s, the Turkish state explicitly sought the contribution of research to affordable housing policy through collaborations and dialogues between ministries, municipalities, universities, research institutions, professional chambers and other construction industry actors, coinciding with the period of adopting the SHH model. Excluding these actors from participating in policy-making and the processes of planning and development has serious consequences for the provision of affordable housing. This paper argues for restoring this research-policy dialogue and underscores the role of legislative frameworks in adopting SHH policies.

In Turkey, the SHH model was adopted in 1966 to prevent informal urban construction, operationalised through SPZs by the General Directorate of Housing (GDH) under Law 775. Research has documented SHH's implementation (Akın et al., 1987; Çezik & Ergen, 1985; Geray, 1973; Kartal, 1985; Keleş, 1988; Ok, 1985) and post-occupancy transformations (Baytin, 1966; Gülaydın, 2004; Tong, 1989). While comprehensive reviews of Turkish housing policy exist (Alkışer, 2003; Batuman, 2006; Keleş, 1990), no study has systematically framed SHH policy failures within the legislative context. Addressing this gap, we propose a structured lens to analyse SHH's viability, focusing on the policy environment that led to its collapse. The study draws

legislative lessons from Turkey's past with the aim of informing future SHH models.

2. Urban self-help housing programs in Turkey

Although Turkey's housing policies have varied over time, they have mainly served middle- and upper-income groups and the housing shortage for low-income households has been overcome by informal housing in each period (Alkışer & Yürekli, 2004). With the acceleration of urbanisation in the mid-1950s, squatter settlements spread throughout Turkey's cities. In 1961, 45% of the population in the capital, Ankara, lived in squatter settlements (Abrams, 1964; State Planning Organization [SPO], 1963). This data demonstrates the housing shortage in the cities and indicates that significant overcrowding occurred quickly without adequate solutions. In this context, helping the self-builder policy was targeted by the government as it offered many advantages for the problem.

From the 1960s onwards, these targets and measures were presented in the government's FYDPs, including a housing section. The first FYDP ensured that squatters were not demolished without building new houses (SPO, 1963). With this agenda, GDH was responsible for developing SPZs in various provincial and urban centres under Law 775 on Squatter Settlements (1966). By 2006, 643 SPZs had been designated in various cities (Ministry of Public Works and Settlement [MPWS], 2006). The plots were primarily allocated to those who were to be resettled due to the rehabilitation and eviction of squatters and other low-income citizens in need of housing. Until 1972, the different methods were implemented to varying degrees in the SPZs (Ministry of Construction and Settlement [MCS], 1973):

- Site+project allocation; 16.887 units
- Site+project+loan allocation; 4.238 units
- Site+project+loan+core house allocation; 2.824 units

In addition to the land and infrastructure measures and the financing instruments, allocating housing projects to support self-builders was a complementary instrument of the GDH to maintain adequate standards for units and settlements. The MCS's efforts to achieve economic construction while maintaining physical standards, based on collaborative research of numerous institutions, led to the development of standards for public housing (MCS, 1963a; MCS, 1963b). Accordingly, projects were prepared for both site-and-service and core housing programs.

In evaluating the practices, Keleş (1988) states that the self-build policy succeeded in rural and post-disaster areas, while it failed to achieve its goals in urban areas. The implementation of the model did not work effectively in terms of time, materials used, quality of execution and adherence to the predetermined project. The main reasons for this are the lack of a good supervision mechanism in the construction process, insufficient financial and technical support, and the scope of technical support in the legislation limited to housing projects (Akın et al., 1987). Although it was stated that the Ministry would provide material and technical support in the implementation of site-and-services projects, the housing units did not comply with the project due to the lack of adequate supervision and assistance (Dinç et al., 1989; Doğukan & Tokman, 1986).

Subsequently, the GDH's SHH implementations in urban areas were halted entirely in 1973-1974, and efforts were concentrated on completing the projects that had been started earlier (MPWS, 2006, 64). The GDH's housing programs implemented two separate projects instead, namely 'Rental or Property Housing Practice' in 1975 and 'Public Housing Practice to be Built in Underdeveloped Regions' in 1976 (MCS, 1977). Although it has disappeared from the urban low-cost housing provisions, the SHH model has continued to be used for post-disaster housing by the government with similar tools, such as the allocation of land, technical assistance, construction materials and other subsidies (Keleş, 2023, p. 648) as well as the allocation of core housing, as seen from prepared projects (MPWS, 1984).

As a result of the neoliberal economic system, housing production in Turkey recently has primarily been left to the private sector, where housing supply is of no interest to low-income households. The provision of affordable housing, on the other hand, is centralised by TOKI. Since its growing prerogatives in the last two decades, TOKI has become a powerful actor in the centralisation of urban planning (Elicin, 2020). Local authorities' involvement in housing provision is delegitimised as the previously distributed planning, regulatory and investment powers and assets of several state institutions have gradually been consolidated in TOKI. TOKI's housing projects are far from affordable for low-income groups, apart from the negative social consequences of developed settlements. For 2022, TOKI announced a social housing project with 250,000 units, which also includes the provision of 100,000 plots with services for low-income citizens. However, neither possible cooperation with local governments nor possible devolution of authority is implicated (Erçetin, 2022). An action plan for financial and technical assistance and the necessary legislation does not support it. Considering the current situation in which the financialisation of housing is enforced through state power (Çelik, 2023) and social policies for the urban low-income groups have disappeared from the agenda, it is important to learn from the experiences of precedents to encourage future projections.

3. Self-help housing model's requirements and mapping legislative gaps through content analysis

From the 1960s to the 1980s, the SHH model, a derived form of user-led informal construction, found a place in housing policy that sought affordable housing for low-income groups in developing countries. The housing alternative dates back to studies by Jacob Crane in the 1940s and Charles Abrams and John Turner in the 1960s (Arroyo & Astrand, 2013; Bredenoord, 2010; Editorial, 2003; Harris, 1998; Ward, 1982), from which the now familiar concept of incremental housing developed. Incremental housing is a process-based approach to providing housing when the finished product cannot be delivered due to the economic challenges faced by both parties. It helps governments overcome economic difficulties through better distribution of subsidies, while it helps low-income groups overcome economic difficulties by (1) spreading housing costs over time through incremental construction and (2) reducing housing costs through participation in construction. Compared to informal construction, the model enables a better living environment as physical standards are achieved through planning and technical support. It promotes community and identity building through participatory methods while formally ensuring the security of tenure. The model requires government support in adopting self-build at various levels and the site-and-services. There are different aid levels and typologies for the starter base; users can receive only a plot, a plot with services, additional subsidies for building materials, technical assistance, technical provision and a 'core house' (Bredenoord, 2010), which has been theorised by researchers and practitioners as a result of the implementation of self-help housing rather than as a new concept (Napier, 2002). However, despite the broad recognition of SHH's principles, existing studies have rarely operationalised these features into a systematic framework for evaluating policy and legislative alignment.

Although SHH programs possess significant potential, they are subject to various criticisms (Napier, 2002; Burgess, 1977; Ward, 1982). Within the Turkish context, these criticisms include the inadequate technical quality of the buildings, the fact that people do not prefer the construction work and that homeless people who migrated to squatter areas in the cities could not find time to build their own houses. (Keleş, 2023; p.435). These can be seen as surmountable difficulties arising from the poorly answered or ignored implementation pitfalls of the model, which brings us to the model's dependence on the political context due to its

inherent features. Despite significant scholarly attention to SHH's social and economic dimensions (Harris, 1998; Turner, 1976; Wakely & Riley, 2011), there remains a notable gap in systematic evaluations of how legislative frameworks enable or constrain SHH programs. Existing literature tends to emphasise project-level outcomes or macroeconomic housing policy shifts (Bredenoord & van Lindert, 2010; Payne & Majale, 2004), often overlooking the structural alignment required between SHH's architectural logic and national regulatory systems. Furthermore, while studies acknowledge financing as a critical barrier (Hoek-Smit, 2011), few have analysed how legislative provisions—or their absence—affect incremental design flexibility, participatory construction processes, actor coordination, and phased financing.

This study addresses this gap by offering a four-theme analytical framework drawn directly from SHH's inherent model characteristics. The structure captures SHH's architectural underpinnings and enables a policy-oriented diagnosis of legislative misalignments.

Methodologically, we map SHH's defining characteristics against Turkey's regulatory landscape. The proposed methodology attempts to conceptually organise the past data; we draw on the characteristics of SHH to articulate its inherent relationship to the policy context and to better formulate legislative imperatives. The study employs a qualitative content analysis methodology, systematically mapping Turkey's housing legislation and evaluating the SHH-related legislation through the model's four foundational characteristics: (1) design process, (2) construction process, (3) actors/roles, and (4) financing. These four themes are drawn from the inherent characteristics of SHH through an architectural lens, where incremental design flexibility, participatory construction processes, actor coordination, and phased financing are critical to success. Through a chronological policy inventory this paper explores the Turkish legislative gaps over SHH model characteristics and addresses pathways towards future SHH programs.

A chronological inventory of forty-five housing laws, twelve five-year development plans (FYDPs), establishment and closure of relevant governmental institutions, and constitutional changes from 1923 to 2025 was compiled. The framework was designed to illustrate the interconnections among these materials while also visualising their validity periods. In examining the visual data from the past century, clear turning points become apparent. The policy context and SHH-related regulations are analysed around these five thresholds, referencing law articles and the objectives outlined in the Five-Year Development Plans (FYDPs). This approach facilitates a structured assessment of Turkey's SHH policy and legislation misalignment while providing valuable insights for future policy development. To clarify the methodological flow, Figure 1 shows a conceptual framework that links the requirements of the SHH model with policy analysis steps.

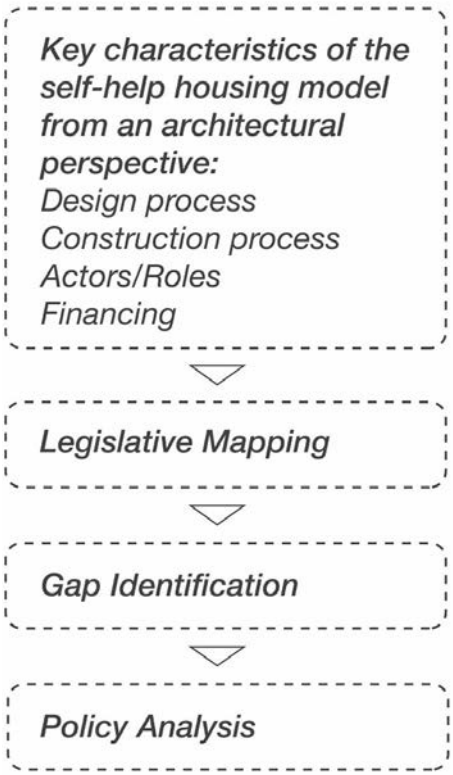


Figure 1. *The process starts with defining SHH model characteristics, proceeds through legislative mapping, identifies gaps and misalignments, and culminates in policy analysis and implications.*

3.1. Design process

The users involved in construction bring new considerations to the design process of an SHH project. Translating and transferring design knowledge to users extends to different levels, depending on whether the user participates in the design process. The design goals of a project can change depending on two interrelated aspects: incremental development and user participation. The preliminary design goal of an incremental project is to enable and facilitate growth through initial design decisions. Another design goal is flexibility and adaptability, as the combinations of units and functions may change over time. The most important design goal is directly linked to the act of self-build. As the users are involved in the construction, an ordinary person's competence and physical abilities come to the fore to guide the decisions about building production systems, construction techniques, building materials, their dimensions and connection details. These design objectives are influenced by the project's target completion time. Decisions about the time devoted to construction must be made, and workflows may differ based on the user
profile chosen for the project.

3.2. Construction process

A salient feature of the construction process is the lengthy wait for families to acquire a home with all the necessary features, extending to 8 to 10 years on average (Greene & Rojas, 2008). Therefore, the following aspects of the construction process should be evaluated for the different phases of a SHH project. Although most of the decisions that affect the construction are made during the design process, the two important factors are (1) the phases and the extent to which the user is involved in the construction and (2) the actors involved in the construction besides the user. The above answers describe the extent to which technical information is passed on to the user, the training of users for construction, and the requirements for machinery/equipment and qualified personnel. The use of cost-effective construction technologies that require low-skilled labour and the existence of an adequately regulated construction sector is paramount for the program's success (Bangdome-Dery et al., 2014). According to Bredenoord and van Lindert (2014), the availability of locally sourced building materials, local architectural traditions and climatic conditions influence the collectivity of forms of self-help housing in each specific context. On the other hand, other involved actors must provide the site and infrastructure (e.g. ministries, municipalities, contractors) for the construction. Following the assessment of Greene and Rojas (2008), the transfer of technical knowledge about construction works is necessary to support users in the initial phase when supervision is still ongoing and other actors are active in the process, as well as for additions and improvements during the years of project development.

3.3. Actors/roles

In a SHH project, the actors and their roles differ significantly from any other housing production alternative. It requires defining the distributed roles of the involved actors from the beginning of the process. The actors may be users, architects/planners/engineers or other professionals, research and educational institutions, governmental institutions, non-governmental organisations, contractors, constructors, and building material manufacturers. These actors can exchange their previously familiar roles or co-execute by sharing differently drawn boundaries of these roles. In practices that require effective collaboration between actors, coordinating multiple actors in housing construction under government programs is of utmost importance. Despite their complementary interests and capacities, a lack of coordination among these actors prevents synergies between policies and leads to duplication and conflicting actions (Greene & Rojas, 2008).

3.4. Financing

Depending on the objective and scope of a policy, financing an SHH project can be modified to the extent to which each component is funded. Essentially, three important aspects influence the variations, namely (1) the components

to be financed, (2) the financing actors and (3) the financing instruments. SHH projects consist of similar financing components as a regular project, although they may differ in scope; site, infrastructure, project costs, fees/taxes, construction materials, machinery/ equipment, skilled labour, and construction works are also components to be financed in a SHH project. These components are approached to reduce costs for users and other actors. An additional component of an SHH project is the training of users to participate in construction, which reduces the cost of construction work. The financing of the above-mentioned components can be distributed differently among the involved actors and through different financing instruments. Instruments for financing an SHH project are the sale, lease or transfer of the land, tax regulations, fee exemptions, subsidies and other instruments the authorities can regulate. To ensure the successful implementation of the program, it is important to provide users with the necessary skills to manage their savings and financial resources so that the project's later phases can be carried out in a healthy and sustainable manner (Greene & Rojas, 2008). Socio-economic factors, especially income capacity and purchasing power, are mainly responsible for the individual differences between self-help housing products in the same neighbourhoods (Bredenoord & van Lindert, 2014).

As discussed in the four themes, the SHH model is a particular approach to tackling housing production. Regulation of each factor is essential as the model aims for a planned participatory process and can be successfully implemented to the extent supported by legislation in urbanisation, land, zoning, the construction industry, and its products. Due to these inherent characteristics implied by the model, the political context can enable or constrain any SHH program.

4. Chronological policy inventory: Self-help housing legislation through historical shifts

While the SHH model's features demand systemic policy support, Turkey's urban programs provide a case where this alignment failed. The study posits that undesirable outcomes in urban areas stem from incompatible implementation of legislative definitions or a lack of sufficiently precise definitions within the legislation itself. In this framework, an inventory of housing and planning legislation is drawn up to provide an overview of the policy context and to identify the legislation required for the study. It is a chronological inventory (Figure 2) that includes planning and housing laws, FYDPs, constitutional amendments and related institutions. It has been designed to show their interrelationships by visualising the validity periods. As for the visualised data of the first century, there are easily identifiable thresholds. The policy context and SHH-related regulations are discussed over these thresholds by referring to the articles of law and the targets of FYDPs.

4.1. 1923-1948: First laws of the Republic

The first threshold naturally follows the founding of the Turkish Republic in 1923 (Table 1). The first land, municipalities and housing laws came into force successively from 1930 to 1934. During this period, the only law enacted with SHH-related regulation was 2510. Settlement Law. The related regulations concerned the financing of sites, materials and labour for self-construction for immigrants, refugees and nomads (Articles 17, 18 and 37). It states that in addition to land, materials or money can be provided for construction following instructions issued by the government. Users can be employed for the construction, and it is also permissible to employ soldiers, civil servants and state employees. Free timber from the state forests and tax exemption were complementary support instruments. However, this law was intended to facilitate the resettlement of a specific population group and did not extend to the broader societal population.

4.2. 1948-1961: Early foundations of SHH legislation

The spread of squatter settlements in the late 1940s and the resulting

problems gained the full attention of the government. Following these consequences, from 1948 onwards, new laws were enacted which defined the inventory's second threshold (Table 2). Among the ten laws, the Law on the Allocation of Municipal and State Lands for Residential Construction in Ankara, 5218, contained SHH-related provisions focused on land allocation. This law ensured that the Municipalities allocate plots of land to those who want to build a house and assign it after the construction of the building (Article

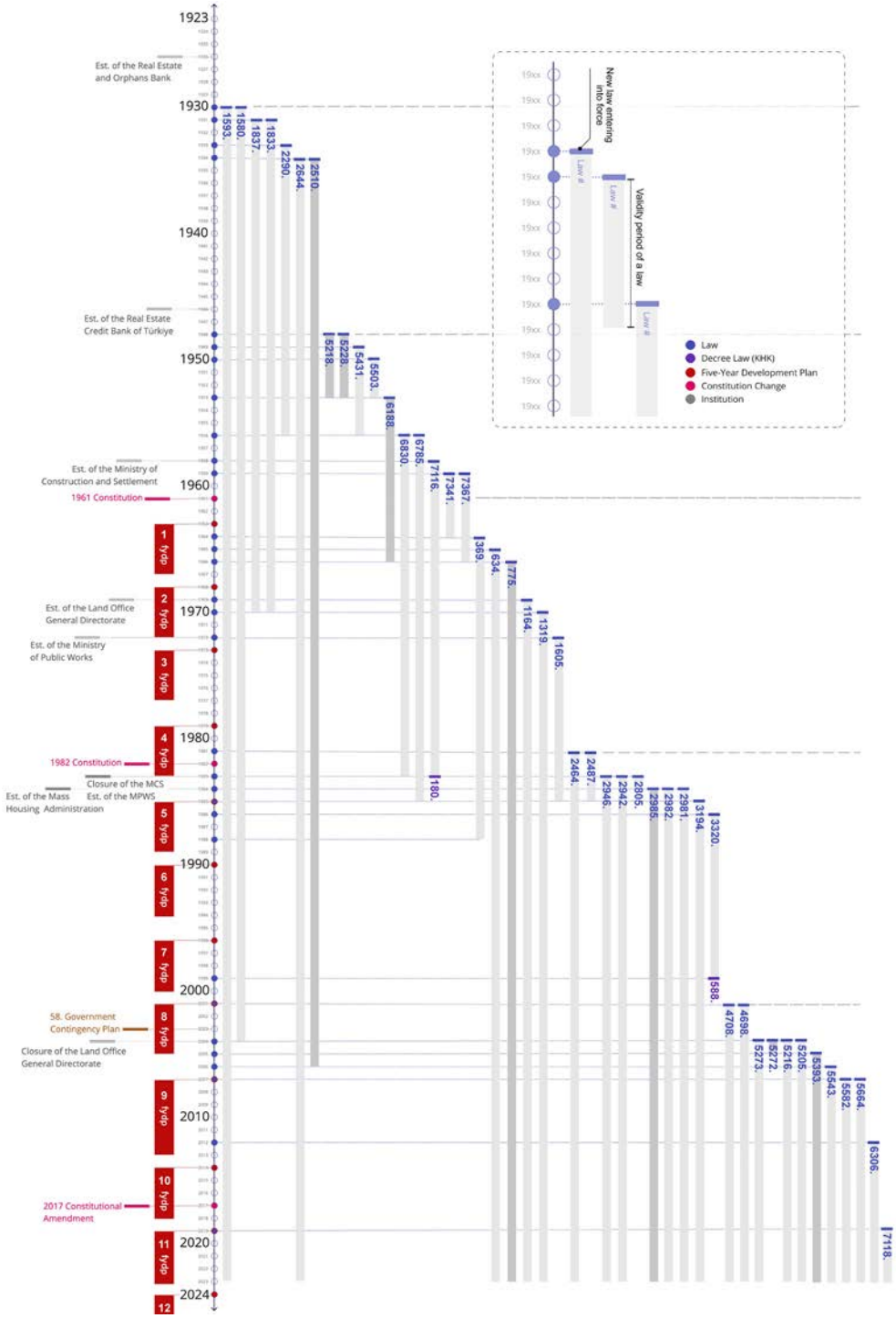
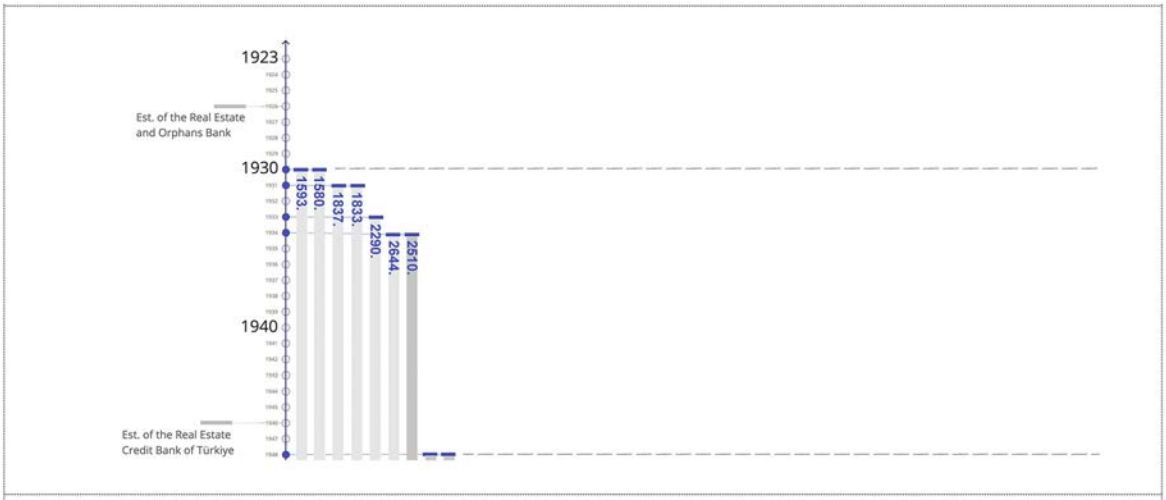


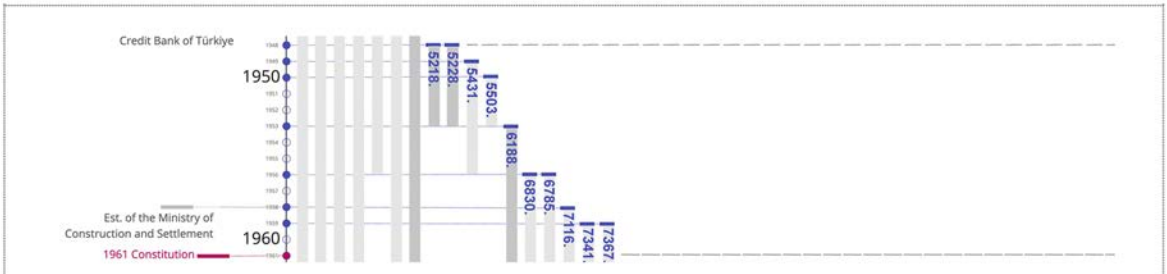
Figure 2. *The chronological inventory that demonstrates the policy context of housing since the establishment of the Republic of Türkiye, comprising the laws on housing and planning, five-year development plans, constitutional amendments and related institutions. The laws are visualized with law numbers and their validity periods. The laws including SHH-related regulations are marked darker.*

Table 1. *The first threshold between 1923-1948.*



1593. Public Hygiene Law (1930)
1580. Municipal Law (1930)
1837. Building Tax Law (1931)
1833. Land Tax Law (1931)
2290. Municipal Building and Roads Law (1933)
2644. Land Registry Law (1934)
2510. Settlement Law (1934)

Table 2. *The second threshold between 1948-1961.*



5218. Law on Allocation of Municipal and State Lands to Residents in Ankara (1948)
5228. Building Construction Encouragement Law (1948)
5431. Law on Demolition of Unlicensed Buildings and Amendment of Article 13 of Municipal Building and Roads Law No. 2290 (1949)
5503. Amending Article 10 of the Building Construction Encouragement Law (1950)
6188. Building Construction Encouragement and Unauthorized Buildings Law (1953)
6830. Expropriation Law (1956)
6785. Zoning Law (1956)
7116. Law on the Establishment and Duties of the Ministry of Reconstruction and Settlement (1958)
7341. Law on Adding an Article to the Zoning Law No. 6785 (1959)
7367. Law on Land and Sites to be Transferred from the Treasury to Municipalities (1959)

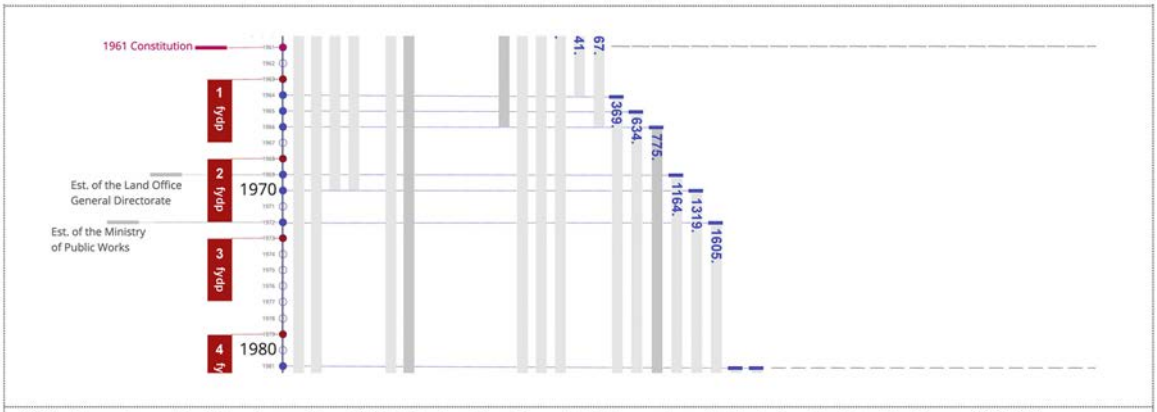
1). Those found suitable were obliged to build a dwelling specified by the municipality within one year (Article 4). The cost of the land to be assigned was to be paid in instalments over ten years and without interest (Article 5). All transactions were exempt from all types of charges and fees (Article 11). This law came into force in 1948 and was only intended for the capital, Ankara. In the same year, 5228. Building Construction Encouragement Law came into force, containing parallel nationwide regulations for SHH. Articles 7, 10 and 12 similarly regulated the exemption from fees. However, Article 3 delineates the obligation to complete the dwelling as two years. In addition, there is a reduction in the minimum tariff for the transportation of construction materials by rail and sea, such as cement, bricks, tiles, iron, timber, plumbing, stone, sand and gravel (Article 9). Five years

after their enactment, these two laws were replaced by 6188. Promotion of Building Construction Encouragement and Unauthorised Buildings Law, whose provisions were expanded to include additional topics on various areas of SHH. In addition to other fee exemptions, it is exempt from the building tax and other taxes levied for ten years (Article 13). Timber and its products used in all kinds of construction have been exempted from transaction tax (Article 14). Article 20 of this law was the first regulation to determine the qualifications of dwellings: "The size and type of land allocated by the municipality in accordance with this law and the buildings to be constructed on such land, the measures to be taken to ensure the cheapest cost according to local conditions, the type of materials to be used, the type of rooms and outbuildings, the area and height shall be determined within the framework of the principles to be prepared by the municipal councils." These provisions signalled the need for a nationwide state institution for housing and led to the establishment of the MCS in 1958. This was a significant step that prepared the way for the approaching developments.

4.3. 1961-1981: Key milestones for SHH

Adopting the social state principle in the Republic of Turkey with the 1961 Constitution and the transition to a planned development period constitute the third threshold for housing policy (Table 3). The first FYDP was published in December 1962, and twelve FYDPs have been prepared to date. The plans aimed to utilise the growing resources to increase social welfare within the framework of achieving social justice. In this context, the FYDPs also included sections on housing to address the country's housing and urbanisation problems and plan policies. Implementing the SHH model was a central tenet of the first two FYDPs and underscored the commitment to comprehensive planning and implementation strategies. In the first FYDP (1963-1968), low-income housing construction was supported through projects and technical assistance to prevent new squatter construction. This included constructing core housing through land allocation and SHH and ensuring self-builders received technical assistance, public facilities, loans, and material aid. The targeted investments in squatters by year show that the largest annual investment was always allocated to prevent squatter construction through SHH and that this share would gradually increase over five years. In other words, the state's targets to prevent squatting were predominantly based on implementing SHH methods. However, the methods and tools for realising this projection were not assessed. The most comprehensive law of the time on SHH, 6188., was repealed with the amendment of 775. Squatter Law in 1966. Being the only law of this threshold that contained SHH-related regulations, the scope of this law was the rehabilitation and clearance of existing squatter settlements, the prevention of the construction of new squatters and the measures to be taken for these purposes. According to this law, the funds collected were to be used to provide land and construct public housing and core houses (Article 13). Article 27 states that the Housing Development Administration, local municipalities or other departments and institutions shall provide technical assistance, long-term housing loans and monetary aid. Users were expected to start building their houses within 1 year from the date of land allocation and complete the core area within 2 years. Forestry administrations shall provide the necessary forestry materials as a priority and at a cost price (Article 28). All kinds of transactions, contracts, declarations, and the like were exempt from savings bonds, taxes, duties, and fees (Article 33). The variety of regulations in this law, which is still in force, was limited to the financing of site, materials and labour, and materials for the design process of SHH projects. The second FYDP (1968-1972) continued to target SHH as a model to be supported by limited credit, extensive technical assistance, material aid where possible,

Table 3. *The third threshold between 1961-1981.*



369. Annulment of the Law No. 7341 Regarding the Addition of an Article to the Zoning Law (1964)
634. Condominium Law (1965)
775. Squatter Law (1966)
1164. Law on Land Production and Evaluation (1969)
1319. Property Tax Law (1970)
1605. Law on Making Some Amendments to the Zoning Law No. 6785 (1972)

and the provision of affordable land. In addition to these objectives, the establishment of a land office, modular coordination studies to improve industrial production of building elements to ensure low-cost and quality, continued use of traditional labour-intensive technologies, training of skilled construction workers through non-formal education programs, and the establishment of a construction research institute are also important objectives for the SHH programs. This plan was followed by establishing the General Directorate of Land Office in 1969 and the Ministry of Public Works in 1972. Unlike the previous two plans, the third FYDP (1973-1977) did not explicitly state the implementation of the SHH model. However, the forecast for housing investment included the construction of core housing to prevent squatters. Core housing is defined as "a housing unit consisting initially of a 30 square meter room and outbuildings, which may be expanded over time to include additional rooms as the project depicts." (SPO, 1973; p.840). The comparison of the cost estimates shows that the unit costs of the core housing were 45.8% cheaper than the unit costs of the cheapest housing. Regarding the plan's housing unit targets, core housing accounted for 8.2% of the total urban housing units. However, there was no statement that financing tools, materials and technical assistance would support the user in the subsequent construction phases. Looking at the fourth FYDP (1979-1983), the problem of squatters and the need for alternative models of housing production persisted. On the other hand, this plan did not mention the SHH method, which was indirectly mentioned in the third plan, nor the issues such as research, training, technical and material assistance and financial support necessary for its implementation. According to the principles and strategies presented on the housing problem, the traditional individual production method should be abandoned by channelling public credit into mass housing with the technology and organisations that enable mass housing production. This goal from the last plan guided most of the following housing policies.

4.4. 1981-2001: The wane of legislative support

The fourth threshold is defined by the enactment of the 1982 Constitution, the closure of the MCS in 1983, and the establishment of TOKI in 1984 (Table 4). Among many enacted laws in this period, 2985. New Mass Housing Law presented the establishment and duties of TOKI, including the practices for transforming squatter areas and providing loans for such projects, as well as interest subsidies for all such loans when necessary (Article 1). Apart from this, there are no other regulations on SHH in the laws enacted during

this period. Similarly, the following FYDP ignored the work carried out on the housing problem up to this plan period on the housing problem, legislation, realisation of previous targets and the current situation. In the Fifth FYDP (1985-1989), the objective of meeting the housing needs of the low-income groups was limited to providing housing loans to this group on advantageous terms. The expectation was that the capacity of housing construction, which was to increase through a steady growth in private investment, would reduce the tendency to meet housing needs through unlicensed housing construction. There is no mention of the quality of these houses to be built, whether they will eliminate the mismatch between supply and demand and what provision will be made to make them affordable to low-income households. In the Sixth FYDP (1990-1994), the SHH method was reintroduced into government plans: "Municipalities will designate certain areas as housing sites and provide infrastructure and prepare core housing projects under the "Assistance to Self-Builders" program to prevent squatter settlements" (SPO, 1990; p.316). Although there was no detailed information on this targeted program, some of the articles under the title of principles and policies are related and supportive. Building components and materials were aimed to encourage modular coordination by developing standards, increasing the number of prefabricated standard components, and supporting related research. It also aimed to promote projects and technologies suitable for climatic conditions and reduce waste by evaluating local materials to reduce costs and conducting studies to determine housing construction technologies ideal for the country's conditions. In the Seventh FYDP (1996-2000), although there was information on the persistence of the housing deficit and the squatter problem, there was no mention of SHH or core housing programs, nor was there any suggestion of an alternative production model to solve the problem.

4.5. 2001 to present: Shifted focus and institutional changes

The fifth threshold is mainly defined by the Emergency Action Plan that came into effect in 2003 (Table 5). In the following years, the General Directorate of Land Office closed in 2004. In the same year, Municipal Law No. 1580, which had been in force for 74 years, was repealed with Municipal Law No. 5272. It only stayed in force for one year and was repealed by today's valid Municipal Law No. 5393. With the enactment of 6306. Law on Transformation of Areas Under Disaster Risk, known as the 'Urban Transformation Law' in 2012, a significant shift in housing policies occurred. Since the constitutional amendment in 2017, when the Republic of Turkey switched to the presidential system, the process has been carried out with Presidential decisions and decrees. In terms of SHH, the only relevant statement is in the 5393. Municipal Law: Within the scope of the municipality's authorisations related to land and housing production, land and housing can be provided to those whose circumstances comply with Article 25 of the Squatter Law No. 775 (Article 69).

The disappearance of SHH program targets is also apparent in the following plans. The Eight FYDP (2001-2005) suggested that TOKI should direct its resources to producing land with infrastructure rather than financing housing. Taking measures to prevent illegal construction and squatters and developing alternative financing models to address the housing problems of lower-income groups were among the objectives. The SHH program was proposed not to solve the squatter problem but to produce permanent housing after the earthquake. In the aftermath of the Marmara and Bolu-Düzce earthquakes in 1999, an SHH program was planned to provide monetary aid to 5,867 people. For the first time, the Ninth FYDP (2007-2013) did not have a chapter on housing and did not include any information on the housing sector. In the Tenth FYDP (2014-2018), although there is no mention of SHH programs, it is presented among the targets that healthy and alternative solutions to

Table 4. *The fourth threshold between 1981-2001.*

2464. Law on Municipal Revenues (1981)
2487. Mass Housing Law (1981)
2946. Law on Public Housing (1983)
2942. Expropriation Law (1983)
2805. Law on the Procedures to be Applied to Structures Built in Violation of Zoning and Squatter Legislation and Amendment of an Article of the Zoning Law No. 6785 (1983)
2985. New Mass Housing Law (1984)
2982. Law on Recognition of Tax, Duty and Fee Exceptions and Exemptions for Investments to be Made in Priority Regions for Housing Construction and Development (1984)
2981. Law on Transactions to be Applied to Buildings Contrary to the Zoning and Slum Legislation and Amending an Article of the Zoning Law No. 6785 (1984)
3194. Zoning Law (1985)
3320. Law on Housing Assistance to Civil Servants and Workers and Their Retirees (1986)

Table 5. *The fifth threshold from 2001 to the present.*

4708. Law on Building Inspection (2001)
4698. Law on the Establishment of the Undersecretariat of Housing and Amending the Law on the Land Office (2001)
5273. The Law on Amending the Land Office Law and the Mass Housing Law and Abolishing the Land Office General Directorate (2004)
5272. Municipal Law (2004)
5216. Metropolitan Municipality Law (2004)
5205. Law on Amending the Law on Building Inspection (2004)
5393. Municipal Law (2005)
5543. Settlement Law (2006)
5582. Law on Amending Various Laws Regarding Housing Finance System (2007)
5664. Law on Payment to Rightholders of Housing Assistance (2007)
6306. Law on Transformation of Areas Under Disaster Risk (2012)
7181. Law on Amendments to the Land Registry Law and Some Laws (2019)

the housing problem will be sought by giving priority to the housing needs of low-income people, the guiding, regulatory, supervisory and supportive role of the state will be strengthened. The production of land with ready infrastructure will be accelerated. The Eleventh FYDP (2019-2023) aims to produce 250.000 social housing units for low-income and disadvantaged groups. In addition, this plan's housing policies and urban transformation practices emphasise that participation principles will be considered; however, these policies did not include SHH programs. In the aftermath of the February 6 earthquakes in 2023, the housing targets of the last published development plan (2024-2028) primarily focused on constructing post-disaster housing and disaster-resilient transformation practices. However, even in post-disaster housing production, SHH programs are not targeted as a model.

5. Findings: Uncovering legislative gaps across SHH model's characteristics

The distribution of regulations by topic shows that the dominance of financing-related regulations stands especially on the issue of financing the site. The site to build on is a central component of housing cost, and it comprises many tasks at varying levels for a government targeting an SHH program. For users who struggle to afford a house, a drastic reduction of this expense is possible through the means available to the government. At the urban planning level, deciding a location for settlement, preparing a development plan, setting parcellation to serve SHH projects, and planning transportation and other urban infrastructure are required. At the parcel level, this includes providing infrastructure and site services. At the financing level, it involves specifying tools to finance the site, whether through sale, rent, or loan schemes for future inhabitants. Financing the site was regulated by laws such as site allocation, identifying beneficiaries, tax regulations, fee exemptions and credit and payment facilities. These issues are widely focused on and regulated for implementing SHH programs.

The second most regulated issue in laws is financing the construction material. Regulations mainly cover supplying construction materials, regulating fees/taxes, and exempting transportation costs. For an SHH project, the construction material and technique are essential to enabling the user to participate in construction and reduce costs. However, the construction techniques and materials selection are covered poorly in regulations, where providing necessary machinery/equipment and enabling users to process material through transmitting technical information are not covered. Limited regulations about the material to be used in the design process are not well-defined in priorities, reasons for preference, limits, and methods.

Participatory labour is essential since the model aims to lower housing costs by reducing the need for an external workforce. It also includes legal preparation, municipal works, design and application project preparation, construction management, and training the users for construction. However, user labour is weakly considered in regulations. There are limited regulations for defining possible actors and their roles in a project cycle; the competency and responsibility of each actor and the new opportunities they provide for the process are lacking in regulations. On the other hand, labour in the design process includes the required planning and project phases, which find a place in regulations assigning this responsibility to the Ministry.

Evaluating the findings, SHH-related regulations have different weights regarding coverage of the model's characteristics. The absence of descriptive regulations on other topics results in a lack of objectives and guidance for users and involved institutions and decreases the chance of implementing and completing an SHH program.

Our analysis identifies the following legislative gaps that obstructed SHH programs' success:

Design Process: SHH design process requires regulatory provisions for incremental growth, user participation, and adaptable standards beside other design goals. Turkey's legislation inad-

equately addressed such demands, undermining project goals.

Construction Process: User participation in construction, technical training, and low-skill-friendly construction techniques must be enabled and encouraged by legislation. The absence of such legislative provisions in Turkey resulted in poor-quality construction and deviations from project plans.

Actors and Roles: SHH necessitates defined responsibilities and coordination among users, professionals, state institutions, and NGOs. Turkish legislative tools failed to institutionalise such coordination, leading to fragmented implementation and unclaimed responsibilities in the work plan.

Financing: While site financing was well-covered in Turkish regulations, critical gaps persisted in savings schemes, progressive loans, and material subsidies necessary for SHH's incremental nature.

Table 6 summarizes these gaps relative to SHH model characteristics.

6. Conclusion: Toward policy frameworks that support self-help housing

The housing policies must be followed by regulations, especially where a special model is aimed to be implemented. As discussed earlier through its features, the SHH model inherently suggests powerful shifts in processes that can only be implemented through legislative interventions. The model's drastic differences in design process, construction process, actors/roles and financing require wide-ranging regulations of different kinds of descriptive, directory or assigning nature upon necessity.

In Turkey, considering the works of the MCS, which was the active and responsible institution in the period when urban SHH was implemented as a policy, its holistic approach to conventional housing provision did not only set policies but also regulated standards and implementation conditions and developed solutions through designing architectural projects (Çelikcan Yozçu & Özsoy, 2024). Starting in the 1960s, the Ministry's GDH prepared 1.275 architectural, reinforced concrete, plumbing, and electrical projects as well as zoning and site plan projects (MCS, 1973) for allocating to low-income groups. However, despite the positive efforts and the extensive research on SHH, such a holistic approach was not legislatively supported for SHH provision.

Turkey's SHH experience is more legible by framing the policy context; the inadequate coverage of the topics in legislation hindered the completion of SHH projects of targeted features. The study addresses the following issues to be underlined that are lacking in the case of Turkey to support the possible SHH programs with regulations:

- Urban planning, lot qualities, site use, and early design decisions need to be covered, as the results show that the requirements for the design process of an SHH project are poorly defined and supported by legislation.
- Although laws widely cover financing, regulations for savings systems and loans or other financing options for the further stages of an SHH project are also necessary.

Table 6. *The SHH's requirements based on model characteristics and Turkish legislative gap.*

SHH Requirement	Model Characteristic	Turkish Legislative Gap
Design Process	Incremental, flexible, user-adaptable	No legal provision for flexible, incremental design processes
Construction Process	Participatory, low-skill-friendly, supported	Absence of construction-phase regulations enabling user participation
Actors and Roles	Coordinated roles: users, professionals, agencies	Undefined actor roles and coordination mechanisms
Financing	Phased loans, savings, subsidies	Incomplete financing tools beyond initial site provision and loan

- Construction process and labour are imperative for adapting an SHH project, but regulations currently lack the topic. Clear objectives and legislative support must be sought to ensure the user's participation and incremental construction.
- Determining the right users and supporting them in balancing the project and their day jobs, transportation to construction sites, and technical knowledge training are pivotal to completing an SHH project.
- Regulations are needed regarding the actors' fields of activity and responsibilities.

Addressing these legislative gaps is vital, given SHH's potential to empower low-income households through incremental, participatory housing. While political intervention is essential, policy and lawmaking must first be grounded in robust research. Compared with earlier periods when government, universities, and researchers within and outside of governmental institutions worked in dialogue for housing policy-making, the failure of this dialogue is today's key peril. Regarding the economic challenges and ongoing affordable housing shortage, the dialogue must be restored to adequately support any housing policy on the horizon.

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First year design education inspired by site-specific and site-determined artworks

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Abstract
This research explores the potential implementation of site-specific and site-determined artworks as a pedagogical tool for the basic design studios of first-year architectural education, investigating whether these artistic creations can pragmatically contribute to the genesis of new spatial concepts. This study also aims to assess the effectiveness of Kolb's Experiential Learning Theory (ELT) in the context of studio pedagogy. The basic design course is rooted in process-oriented and student-centred studio pedagogy, drawing on Kolb's Experiential Learning Theory, and is structured around three site-specific projects that focus on the reproduction of space and the potential of spatial studies. These projects range from building scale to urban pattern, with a focus on various facets of a place, including tangible and intangible qualities, as well as explicit and implicit characteristics, while also exploring the dynamics of human-space relationships. Qualitative data were collected through participant observation, informal interviews, and the analysis of students' work documents. The course's progression and outcomes are evaluated in terms of spatial perception, critical and conceptual thinking, and multisensory engagement with space. This course enhanced students' abilities to interpret spatial experiences, develop a critical perspective, and produce original solutions to spatial problems within the framework of site-specific and site-determined design approaches. The process of the course exposes the latent potential within user-space interactions and the intermediate spatial practices bridging art and architecture. The research is original in that it suggests that many possibilities for interaction, dialogue, and collaboration between art and architecture can be incorporated into architectural education.

Keywords
Experience of space, Experiential learning theory, First-year design studio, Site-specific and site-determined art, Spatial perception.

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1. Introduction

The boundaries between art and architecture have often been a controversial topic of discussion within the architectural world. However, these disciplinary boundaries are becoming increasingly blurred today. In the field of art, site-specific and site-determined artworks have appeared as a form of critical spatial practices since the 1960s. Although, the terms 'site- specific' and 'site- determined' sometimes are used interchangeably in the literature, according to Robert Irwin's (1985) conceptualisation, 'site-specific' artworks are the works whose parameters have been set by the site, and 'site-conditioned/ determined' artworks refer to the works whose existence, form, and composition are determined by the physical, natural, social, and historical features of the site as well as the temporal conditions like snow, wind, etc. and visual and aural density (Üstek, 2011, p. 12; Kwon, 2004).

In the 1960s and 1970s, artists like Robert Smithson, Michael Heizer, Nancy Holt, and Walter De Maria created large-scale Land Art works using natural materials and vast open spaces, emphasising art's relationship with the environment. Concurrently, the Environmental Art Movement, with artists like Andy Goldsworthy and Christo and Jeanne-Claude, focused on engaging directly with nature to raise ecological awareness (Antmen, 2014). These works were deeply connected to the political and environmental activism of the time, merging ethics and aesthetics in critical spatial practices in contemporary art (Rose, 1969). In the 1970s and beyond, artists began creating site-specific indoor installations that responded to architectural features and spatial qualities. Installation artists such as Dan Flavin, James Turrel, Maya Lin, Megan Geckler and 'Numen/ For Use' collective group explored light, space, and materiality, transforming galleries and museums into immersive environments (Antmen, 2014) (Figure 1).

Site-specific and site-determined artworks extend beyond visual artists to include architects who create installations responsive to their surroundings. In the 1970s, CoopHimmelb(l) au and Haus-Rucker-Co produced architectural installations in public spaces as alternative suggestions for space appropriation, introducing a twist in the experience of both public and private spaces. Sami Rintala and Marco Casagrande questioned the role of the architect, the position of the users, their relationship with the built environment, and the term sustainability in their architectural installations, such as 'Land(e)scape' (1999) and 'A Chapel for Nature (2014) in the 1990s and 2000s (Zecevic, 2017, p. 65). While some architects, such as Chris Bardt and Kourosh Mahvash, focused on the tectonics of space and explored light-space relationships, others, like Mark Goulthorpe and Frances Bronet, concentrated on spatial perception and bodily experience. Philip Beesley and Pierre Thibault Architects questioned the interdependency between nature and artifice, while Peripheriques Architects, Arqhe Collective, Fieldoffice, Renzo Piano, and Alvisi Kirimoto argued the boundaries and the perception of the city (Bonnemaison & Eisenbach, 2009). Sou Fujimato and Tin Drum designed a virtual reality installation named 'Medusa' at the Design Festival 2021, allowing visitors to experience a fluid relationship between virtual and physical worlds (Pires, 2021) (Figure 1). Through installations, architects critique the status quo, and due to the transient nature of

a. b. c. d.

Figure 1. *a. 'Tape des Moines', Numen (Numen/ For Use Collective Group, 2017) b. 'Medusa', Sou Fujimato, Tin Drum (Pires, 2021) c. 'Spread the ashes of the colors', Megan Geckler (Geckler, 2010) d. '3013 Installation', students from AA School of Architecture (Frearson, 2011).*

the installations, they have the freedom to experiment with novel architectural forms, techniques, and concepts. The artefact's purpose shifts from utility to criticism and reflection (Bonnemaison & Eisenbach, 2009). By integrating site-specific artworks as critical spatial practices, architects enhance the human experience, foster creativity and innovation, and promote inclusive and socially conscious architectural practices.

In recent years, site-specific and site-determined/conditioned artworks have also appeared in workshops done by some universities, intending to discover the opportunities embedded in practice between art and architecture. For instance, at Warsaw University of Technology, students designed the project 'Halas: W Centrum' as a spatial installation to criticise the noise problems of the site and raise social awareness (Warsaw University, 2023). Another notable example comes from the Architectural Association (AA) School of Architecture in London, where students designed and fabricated a suspended sculpture, the 3013 installation, that gracefully curled down from the terrace of the AA building into the courtyard. This project was developed as part of one of five units in the AA's Summer School 2011 programme (Frearson, 2011) (Figure 1). These ephemeral artworks engage with changing site dynamics and foster dialogue between artists, sites, and audiences, often involving local communities. Artists are keenly aware of the historical, social, political, and environmental contexts, aiming to respond to or challenge these aspects. The relationship between the artwork and the site often carries metaphorical or symbolic implications, addressing themes relevant to the site's history, identity, or cultural significance. Integrating these artworks into education fosters a better understanding of how architecture interacts with its surroundings and challenges students to question the conventional roles of architecture by exploring its potential to engage with social, cultural, and environmental issues. Site-specific and site-determined artworks promote an experiential understanding of place (Zecevic, 2017), highlighting the interplay between tangible and intangible aspects and revealing tacit knowledge. Architecture is not only composed of 'rational', 'pragmatic' and 'tectonic' issues but also has 'imaginative', 'poetic', and 'experiential' qualities. Implementing these artworks into architectural education encourages students to develop a holistic way of thinking about the interwoven components of place and to discover the reciprocal relationship between man and place. It liberates them to think outside the box and to develop imaginative design solutions.

It is apparent that in architectural education, questioning existing solutions and exploring original paths of thought become crucial skills for students to gain through their design studios. In that sense, the first-year design studio plays a crucial role in fostering creativity and critical thinking. Generally named 'basic design studio' in the curricula of several universities in Türkiye, first-year design studios in architectural education are structured to introduce students to design basics. Students generally practice abstraction methods, Gestalt theories and visual organisation principles through placeless, scaleless, and abstract exercises where two-dimensional tasks gradually evolve into three-dimensional works. However, this approach often lacks meaningful engagement with real-world spatial experiences, potentially delaying students' ability to develop an embodied understanding of space and place. In this regard, site-specific and site-determined artworks provide a valuable pedagogical tool for exploring spatial experience, perception, and interpretation—core concerns of both art and architecture—through direct engagement with real environments.

This article presents a case study of an experimental first-year design studio implemented at Işık University, which integrates site-specific and site-determined artworks as a pedagogical strategy grounded in Experiential Learning Theory (ELT). The central aim of the study is to investigate how this approach fosters students' spatial awareness, critical thinking, and interpretive design skills through embodied engagement with real sites.

The originality of the study lies in its interdisciplinary pedagogical model that connects ELT, site-specific art practices, and basic design education. The research is guided by the following questions:

- How can site-specific and site-determined art practices be integrated into first-year architectural design education to enhance students' understanding of space and place?
- In what ways does Experiential Learning Theory provide an effective framework for structuring and assessing such a design studio?

Accordingly, the course structured three sequential site-specific projects that encouraged students to investigate the tangible and intangible qualities of place. Each project was mapped to Kolb's Experiential Learning Theory, providing a coherent framework for designing, implementing, and evaluating the learning process.

The paper begins with building a theoretical framework for first-year design education, reviewing the critics of basic design education and ELT in design education in section 2. Section 3 continues with an overview of the course's aim and methodology, with a special focus on studio pedagogy. The process and outcomes of tasks based on the perception and experience of space are explained in Section 4, followed by a discussion that includes an evaluation of the learning process.

2. Theoretical framework for first-year design education

This section explores foundational theories and critiques shaping first-year architectural design education. It first examines long-standing debates on basic design education, tracing its historical evolution, limitations, and pedagogical challenges. It then introduces Experiential Learning Theory as a contemporary pedagogical approach that complements design thinking through active engagement, reflection, and the construction of knowledge.

2.1. Critics of basic design education

Basic design is one of the initial stepping stones in design education, also entitled as a foundation course (Boucharenc, 2006, p. 2). Basic design education, which supports students in solving design problems, establishes a relationship with one's existing knowledge and forms the basis for relating to future architectural education. Basic design education goes by various names, including 'Visual Design', 'Basic Design', 'Applied Design', 'Introductory Design', 'Gestaltung Lehre', 'Form und Gestalt', 'Designo Communicatione' (Seylan, 2019, p. 22). Accordingly, in this study, the concept of 'basic design' refers to the foundation courses in the first year of architectural education. Different educators have employed various approaches to basic design education, with differences in epistemology and content across institutions and times. According to the curricula of universities, the duration of this education, its intensity in the total credits and its applications vary. Today, the contributions of basic design education to students, its application methods, and its role in design education are subject to debate among students, educators, designers, and researchers. Considering the changing perspectives in design education, the importance of increasing the number of studies that provide information about the different methods used in this course cannot be denied.

The Basic Design course traces its roots to the preliminary course of the Bauhaus, founded in the early 20th century. Among many other reasons, the Bauhaus was founded in response to the problems in art and design education that had developed from the Royal Academy of Architecture in France in the 18th century to the Beaux-Arts System of the 19th century (Drexler, 1984 pp. 6-10; Hudson-Miles& Broadey, 2022). In the structured framework of the Beaux-Arts School, specific expertise was acquired through the mastery of various skills, including the transformation of materials into tangible forms, the comprehension of geometry, colour theory, spatial arrangement and architectural structure through practices such as drawing, painting and model crafting (Pasin, 2017, p. 1271). The artists and architects in the Bauhaus attempted to develop rational and objectively correct

design methods (Jormakka et. al., 2014, p. 40). Bauhaus was not a monolithic movement, and it never set out with any fixed pedagogic precepts. It began as an ad hoc, spontaneous attempt to introduce a more open-ended and experimental working mode (Yeomans, 2005, p. 209). The 'Basic Design Movement', which embodies the dissemination of Bauhaus educational principles, spans over a century (Yeomans, 2005, p. 195, 209). The 'preliminary course', developed and implemented as a key component of Bauhaus and Modernism, has led to notable transformations in related disciplines, fostering innovative approaches (Droste, 2012, pp. 16-17). Basic Design formed the basis of the pedagogy of the classical schools of design and architecture, such as the Vkhutemas, the School of Chicago and the School of Ulm (Hochschule für Gestaltung) (Boucharenc, 2006, p. 2). In Türkiye, basic design education was introduced to architectural programs in the 1960s and was first discussed in the 'Mimarlık (Architecture)' magazine in 1966 (Akış, 2009, p. 22). Thus, the Bauhaus, which once offered a pioneering design education, gradually evolved into a globally established practice. According to Boelen, Botha and Sacchetti, the main difference between Bauhaus education and today's institutionalised Bauhaus-style education is that the original Bauhaus was a utopian experiment (Boelen et al., 2018, p. 43).

Basic Design education continues to be questioned, developed and reconstructed today. In this respect, it is essential to evaluate research and criticism on Basic Design education, as well as research on the design process. The aspects that need improvement should be addressed not only in the context of the 'Basic Design' course but also within the scope of first-year design education. Recently, due to changes in curriculum and pedagogical transitions, the design learning processes in architectural schools have undergone significant variations. Moreover, facing the studio culture and challenges through the instructional method makes the first year of the architectural design period more crucial.

It is recognised as a significant issue that the basic design content cannot be effectively integrated into advanced stages of education, and that the current presentation of these concepts fails to establish a knowledge framework conducive to architectural design practice. Gelernter (1988) argues that the design principles imparted in Basic Design Studio inadequately contribute to shaping projects in subsequent studios. Therefore, students are unable to work on or develop visual forms to the extent expected of them after the intensive Basic Design course. Considering the disconnection problem of Basic Design, Gelernter (1988) states that the acquisition and application of knowledge do not occur sequentially and, as such, cannot be assigned to separate, sequential sections of the curriculum. According to Farivarsadri, largely due to the longstanding tradition of commencing architectural education with a (Bauhaus-based) Basic Design course, it is regarded as a distinct component of design education, addressing topics that are tangentially relevant to architectural design but not directly related to it (Farivarsadri, 2001, p. 10).

However, believing that visual intelligence, ethical sensitivity and aesthetic intuition can be developed and strengthened through some kind of basic design education, Findeli emphasises that basic design should not be taught as a preliminary course in the first year but should be taught in parallel with studio work throughout the entire course of study, from the first year to the last year (Findeli, 2001, p. 16). Nonetheless, the primary objective of design education is to equip students with the ability to reason effectively (Özkar, 2017, p. 4). Basic design studios are where the initial challenges in design learning and teaching most commonly emerge. This stage is the most difficult for students to develop their thinking and design skills. The basic design is prior to any design knowledge and deliberately neglects this knowledge to benefit a creative process (Özkar, 2004, p. 121). However, basic design studios remain abstract in both problem definition and educational outcomes, engaging students with various abstract tasks that are detached from real-life architectural problems (Gürsoy & Özkar, 2015, p.

982). Therefore, finding new approaches that could broaden the experience of acquiring knowledge by learning how to think has been crucial. Farivarsadri (2001) finds the course beneficial for students in organising their design ideas and thoughts by solving abstract problems. However, she notes that these problems can easily become mere geometric puzzles, losing sight of the fact that space design encompasses responsibilities beyond formal attributes (Farivarsadri, 2001, p.7). Özkar also states that basic design instruction has been reduced to a basic vocabulary of forms that are universally shared (Özkar, 2004, p. 14).

Another key component of contemporary applied approaches is technology. In basic design courses, however, paper-based culture of design remains the predominant model for explicating thought and reasoning. On the other hand, since the early 2000s, digital methodologies have enhanced certain capabilities of performative and generative processes that were previously unavailable in conventional, paper-based methods (Oxman, 2008, pp. 101-102). In this sense, it is argued that design education requires extensive restructuring to incorporate new developments and paradigmatic shifts introduced by the information age (Uysal & Topaloğlu, 2017, p. 33). Due to the issues with applying the knowledge acquired through the Basic Design course, it has been determined that this course is not included in the curricula of architecture schools in the EU and the USA. Instead, it is commonly taught within the scope of first-year education, featuring varied content that explores the abstract-concrete relationship, particularly within the framework of digital environment possibilities (Yurtsever, 2011, p. 22).

The field of architectural production encompasses activities in interdisciplinary and transdisciplinary fields where problems are viewed as multi-faceted and multi-layered investigations. In this context, it is also argued that there should be an architectural education environment that integrates different disciplines and includes an interdisciplinary learning approach. It is believed that these disciplines can only be understood in a holistic and relational manner through the application of critical thinking skills (Yurtsever, 2011, p. 95). Therefore, Findeli states that "a careful distinction should be made between the content of a design program and the pedagogical principles that are fit to transmit it" (Findeli, 1990, p. 18).

Design education requires continuous improvement and knowledge, as well as constant reevaluation. Of course, centennial perspectives are outdated in many respects. However, these perspectives and critiques provide a framework for understanding the origins of current ideas, as well as traces of alternative paths. In this context, various approaches follow alternative paths in basic design education, transforming the traditional, established principles and methodologies of basic design studios into new perspectives.

Among the current approaches discussed in the literature, several examples illustrate the use of intellectual methods as tools: creative drama, analogy and metaphor creation, music, rhythm and form, transition from text to space, philosophy and architecture, and cinema and space (Kılıçaslan & Vural, 2018; Usal & Evcil, 2017; Bekdaş & Yıldız, 2018; Kasap & Türkmen, 2018; Durmuş, 2015; Atik, 2020). These thought-centred practices emphasise creative ideas and processes and aim to reveal creative personality traits. Therefore, they seek to develop students' abilities to generate original ideas, think flexibly, and form meaningful associations (Onur & Zorlu, 2017). However, there are also studies that focus mainly on the creative product and its development. Space games, body, space and structure, verb to void, folding, digital production, design diagrams, algorithmic design, computer games (Çakmaklı et al., 2023; Sağıroğlu, 2017; Selçuk, 2018; Vyzoviti, 2008; Yazar, 2009; Terzidis, 2006; Coşkun, 2019) are examples where formal methods are used as tools. In these applications, which encourage three-dimensional thinking, it is aimed to produce original, innovative, flexible and unusual forms in two and three-dimensional compositions in order to develop the student's ability to

produce forms. These examples, briefly mentioned here, encompass various approaches that address both concept representation and form production.

Examples of current approaches used in basic design education include studies that focus on the content of the basic design course and examine various course curricula. (Boucharenc, 2006; Aktaş, 2020; Türkmen, 2022; Erdoğdu, 2016; Jormakka et. al., 2014). Although these approaches differ from one another, they contribute to the enhancement of students' basic cognitive reasoning skills and the development of skills that emerge from abstract forms and relationships. According to Özkar (2004), it is this quality that makes basic design education current and makes it an important tool that can support new design thinking and methods, especially today.

By incorporating site-specific artworks into basic design education as a pedagogical tool, this study aims to be among these alternatives that go beyond traditional approaches and support and improve the teaching/learning process. The differentiating aspects of this study from the aforementioned approaches are that first year students, who have not yet been introduced to concepts such as place, space and void and whose perception of space is limited, start working directly in real space; students at this early stage of education change their thinking habits and comprehend space independently of function; they progress by starting with three-dimensional proportional and scaled works; two-dimensional works accompany these works; they transform real spaces into design objects with their own analysis, similar to the process of creating site-specific artworks; and students interact productively and creatively with the space and their designs throughout the process. Accordingly, this study discusses the architectural basic design studio process within the framework of Kolb's Experiential Learning Theory by taking three untested case studies as its axis.

2.2. Experiential learning theory in design education

'Experiential Learning' is a process-oriented and student-centred pedagogy in the 21st century. Rooted in the works of William James, John Dewey, Kurt Lewin, Jean Piaget, and David A. Kolb, this theory underscores the pivotal role of experience in learning. Rather than being an alternative to behavioural and cognitive learning theories, ELT offers a holistic, integrative approach to learning by blending experience, perception, cognition, and behaviour (Kolb, 2015). It advocates for using non-formal, out-of-class experiences as the foundation of the learning process (Sanoff, 2007, p. 21). This theory posits a transactional relationship between individuals and their environment, where objective conditions and subjective experience interact in a fluid, interpenetrating manner. According to Kolb (2015), learning is a dynamic process that involves the transformation of experience into knowledge, guided by the dual dialectics of experience-abstraction and action-reflection, unfolding in a cycle of four stages: concrete experience, reflective observation, abstract conceptualisation, and active experimentation (Figure 2). Grasping experience and transforming experience are two key concepts in experiential learning. Grasping experience encompasses 'concrete experience' (CE) and 'abstract conceptualisation' (AC), illustrating the acquisition of knowledge. Transforming experience involves 'reflective observation' (RO) and 'active experimentation' (AE), demonstrating the explanation or interpretation of knowledge. In the initial stage of concrete experience, learners engage in new experiences or encounter problems. This is followed by reflective observation, during which learners contemplate and analyse their experiences from various perspectives. This stage is crucial for making sense of experiences, identifying patterns, and extracting meaningful insights. In abstract conceptualisation, learners develop concepts that integrate their observations into logically sound theories. Finally, learners use these theories to make decisions in active experimentation (Kolb, 2015).

Due to its capacity to stimulate critical thinking and learning through

hands-on experience, design education has been a field that has embraced ELT in higher education (Khorshidifard, 2014). The design process, as articulated by Schön (1983), constitutes an iterative cycle of reflection that closely mirrors Kolb's learning cycle. Schön's perspective portrays design as a field grounded in reflective practice, highlighting the significance of self-reflection and deriving lessons from experiences to enhance both the design process and its outcomes. Numerous studies have applied ELT in design education, particularly in architectural education (Demirbaş & Demirkan, 2003; Kvan & Jia, 2005; Sanoff, 2007; Wallis, 2007; Khorshidifard, 2014; Altay, 2017; Rodriguez, 2018; Yahia, 2018; Thamrin et al., 2019; Özçam & Kayan, 2022; Bindal, 2022; Avcı & Beyhan, 2023). ELT has also been integrated into basic design studios in architectural education (Temple, 2010; Yüksel & Uyaroğlu, 2021). Academic research has highlighted several advantages of experiential learning in design education. Avcı and Beyhan (2023) found that students gained and applied theoretical knowledge more effectively by integrating experiential learning. Bindal (2022) noted that experiential learning helped to clarify concepts, and a better understanding of concepts was evident in students' design projects. Kvan and Jia (2005) and Demirbaş and Demirkan (2003) observed that the design studio embraced a wide range of learning styles (diverging, assimilating, converging and accommodating learning styles) throughout the experiential learning process. Özçam and Kayan (2022) and Yüksel and Uyaroğlu (2021) described the entire process as an articulated and dynamic one, enriched by ongoing discussions, and claimed that experiential learning helped increase students' sensory awareness of space, encouraged self-reflection on theirperceptions of space, and enhanced their creativity in designing spaces.

3. The aim and methodology of the course

Our lives in the physical environment inevitably involve acquiring and making sense of environmental information. As emphasised in Experiential Learning Theory, due to the dynamic and variable nature of its relationship with the individual, the space contains layers that can lead to various subjective understandings (Kolb, 2015). Based on this understanding, this course primarily focused on the representation and reproduction of spatial experience rather than the representation of space. A novel course curriculum was developed to provide a contextually sensitive and experiential foundation in basic design education, fostering students' spatial experience practices, strengthening their observation, analysis, and synthesis skills, and supplementing their understanding of core design principles. Inspired by site-specific and site-determined/conditioned artworks, site-specific design was utilised as a tool in projects developed in 'real venues', focusing on concepts such as the perception

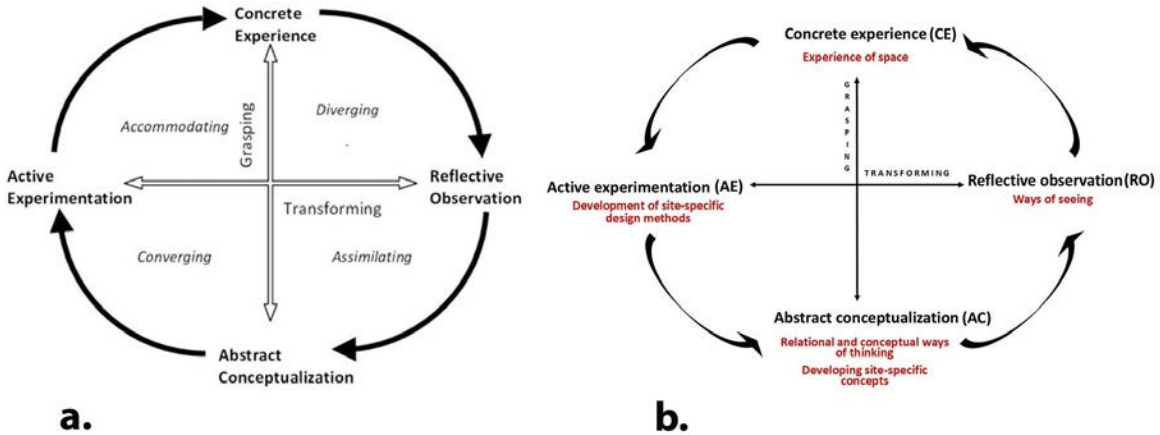


Figure 2. *a. Kolb's experiential learning cycle Source: Passarelli & Kolb, 2009, b. Experiential learning cycle implemented in the course. Source: Authors.*

of space, tangible and intangible elements of space, spatial organisation, the multi-sensoriality of the spatial experience, and the explortionof time-space routines. Accordingly, the notion of function was opened to discussion, and the potentials of spatial studies independent of function were explored.

The course implemented ELT as the studio pedagogy to provide a process-oriented and student-centred learning environment. Experiential learning defines iterative, dialogic, creative, critical, and transformative processes in which the students actively participate. In the projects carried out within the scope of the course, special attention was paid to the fact that ways of seeing (reflective observation) based on the real experience of space (concrete experience) trigger relational and conceptual ways of thinking (abstract conceptualisation), which in turn support the development of site-specific design methods (active experimentation) (Figure 2). With this perspective, students were encouraged to examine the situations, possibilities, and potentials of the spaces they experienced and to explore alternative design tools. The process was developed in the framework of ELT, and the stages of spatial experience, analysis, representation, and site-specific design production progressed in a spiral structure that provided feedback to each other. To assess the effectiveness of each phase in the process, qualitative data were collected through participant observation, informal interviews, and document analysis of students' work. These methods, which are utilised in studies examining the processes associated with the generation and adoption of creative ideas (Katz-Buonincontro & Anderson, 2018), provided valuable insights. The design studio environment, characterised by relatively intense and prolonged student-instructor interactions, facilitated the observation and evaluation of students' design thinking activities and concept development processes. Detailed field notes of instructors were meticulously recorded throughout the entire semester to ensure a comprehensive assessment of the course. Open-ended discussions that are conducted every week, facilitated students a deeper understanding of the specific stage of the project but also offered them an opportunity to express their opinions about the process. Instructors prepared a process-oriented assessment table for the evaluation of each student's learning process.

4. Process and outcomes

The course was structured around site-specific projects, complemented by seminars, readings, critiques, and open-ended discussions (Figure 3). This approach aimed to create an active studio environment that enriched the students' learning experience. While students were expected to engage in investigation, pose questions, evaluate, and construct meaning, instructors fulfilled roles as mentors, facilitators, and assessors. Throughout the semester, three types of informative seminar series were held on design concepts, architectural space, and tools

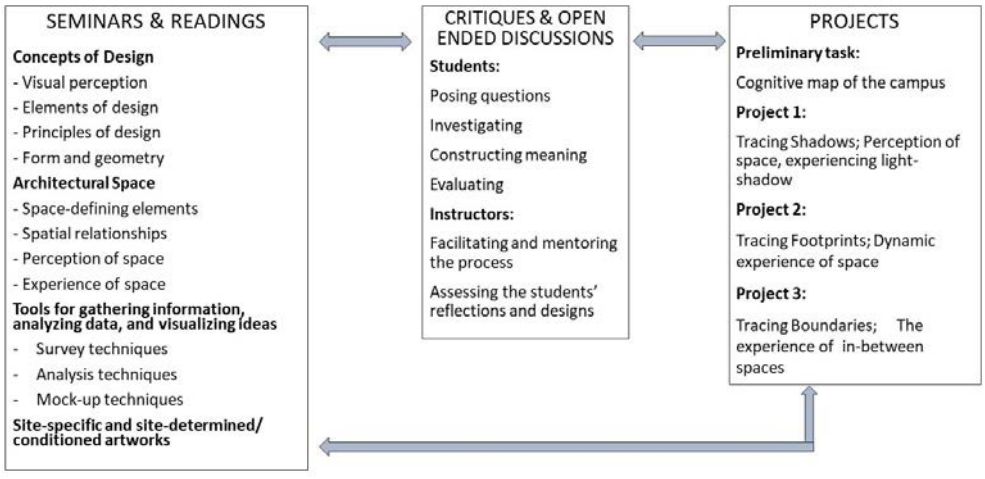


Figure 3. *Content of the course developed by authors. the course. Source: Authors.*

for gathering information, analysing data, and visualising ideas. Students were informed about visual perception, elements of design, principles of design, form and geometry, space-defining elements, spatial relationships, and the perception and experience of space. Additionally, site-specific and site-determined artworks were discussed as an approach that blurs the borders of art and architecture.

Fifty-one students participated in the study and worked in groups of 2-4 people. As a preliminary exercise, to enhance the students' awareness and to provide a basis for the discussions about their perception and experience of the space, students were asked to prepare a cognitive map of their university campus. Three project topics were identified to fully test the hypothesis of the study. Each project lasted four weeks and followed Kolb's learning cycle as a framework. The projects were named 'tracing shadows' (about the perception of space), 'tracing footprints' (about the dynamic experience of space) and 'tracing boundaries' (about experiencing in-between and transit spaces).

4.1. Tracing shadows; perception of space, experiencing light-shadow

Spatial knowledge is subjective, contextual, and time-oriented but not absolute and stable. On the other hand, spatial knowledge stemming from spatial experience is a network of interwoven concepts, including scale, proportion, perception, atmosphere, senses, time, memory, context, light, structure, materials, architectonics, spatial articulation, and syntax. Accordingly, this project utilises the potential of light and shadow to create and enrich spatial knowledge by focusing on the experience of space. Because light and shadow play a crucial role in our perception of and response to space, they continually shift and evolve, never remaining static.

According to Rasmussen (1964, pp. 186-214), light and shadow are architectural elements that contribute aesthetically to the perception of space. Meiss (1990, p. 121) states that space is perceived differently in daylight and artificial light, with different qualities. Light gains importance in perceiving the characteristics and textures of the elements that define the space, creating plastic effects in conjunction with shadow. Consequently, light and shadow, which add movement to the space, are effective in the perception and use of the space.

To begin, students were asked to select an outdoor location on the university campus with dramatic light and shadow effects (Figure 4). Then, they were asked to spend a whole day there and take pictures at different times to comprehend how light, as an essential element of design, changes the perception of space. The next step was to identify the physical properties of space. As a group, they measured the dimensions of the space, drew plans, sections, and elevations, and created a model. Experiencing the tangible elements and the light-shadow effects in the selected spaces is the concrete ex-

Figure 4. *Map of the campus indicating the selected places for design, pictures of the sites and selected student works. Source: Google Earth and authors.*

perience (CE) stage in Kolb's learning cycle.

The design process began by applying shadows of a specific time of day to the existing model. This is the 'reflective observation' (RO) stage in Kolb's learning cycle. Then, students were asked to develop a three-dimensional design by using the traces of these shadows and the boundaries of the space. Design components should be linear or planar elements. Composition should be based on the site-specific concepts they developed, considering visual design principles (Figure 4).

Developing site-specific concepts is the 'abstract conceptualisation' (AC). The concepts derived from the students' observations and perceptions of the space included solid-void, continuity, monotony, articulation, dichotomy, fragmentation, stratification, similarity, curvilinearity, homogeneity, order, transition, boundary, clustering, equality, and proportion.

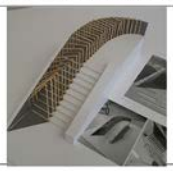
As the final stage of Kolb's learning theory (active experimentation AE), students developed their 3D works as an interpretation of their knowledge about the space. Rhythm, balance, unity, variety, harmony, contrast, hierarchy, repetition, and movement were the principles of design commonly used in projects (Table 1).

4.2. Tracing footprints; dynamic experience of space

As architects seek to design spaces that engage, inspire, and accommodate users, the concept of user experience and movement within space has a significant role in comprehending multi-faceted design decisions.

Maurice Merleau-Ponty (2012) emphasises the embodied experience of space and highlights how users' movements and bodily interactions shape their understanding of architecture. He claims that the sensory experience, bodily movement, actions, and skills (motor facilities) of the 'lived body' are integrated into our 'perceptual fields'. Seamon (2018, p. 31) classifies the motor facilities of the lived body as 'body routines' that refer to particular tasks or actions and as 'time-space routines' that identify habitual bodily actions. Movement within spaces is one of the key factors that shape our understanding and interpretation of those spaces. Movement alters our spatial awareness as different viewpoints and sensory experiences come into play. Our perception of space is not fixed; it is dynamic and continually influenced by our movements within it (Bachelard, 1994). By prioritising the human experience, architects can create environments that resonate with users, facili-

Table 1. *Assessment of the student works of Project 1: 'Tracing Shadows'. (SSC: Site-specific Concept and DP: Design Principle) Source: Authors.*

			
SSC: continuity	SSC: monotony, solid-void, order	SSC: articulation	SSC: fragmentation
DP: rhythm, asymmetrical balance	DP: rhythm, unity	DP: rhythm, balance, harmony, contrast	DP: unity/variety, asymmetrical balance
			
SSC: proximity, stratification, solid-void	SSC: similarity	SSC: homogeneity, continuity	SSC: clustering
DP: repetition	DP: rhythm, contrast, unity-variety	DP: rhythm, hierarchy, contrast	DP: contrast, unity-variety
			
SSC: transition	SSC: proportion, equality, solid-void	SSC: dichotomy, curvilinearity	SSC: boundary
DP: rhythm, movement, contrast	DP: rhythm	DP: rhythm, movement, contrast	DP: hierarchy, repetition

tating movement, engagement, and a sense of connection with the built environment.

The 'Tracing Footprints' project is conducted to increase the students' awareness of the spaces they utilise in their daily routine, regarding Seamon's 'time-space routine', to make them think about the concepts of 'experience of space' and 'movement' and to incorporate the user-site relationship into their design.

At the beginning of the project, each student group selected a transitional space on campus as their project area, based on the frequency of use and diversity of users (Figure 5). In the first step, which is the initial stage in Kolb's learning theory (CE), students were asked to monitor the site throughout the week, talk to users, make sketches, take notes, and make recordings to track movement in the space using time-lapse videos. The observations of the students not only focused on the physical properties (size, shape, height, etc.), components (vertical/ horizontal, and linear/ planar elements), and the visual, audial, and tactile properties of space but also concentrated on the patterns, timing, frequency, and density of use, the profile of the users, the form, the direction, and the speed of the movement in the space.

In the second phase —reflective observation (RO) in Kolb's learning cycle—students were asked to articulate their insights through visual representations such as movement patterns, time-space routines, graphic sequences, and similar formats (Figure 5). Finally, in the third step, they were expected to develop a concept (AC in Kolb's learning cycle) and three-dimensional site-specific work (AE in Kolb's learning cycle) grounded in the findings of their observations. This phase opened the path for developing design skills, getting used to group work, and producing alternatives supported by a concept. After serious discussions, students prepared the final mock-up and a poster of their design. At this stage, students grasped the power of poster design as a communication tool (Figure 5).

The concepts derived from the students' observations and perceptions of the space included solid-void, heterogeneity, equality, linearity, curvilinearity, closure, threshold, sequences, clarity, and fluidity.

Rhythm, balance, unity, variety, harmony, contrast, hierarchy, repetition, movement, and figure-ground are the principles of design that were commonly used in projects (Table 2).

4.3. Tracing boundaries; the experience of in-between spaces

In-betweenness can be defined as any object existing between two or more other things, but it also refers to an ambiguous and unstable condition that is difficult to define. It is often perceived as a 'negative' condition. On the contrary, the in-betweenness holds great potential to allow liberation from pre-established constraints. Thus, it is defined by Grosz (2001, p. 91) as "it is that which facilitates, allows into being, all identities, all matter, all substance" and by Derrida (Burchill, 2011, p. 27) as "the primordial milieu in which differentiation, in general, is produced".

Van Eyck considered this 'in-between' in the physical sense and as the medium of this relationship. He utilised 'intermediary places' as a design tool that formulates the relationships within the design object, as connectors

Figure 5. *Map of the campus indicating the selected places for design, pictures of the sites, analysis of movement, selected student works and posters. Source: Authors.*

of the integral parts to the whole in different scales and outside the object via its connection with the 'human' (Venturi, 2002, pp. 80-81). In this context, the theme of 'in-between spaces' was addressed as a design strategy in the third project of this course, focusing on students' experiences in 'real spaces'.

Although they differ in their existence within the city, various intermediate spaces connect or buffer urban areas. In other words, in-between spaces provide communication and continuity between boundaries and functions. They can include open spaces in front of or between buildings, cul-de-sacs, courtyards, and various pedestrianised transitional spaces that can be used at different times.

The in-between spaces are defined by visible and invisible boundaries. They create thresholds between these boundaries and enable movement across these thresholds. Therefore, unexpected uses are possible in in-between spaces. They are open to change and allow for new relationships and possibilities. In these spaces, standards become meaningless, and new interpretations emerge. They can contribute to the public space as a potential value with their characteristics of temporality, adaptability, spontaneity, freedom, and permeability.

In line with this approach, this project aimed to help students develop alternative ways of relating humans to space and the city. The in-between spaces identified for this project were analysed by considering their physical, environmental, social, and experiential contexts within the city, and these spaces were questioned and reinterpreted. While the social context included the perception of space shaped by human activities in everyday life, the urban context provided input to design research through examinations of in-between spaces. In addition, a design process was conducted in which students examined the possibilities and potential of the space and developed new design tools. Therefore, this project, like the previous two, aimed to change the way students perceive the urban setting in which they interact on a daily basis.

The project started with a site visit to Şile, an old fishing village on the coast of the Black Sea. The coordinators predetermined possible locations in accordance with the project topic (Figure 6).

Students spent a full day on the site, attempting to identify the tangible and intangible assets of their project area as part of the CE stage in Kolb's learning cycle, focusing on both the visible and invisible boundaries of the space. In the 'reflective observation' (RO) stage of Kolb's learning cycle, students explored the tacit knowledge of space

Table 2. *Assessment of the student works of Project 2: 'Tracing Footprints'. (SSC: Site-specific Concept and DP: Design Principle) Source: Authors.*

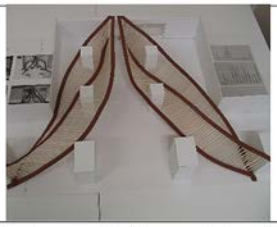
		
SSC: sequences solid-void	SSC: equality	SSC: linearity
DP: movement, rhythm	DP: rhythm, movement, contrast	DP: contrast, figure-ground
		
SSC: heterogeneity, solid-void	SSC: threshold, fluidity, solid-void	SSC: closure, clarity, curvilinearity
DP: unity-variety, contrast, hierarchy	DP: asymmetrical balance	DP:symmetrical balance

Figure 6. *Map of Şile indicating the selected places for design, pictures of the sites, selected student works and posters Source: Google Earth and authors.*

by sketches and collage work. Through this studio experience, students were encouraged to brainstorm with their group mates and explore new ways of perceiving, analysing, representing, and designing the space. With the integration of conceptual and relational thinking, they have gained the ability to recognise alternative situations related to space and interpret existing spaces.

In the third stage of Kolb's learning cycle (AC), students were asked to identify a concept based on their observations and perceptions of the space. Accordingly, one of the groups aimed to draw attention to the facade organisation of the historical houses and produced a stratified facade. The dramatic height difference between the two buildings, which compose an unbalanced street line, was interpreted by another group of students with a dynamic and parametric design. Two groups worked at the same site but produced different approaches; one focused on the patina of the historical building, generating a concept of continuity, while the other explored the horizontal and vertical voids of the site, inspired by an old well. One group, after talking to inhabitants, realised people often stared out of windows, leading to their concept of 'projection.' Another group's inspiration came from the hierarchy of voids on lateral facades. The final group was inspired by the eolian environment of in-between spaces, creating a responsive design (Table 3).

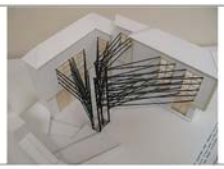
In the final stage, students designed the final mock-up of their installation and a poster, which was a 2D interpretation of their design (AE stage in Kolb's learning cycle) (Figure 6). Solid-void, proportion, rhythm, unity, variety, harmony, contrast, hierarchy, repetition, movement, and figure-ground are the design principles commonly used in projects (Table 3).

5. Discussion: evaluation of the learning experience

This study explores the impact of incorporating site-specific artworks as a pedagogical tool in basic design education, aiming to enhance first-year architectural students' understanding of spatiality through direct, personal engagement with place. Additionally, the study seeks to evaluate the effectiveness of Kolb's Experiential Learning Theory in the context of studio pedagogy. A variety of pedagogical tools were employed throughout the course, including visual materials, seminars, readings, field trips, digital technologies, juries, and discussions, to support experiential learning and multi-sensory engagement. Following a preliminary cognitive task, students progressed through three projects over the semester, each becoming increasingly complex. These projects ranged from building scale to urban patterns, with a focus on various facets of a place, including tangible and intangible qualities, as well as explicit and implicit characteristics, while also exploring the dynamics of human-space relationships. Therefore, in the studio process, the interdisciplinary nature of basic design education is transformed into a systematic learning space.

The course enhanced students' abilities to interpret spatial experiences and supported the development of a critical perspective within the context of site-specific and site-determined design approaches. As Zečević (2017) argues, such artistic works cultivate an experiential understanding of place by

Table 3. *Assessment of the student works of Project 3: 'Tracing Boundaries'. (SSC: Site-specific Concept and DP: Design Principle) Source: Authors.*

			
SSC: view of the street, projection	SSC: facade organization, stratification	SSC: height difference, dynamism	SSC: voids on surfaces, centrality
DP: emphasis	DP: solid-void	DP: emphasis, proportion	DP: repetition, emphasis
			
SSC: patina of historic house, continuity	SSC: closeness of cumba, connection	SSC: hierarchy of voids, irregularity	SSC: wind effect, responsive
DP: rhythm, figure-ground, contrast	DP: harmony, solid-void	DP: solid-void, proportion, hierarchy	DP: movement

engaging with both its tangible and intangible qualities, uncovering the tacit meanings of space through the artist's unique lens. Similarly, students in the studio engaged directly with real sites, explored them through diverse perspectives, and produced site-specific responses. Although the final outputs developed in the studio are spatial and architectural in nature, they simultaneously operate as artistic installations that embody the students' interpretive engagement with place.

ELT provided a comprehensive learning framework for this study. Correlating with the four modes of the learning cycle, concrete experience (CE), reflective observation (RO), abstract conceptualisation (AC) and active experimentation (AE), students produced their site-specific works (Table 4). In line with studio pedagogy, students were assessed not solely on their final products but through a process-oriented evaluation. As presented in Table 4, students' progress for each project was assessed based on the four stages of Kolb's learning cycle and the corresponding expected learning outcomes. The interactive nature of the studio environment enabled close observation throughout each phase of the process. At the end of each stage, students presented their work, followed by open-ended discussions. Rather than relying on a fixed set of questions, these discussions allowed instructors to engage with students more organically to understand their reflections on the process. Consequently, the assessment of the learning process is based on instructors' field notes and their evaluation of each phase as outlined in Table 4.

Accordingly, during the CE stage, students actively engaged with the university campus and the Şile historical centre, immersing themselves in various aspects of these locations. This experience significantly contributed to their understanding of the physical and social dimensions of urban and architectural space, as well as spatial organisation. Moreover, it increased their sensitivity to natural and man-made environments, fostering a deeper comprehension of human-space relationships. Additionally, the students demonstrated an enhanced understanding of visual perception, becoming more skilled at recognising how the eye perceives visual elements, structures, shapes, and compositions. Working in real-world settings created a highly conducive learning environment, with students actively participating in tasks. As noted by Lau (2009), such a creative learning environment inherently motivates students, making their learning process enjoyable and engaging. However, some students expressed difficulty with repeated site visits and the technical challenges of modelling existing conditions.

After the concrete experience, students were asked to reflect on the task RO. As Khorshidifard (2014) points out, there are various possible ways of grasping and transforming experiences, which are tied to the uniqueness of each designer's way of thinking. In the RO stage, students interpreted the effect of light in Project 1, found out time-space routines and patterns of

Table 4. *Assessment of the learning experience developed by the instructors.*

Kolb's Learning Theory Phases	Project 1 Tracing Shadows; Perception of space, experiencing light-shadow	Project 2 Tracing Footprints; Dynamic experience of space	Project 3 Tracing Boundaries; The experience of in-between spaces	Learning outcomes	%
Concrete Experience (CE)	Experiencing tangible elements of space	Experiencing tangible and intangible elements of space	Experiencing tangible and intangible elements of an urban space	* demonstrate an understanding of visual perception, recognizing how the eye perceives visual elements and structures, and different shapes and compositions by default.	5%
	Experiencing light and shadow effects	Experiencing space through movement	Experiencing visible and invisible boundaries of space	* identify urban and architectural space, understanding the physical and social elements of space and spatial organization	5%
				* increase sensitivity to the natural and man-made environment, enhancing the perception of space.	5%
				* realize human-space relationships, developing an understanding of the experience of space.	5%
				* develop teamwork skills	5%
				Total	**25%**
Reflective Observation (RO)	Drawing traces of shadows	Sketches, notes, time-lapse videos Trying to find out time-space routines, patterns of movement by drawing graphics, sequences	Sketches, analysis, photographing, mapping, diagrams Trying to find out the tacid knowledge of the space with collage works	* gain the ability to express observations as analytical drawings, demonstrating analytical thinking skills.	10%
				* demonstrate critical thinking skills essential in the development of a designer, including new ways of seeing, thinking, and expressing.	10%
				* develop teamwork skills	5%
				Total	**25%**
Abstract Conceptualisation (AC)	Develop a site-specific concept	Develop a site-specific concept	Develop a site-specific concept	* develop strong conceptual thinking skills	20%
				* develop teamwork skills	5%
				Total	**25%**
Active Experimentation (AE)	Design a site-specific work	Design a site-specific work	Design a site-specific work	* approach design through basic principles and elements of design, form, space, and order	10%
				* gain the ability to transform abstract concepts into concrete designs	10%
				* develop teamwork skills	5%
				Total	**25%**
				Sum	100%

movement in Project 2 and the tacit knowledge of the space in Project 3 by using different mediums such as sketches, graphics, collage works, mapping, diagrams, photographs, sequences, time-lapse videos and animations. This stage in the learning cycle stimulated students to demonstrate analytical and critical thinking skills, which are essential in the education of a designer, including new ways of seeing, thinking and expressing.

Temple (2010) argues that, in first-year architectural design studios, merging physical reality with abstract concepts requires integrating both concrete and abstract learning experiences. In the AC stage, students learned to develop site-specific concepts for their design. This required abstract thinking and idea generation, supported by group brainstorming sessions. While students initially struggled with this conceptual leap, often citing a lack of prior experience with such modes of thinking, greater engagement and confidence emerged once a conceptual direction was established. Students experimented with design concepts such as continuity, fragmentation, clustering, and boundary, developing a richer vocabulary for design thinking.

Finally, in the AE stage, students transformed abstract concepts into concrete, site-specific designs. Although many reported that transforming abstract concepts into tangible forms was the most challenging aspect of the process, it was observed that they became increasingly capable of expressing their ideas through design and demonstrated a more refined three-dimensional understanding of space. Additionally, despite the project's emphasis on avoiding predefined functions, there was a tendency to focus on developing a specific function at the beginning. However, students gradually came to understand that the primary objective was to critically interpret space.

Throughout the studio process, students incorporated design principles, visual perception techniques, and Gestalt theory—introduced through supplementary seminars and exercises. Although spatial experience is inherently subjective, collaborative discussions allowed students to share interpretations, develop communication skills, reduce fear of failure, and engage in constructive self-critique.

Analysis of student performance (Table 4) reveals that the Reflective

Observation (RO) phase consistently received the highest scores, while the Abstract Conceptualisation (AC) phase posed the most challenges. These findings align with student feedback and suggest the need for curricular refinement.

In response, we recommend integrating short, focused exercises that support the transition from abstract concepts to concrete design proposals. Additional strategies could include guided visits to site-specific artworks and interactions with practising artists, fostering deeper insight into interpretive design approaches.

6. Conclusion

Advancing through multi-component and multi-layered research, architectural production increasingly touches interdisciplinary and transdisciplinary fields. For this reason, especially in the early years of the educational process, learning methods that establish a relationship with these disciplines and that do not treat these disciplines as separate and independent from each other gain importance. The experimental syllabus implemented at Isik University in Türkiye demonstrates the potential effectiveness of utilising site-specific artworks to foster students' ability to develop site-specific concepts for their designs. Therefore, by integrating an approach from within the discipline of art into the pedagogy of the course, this course fosters an environment of architectural education that engages with different disciplines and incorporates an interdisciplinary approach to learning. This interaction enabled students and instructors to go beyond the established boundaries of studio pedagogy and explore innovative ways of thinking.

The findings of this study suggest that incorporating site-specific artworks as a pedagogical tool in basic design education can significantly enhance first-year architectural students' comprehension of spatiality through personal experiences and perceptions of place. In the first year of architectural education, non-abstract, defined problems are presented, with an emphasis on students' understanding that space becomes visible and perceptible through various elements. These spatial experiences, which are independent of function, also provide a transition to the later stages of architectural education. This course, rooted in process-oriented and student-centred studio pedagogy of Kolb's Experiential Learning Theory, not only underscores the viability of such an instructional model but also provides a robust framework for guiding future educational endeavours in this domain. ELT allowed students to understand the reciprocal relationship between man and his environment, increased their awareness and contributed to enhancing their creativity in the representation of spatial experience and the (re) production of this representation. It is believed that participating in an experience like this will have a positive impact on the studio performance of students in subsequent semesters. It is important that basic design knowledge creates a knowledge environment that can be used in the architectural design process. For further research, collaboration with artists might enrich the studio environment, and real-scale exercises can be conducted to observe how users interact with these spaces in a way that differs from their usual experience, thereby opening a path to discussing new design possibilities. Additionally, the evaluation of the learning process could be further developed by incorporating different learning styles into the design process. This experience also highlights the numerous possibilities for dialogue, interaction, and collaboration between art, design, and architecture studios.

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A method proposal for interior architecture education: Patch-merger workshop

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Abstract
Design, as a discipline, envisages the development of each problem with its own unique and rational solutions. The act of designing can be defined as presenting a specific and up-to-date solution in response to the function at the point brought by the problem. Design by interior designers, a problem within the space; function, aesthetics, atmosphere, durability and cost aspects are examined from a holistic perspective. The qualifications sought in newly graduated interior architects are not only knowledge, but also the ability to adapt and reproduce information, use it within various programs, and combine and develop it with information from different backgrounds. In this context, a new studio was designed within the scope of the Materials course, which is one of the compulsory courses of a University in Ankara, Department of Interior Architecture and Environmental Design. The proposed study is intended to enrich the content of the course and strengthen the learning experience. It was primarily preferred for the studio work recommended in the material courses, where the interior components are exemplified in the design and the material knowledge of the interior architecture profession is deepened. As a result, Design education has a practice-based process due to its nature and methodology. In addition to the acquisition of the student in the studio lessons, it is valuable in terms of supporting the interaction with the material with new methods, self-development on behalf of the student in this process based on experience, and following the learning process on the behalf of the educator.

Keywords
Interior design education, Learning method, Material, Material board, Workshop.

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1. Introduction

Today, creating a lesson plan is one of the areas that academicians think about the most. With the developing technology and increasing sub-disciplines, it has become an important issue to be able to effectively convey the basic principles of education to the students. While preparing the lesson plan, the whole process should be emphasized, and the last lesson and activities should be handled carefully as well as the first lesson. It is emphasized that the most important competence that students acquire is the knowledge of how they will use what they have learned in the lesson in the future (Burgess-Van Aken, 2017). The three learning types as project-based learning, animation/simulation and reflecting are presented. The training we received by developing projects on the given problems and developing a design in line with the critiques, as in the design studios, has been evaluated as "project-based learning". Solving the problem, which is frequently used among different disciplines, with a user-based empathy by animating is called "animation/simulation". The learning methodology, which is referred to as reflecting, can be simply explained as the student's use of past experiences/ acquisitions in the learning process (Altay et al., 2016). Altay et al. (2016) suggest that using student-centered practices and methods will help students grasp the subject more clearly and from different angles. Design studios, workshops, on-site designs are all accepted as experimental learning and emphasized their importance in architectural design education (Folić et al., 2016). At this point, within the scope of the research, it is aimed to reveal the benefits of activities that enable the student to think in the focus of the user by empathizing.

It is thought that supporting and nurturing the education program with the aforementioned workshops will meet the needs in order to bring the above-mentioned elements to the students. In the first stage of the research, the material lesson in interior design and the value of innovative workshops in this context were emphasized. In the next stage of the study, the workshop applied was discussed in detail and its gains were examined. The research proceeds on the thesis that the workshop is one of the methods that can be applied to the needs emphasized in the course and is useful in the development of the curriculum. The achievements of this study are considered valuable in that they can be adapted to other courses in the practice-based interior architecture practice.

1.1. The role of material courses in design education

Materials are pivotal in actualizing design concepts and serve as a catalyst for innovation, inspiration, and the imbued significance of a project. Designers engage with materials not only to realize their visions but also to articulate their assessments and insights regarding their interactions with these substances (Manzini, 1986; Ashby & Johnson, 2014). The design process determines the point where the material will be located, and the knowledge of how it will become a solution also shapes the type of material and the elements that affect it. The effects of the material on the quality of design have brought it to be a part of design education.

Material education can be conducted in a variety of environments beyond the conventional classroom. For instance, material libraries and fabrication labs offer valuable hands- on experiences that support designers in navigating the material selection process. This is particularly important given that numerous material properties remain challenging to quantify through experimental methods (Wilkes & Miodownik, 2018). Material libraries, by providing access to physical samples, enable designers and design students to translate abstract data from material databases and catalogs inti tangible experiences (Akın & Pedgley, 2016). Furthermore, such interactive engagements are not limited to material libraries alone; physical samples can also be presented during lectures, thereby allowing students to engage directly with the materials (Zhou & Rognoli, 2019). Facilitating workshops plays a crucial role in fostering enthusiastic engagement and active

involvement among students, thereby enhancing their skills and expertise. The significance of workshops in design education is widely recognized as a prominent priority (Rastogi, 2023). Workshops can be seen as a supportive aspect of material lessons and design education, forming another focus of this experience. Content and processes are equally important in design education (Zhou & Rognoli, 2019). Content can be seen as a combination of form, meaning and function expression in design education. The material not only supports the design in terms of form and meaning, but also offers a solution in terms of functionality. In the focus of the content conveyed in the schools of design education; form, meaning and function. While the material corresponds to the points specified by the content for the design of the space, it also became a tool for the designer to interact with the user of the space. From the framework of design education, this situation has brought a multi-faceted approach with the understanding of the design, application and coming together of the material.

The feel of the materials informs the designer: "Here it is soft and flowing, here it feels hard and bumpy" (Norman, 2007). Based on this statement, it can be said that the user should experience this feeling as interior designers know that the spaces they design will be used by people. Therefore, space designers must analyze and use the material and its effect correctly. In this sense, within the scope of material lessons in design education, the student must establish an experience-based bond with the material in order to obtain the necessary information.

The diversity, use, performance, texture, color, structural characteristics of the material, the identity it will add to the space, preference criteria, application methods are taught in material lessons during the education and are expected to be applied in design projects. In this context, it is aimed that material courses will support studio projects intensively. On the other hand, knowing the color and texture, which are the descriptors of the material, teaching it and using it correctly is of great importance in perceiving the design and transferring it to the projects. The materials that give the identity of the surfaces and form created in the projects constitute the tactile and visual language in space design. These expressions of surfaces affect the design with various ways of reading psychologically, intuitively and instinctively, as well as physically felt at the level of perception (Gezer, 2012).

It is very important for a designer to know the technical and perceptual properties of the material to be used during the selection and use phase. Knowing a material well means knowing the general and technical characteristics of the material, its production stages, possible places of use in the structure, the elements to be considered in its application and its maintenance (Perker, 2011). In this context, it is aimed to equip the students with this information within the scope of the material course. The stated goal can only be achieved with a versatile material education in accordance with the design, where the materials can be learned by experience by the students, and with a specially equipped environment for this education. In order for designers to keep up with the social and economic background of today's world, they need to have analytical and creative thinking skills in a broad perspective. It is important to understand and follow the world in order to improve design and design education. In order to keep up with the changing world, designers need to have more adaptable creative abilities in addition to program knowledge and basic design skills (Friedman, 2012). In this context, the course contents and teaching styles of universities that have been giving Materials courses for 10 years or more have been examined. According to the content analysis of the curriculum, it can be said that material education is mostly handled with a content that is suitable for theoretical explanation and fed with technical information. However, material lessons should prepare the ground for an understanding in which the skills of students to determine material selection criteria in their professional lives and to understand the nature of the material are developed and taught, and materials are learned by experiencing one-on-one.

The Bauhaus educational framework delineated its foundational course into several key components: "study of materials and tools", "study of nature", "study of materials", and "space study-color study- composition study". In the third phase of this curriculum, materials- including clay, stone, wood, metal, glass, textiles, and color- served as central elements. The principal objective of this approach was to foster an in- depth exploration of the intrinsic and unique properties of materials through direct, experimental engagement (Rognoli & Levi, 2004). At this point, Ashby and Johnson (2014) state that in order to use materials effectively, it is necessary to have some knowledge about their technical properties and production methods. In parallel with the technical features of the materials, the sensory properties that appeal to people's emotions are also important for the selection of materials to be used in the product (Zuo, 2010). In this context, the teaching methods should have a quality in which students will be more active (Kauppila, 2018). In this way, interactive learning of material design in different layers is possible. Considering the relationship between material and experience in design education, material lessons are taught on a single axis and theoretically bring along a single dimension of learning.

Today, it is seen that material lessons in design education are handled as learning by seeing instead of learning by experiment with the effect of technological developments. Students focus on developing technology instead of traditional craft (Lawson, 1997). Although this situation has positive results in learning new materials and production methods, it gradually causes the practical interaction of design students with materials to decrease. In the light of this information, it is concluded that a material course where students and materials can interact is important for design education.

1.2. The influence of workshops on design education

Experiential learning is an educational model within the constructivist paradigm that defines a free and collective space for students, emphasizing the integration of design and construction processes. Known by various names such as design build, learning by doing, and experiential learning, this method is integrated into the curricula of many educational programs today, including summer schools, elective courses, and studio education (Yıldırım Okta, 2019). In the experiential learning approach, individuals access knowledge not through hearing or reading about others' experiences, but by exploring and experimenting based on their own reality. This allows them to reflect on past knowledge and use it as a foundation to establish new connections and make syntheses through reflection. Maker-centered learning, built upon the work of education theorists like John Dewey, Jean Piaget, and Seymour Papert, unfolds through interactive, open-ended, student-centered, interdisciplinary experiences, organized horizontally. In contrast to traditional approaches based on theoretical knowledge acquired in classroom settings, students engage in developing design ideas using models, prototypes, and sketches. They must concurrently and cyclically consider numerous parameters such as main concepts, materials, details, time, budget, and location-related constraints and decisions. At this point, design based on action-reflection thinking can be defined as a transformative process where students actively participate in iterative, dialogic, creative, critical, and reflective actions (Yorgancıoğlu & Güray, 2018). According to Mezirow (1990), the exposure to novel situations during practical applications enhances students' ability to devise new strategies and resolve problems, thereby promoting constructive and creative thinking. In a similar vein, Kolb (1984) posits that knowledge is acquired through environmental experiences and practical application of theoretical concepts. He underscores the necessity in educational settings to facilitate opportunities for students to engage in innovation and discovery.

Heidegger provides the interpretation of "self-giving/self-throwing" in relation to the experiential learning model where individuals actively engage. According to Heidegger (1998), "Learning

does not occur when a student passively receives information; it begins only when the student actively engages with and internalizes the material as personally meaningful. Genuine learning arises when this process of appropriation becomes an act of self-investment, experienced as such by the learner. It is not solely the outcome of instructional guidance, but rather emerges through the collective participation of all involved—including workshop facilitators—and most critically, through the student's autonomous and reciprocal engagement in the learning process." It highlights that in workshop settings, meaningful learning emerges when students take ownership of their learning process and engage collaboratively with peers and facilitators, moving beyond passive reception toward deep, transformative understanding.

In parallel with these views, it is recognized as important to include the experiential learning model in the curriculum of design education, allowing tactile interaction with materials, sensory experiences, and active involvement of the body in cognitive processes. Especially in the face of the egocentric perspective caused by contemporary technologies, the significance of sensory gains through bodily experiences becomes even more apparent. Such a system where students actively participate necessitates arrangements outside standard formal education, in informal working environments. Formal education typically occurs in classroom settings, focusing on theoretical knowledge, whereas informal education often takes place outside the classroom, beyond planned curricula, fostering learning through communication, collaboration, and experiential interaction. Informal education, defined as informal learning environments, can be partly pre-arranged or entirely spontaneous. Workshops constitute a significant portion of organized informal education systems (Yürekli & Yürekli, 2004).

Donald Schön developed more intricate and profound theories, known as reflective practice, to elucidate re-processing of knowledge. He introduced concepts such as reflection- on- action and reflection- in- action (Schön, 1983). Schön argued that the development of individual insight relies on a critical examination of practical values and theoretical frameworks. This process is described as "examining practice reflectively and reflexively" (Bolton, 2010). A prominent model of reflective practice is experiential learning (Kolb, 1984), which offers a methodology for evaluating a person's abilities in a language that allows for measurable commensurability. This model provides a comprehensive view of learning by incorporating experience, perception, cognition, and behavior, and considers learning as a cyclical process involving concrete experience, reflective observation, abstract conceptualization, and active experimentation.

Teaching involves both the delivery and transmission o information and knowledge, as well as facilitating students' growth, learning, and transformation of their own understanding of the subject matter. Traditionally, lecturers have employed a transmissive approach to teaching, which emphasizes the act of teaching itself over the process of learning. This method, which often appears to be student-driven with minimal interaction between the instructor and students, can inhibit creative thinking and may be less effective in the context of design education (Guo, 2016).

2. Method

This study has been designed within the scope of "Construction and Material" course, which is one of the must courses of a university, Department of Interior Architecture and Environmental Design. The aim of the proposed study is to enrich the content of the course and strengthen the learning experience. The Construction and Material course, in which the interior components are exemplified in design and the material knowledge of the interior architecture profession is deepened, was primarily preferred for the proposed workshop. In this context, the study is aimed to be supportive in the following subjects:

- Measuring the ability to establish the link between the material and the atmosphere of the interior space
- Measuring the effects of activities within the scope of the course

- Organizing the interaction of material lessons with design studios
- Using creative activities for the clarity and efficiency of the course

In these respects, it offers an action plan to close the gap of Construction and Material course by proposing an interactive activity. The hypotheses (H) developed within the scope of the stated research objectives are presented below;

H1. Interactive workshops within the Construction and Material course will positively impact students' ability to connect materials with the atmosphere of interior spaces.

H2. Student engagement in creative activities as part of the course will enhance the clarity and efficiency of learning, improving overall course comprehension.

H3. Students involved in interactive workshops demonstrate greater self-efficacy in selecting and applying construction materials in their design projects.

H4. The integration of material lessons with design studios through interactive methods will foster stronger connections, leading to more effective learning outcomes in interior architecture students.

It adopts the action research approach, which can also be described as educational work, as a method. As in the proposed approach, a deficit has been identified in this study, an action plan (workshop) has been prepared for it, it has been adapted, and application-oriented evaluation (student feedback) has been received. In order to receive student feedback, a survey consisting of a total of nine questions, one of which was open-ended, was applied to the student group where the workshop was applied. The answers from the participants were evaluated by content analysis. In the survey study, which was used as a data collection tool, the first eight questions were presented by analyzing quantitative data. In the ninth question, which was designed as open-ended, the answers from the participants were analyzed by content analysis, categories were created, and categories and opinions were presented by table. With the survey study, it was aimed to measure the extent to which the application approached its goals and to improve the action plan.

As part of the action research framework, the workshop was designed to serve as the core action phase. Osgood developed a scale using bipolar adjective pairs to measure perceptions and reactions toward specific concepts, objects, or events (Osgood et al., 1957). This method, known as the "semantic differential," remains widely used in contemporary research. In this study, the method was adapted into a five-point Likert scale to evaluate materials and products. However, the primary aim was not to assess perceptions of material quality, but rather to make the classification of materials and products more enjoyable and accessible for students, thereby fostering their ability to connect materials with the atmosphere of interior spaces. The adjective pairs were carefully selected to avoid negative or threatening connotations and were limited to ten pairs to ensure clarity and focus. As noted in the work of Ashby and Johnson (2014) on material perception, these qualities play a significant role in how users describe a product or material. When supported by visual representations, these descriptors help strengthen communication and serve as effective tools in the design process. In the planned workshop, materials were paired with adjectives through images, allowing students to directly experience this process. This experience also helped them transfer knowledge from the materials course into their design studio work.

2.1. A proposal for the application of the material course: Patch-Merger

One of the most important deficiencies seen in the students of IAED Department is that they cannot establish the relationship between the atmosphere of the space and the material/product. In this context, it is thought that this link will be strengthened with the "Patch-Merger" workshop proposed in the "Construction and Materials" course. The main point of view of the proposed workshop is to be able to look at Interior Architecture by examining furniture/equipment not only in the focus of form but also in terms of color, texture and product.

In interior design projects, it is emphasized that the choice of materials is effective in establishing a connection with the concept and the essence of the space. At the last stage, the presentation of the choices as well as material selections made to convey and explain the project becomes important (Dodsworth, 2009). The proposed workshop is also aimed to meet this need.

In this direction, it is suggested that the workshop be conducted in the material-oriented courses included in the program. It is thought that the workshop will both bring different perspectives to interior design and enrich the course content. The Construction and Materials course in our department is a must-course offered to second-year students. The workshop was held for all the second-grade students at the same time in their own lesson time. Since the average number of students taking the course is 60, taking into account the content and intensity of the workshop, two-week course hours are allocated to the workshop to obtain the necessary efficiency. After informing the students about the requirements of the planned workshop and what was requested, the process started with 49 students who came on the day of the workshop. The workshop be planned to be made in the middle or toward the end, not at the beginning of the semester when the students do not have enough knowledge yet. In this direction, the workshop was held to the second-year students in the 7-8 weeks of the 11-week summer term.

2.1.1. Workshop preparation phase

During the preparation process of the workshop, students were asked to bring material images from the 21st century that could be used in the workshop. Information regarding the requested images was made before the workshop. According to this preliminary research, the subject can be diversified as material, product, or art, but it is basically limited to a desired material/ product/ designer/ company, or a movement. As an example, a company that produces only cotton textiles can be examined by students. Examples of the material's texture, colors, artists, history, and areas of use can be presented by research. In addition, an announcement was made to the students and a list of materials they should bring for the workshop on the day of the lesson was sent. The list of required materials is as follows:

- Tools for cutting (ruler, utility knife, cutting pad, etc.)
- Tools for sticking (tape, glue, etc.)
- Tools for drawing (pen, eraser, marker, etc.)
- 35x50 cm white drawing paper
- Paper tape
- Post-it
- 5 images (2 copies for each)

After clarifying the requirements within the scope of the workshop and conveying them to the students, the requirements for the space were revealed. The work area is arranged according to the requirements of the workshop. The venue where the workshop will be held has been chosen in such a way that it can accommodate 60 people and has a large white surface or wall. In order for the workshop to take place, the desired surface had to be prepared as shown in Figure 1.

Preparation of the specified surface was the first step of the workshop. A grid of 10 columns / 5 rows were created on the surface with the help of paper tapes. Adjective pairs were added to the columns of this table prepared with the students with the help of post-its. Adjective pairs were chosen by the instructors prior to the workshop among word groups that would not have any negative effects and were frequently encountered in Interior Architectural Studios. In the workshop, the ten adjective pairs mentioned were found appropriate and sufficient. The adjectives are placed in the columns so that the pairs are on the same axis. For example, while the adjective warm is at the top of the first column, the adjective cold is placed under the same column on its axis. A five-point scale was created on the rows of the table with the help of post-its. From the top grid to the bottom, each row is designed to meet one scale.

2.1.2. Workshop: Patch-Merger 1st phase

Following the organization of the workshop area, the various stages were communicated to the students. The initial step involved determining

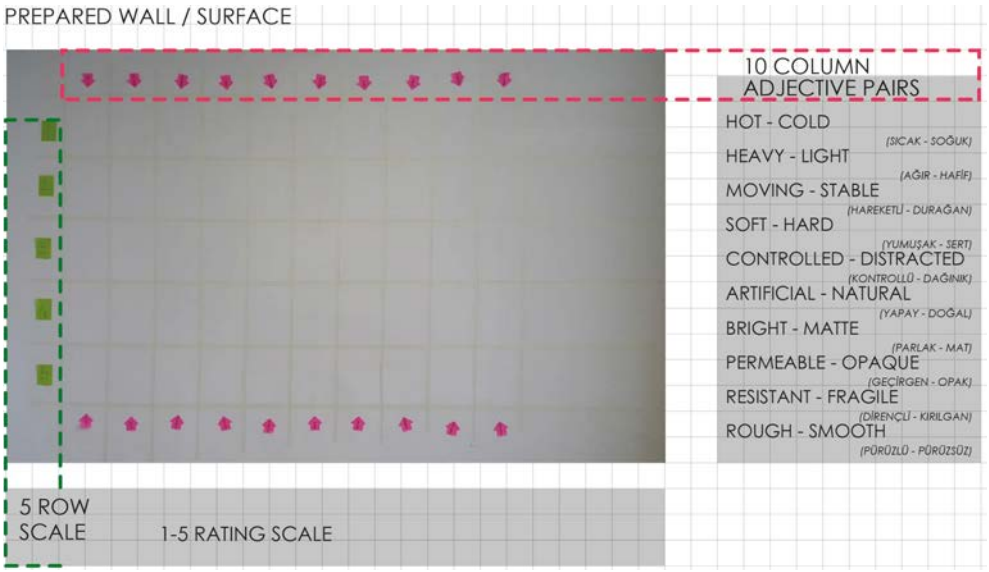

Figure 1. *Prepared surface and scale system (Prepared by Authors, 2022).*

study groups based on the number of participants. A total of 49 students were instructed to form 10 groups, each consisting 4 to 5 individuals. Once the groups were established, the students were tasked with selecting three pairs of adjectives displayed on the wall, curating images they had brought, and hanging five of these images on the wall. Fort his particular task, a sample was created in the studio, and a selected image was analyzed and categorized within an adjective pair column according to a 1-5 scale.

For example, if a seating (product) is placed on the surface, the adjective pair must be determined first. Due to the structure of the product, one of the soft-hard or hot-cold pairs can be preferred due to the texture of the fabric. If 1 indicates hot and 5 indicates cold in the selected adjective pair, it is considered appropriate to place it in a range of 1-3, since it creates a warm impression due to the texture of the product. After a similar sampling, the students were given 30 minutes and they were expected to choose the adjective pair and the images (materials/products). After the selection, the images were placed on the surface by the groups (Figure 2).

After these stages, the surface was opened for discussion and each group was asked to state their ideas and suggestions about the table in general. In this way, it is aimed that all groups have an idea and express their opinions about all the materials/products at hand. At the same time, empty and overfilled areas on the surface were evaluated. The important thing is to create a discussion environment on the images and to be able to make a collective analysis.

After the discussion, some changes were made in the places of the images on the grid. An idea was taken to distribute the images in the same adjective pair and scale. At this stage, the surface was photographed and the things to be done for the second stage group work were explained to the students. It is planned to change the group dynamics in order to keep the students alive. The 10 working groups were reduced to five working teams by combining both groups. The five rows on the surface are distributed to the combined groups according to the group number. The final stage of the workshop progressed depending on these rows and the images on it. It was expected that each group would create a material board by using the images on the row and the value of the adjective pairs (scale) to which they were attached.

For example, the combined 4th group was expected to construct a material board from row 4. In row 4, no images were assigned to the adjective pairs 'moving-stable, artificial-natural, and resistant-fragile'. In this case, the students should consider the adjective pairs with images while creating the atmosphere. Making a layout with the images in their hands and arranging the materials, products, and col-

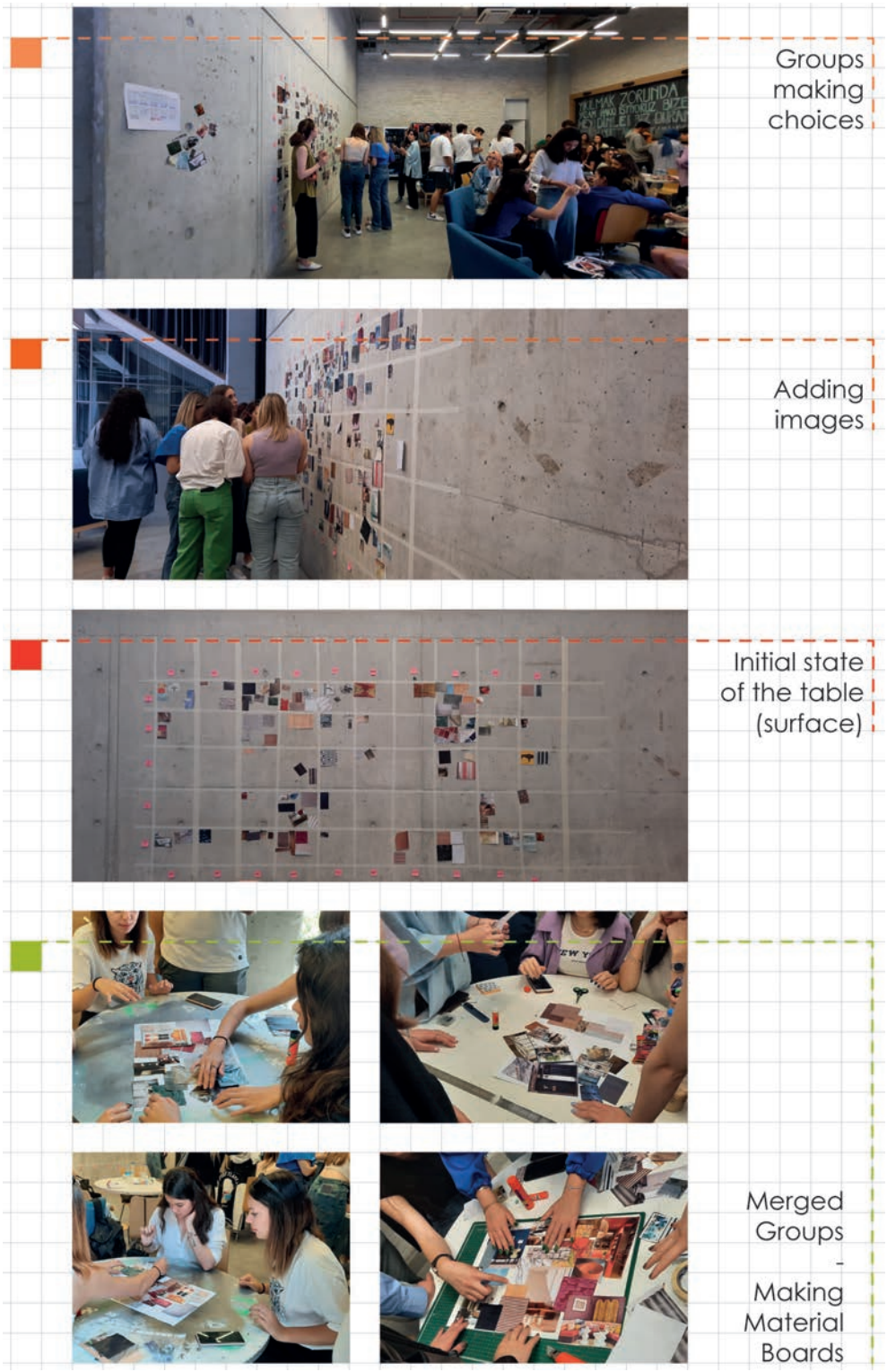

Figure 2. *Adding the selected images to the workshop surface and material boards (Prepared by Authors, 2022).*

ors in harmony were the last stages of the workshop. They were asked to make a board on the 35x50 cm white paper they were asked to bring. They were also expected to bring this board to the studio the following week, and to prepare a text about the space they constructed. The text was expected to reflect the atmosphere constructed through material product and adjective pairs. At the end of the workshop, groups started to work on creating a material board (Figure 2).

The stages of the workshop held, the time given and the contents are presented in Table 1.

Table 1. *First phase of workshop (Prepared by Authors, 2022).*

	WORKSHOP: PATCH-MERGER		
First Phase of Workshop	**Stage**	**Content**	**Time**
	1	Preparing the Workshop Environment Preparing the Workshop Surface	45 min
	2	Makinggroups (initial group structure - 10 groups)	15 min
	3	Teamwork	30 min
	4	Image and adjective pair selection	30 min
	5	Teamwork	30 min
	6	Adding images	15 min
			2 hour 45 min

2.1.3. Workshop: Patch-Merger 2nd phase

The second part of the workshop was held and completed on the next week's course hour and day. The presentation of the material board, which was given as a task in the first phase of the workshop, was carried out by the groups. A total of 5 groups presented the 5 material boards they created within the scope of the workshop. Each group was asked to imagine a space containing the materials/products/designs on the board they created and to verbally convey the atmosphere of it. The groups convened the space-atmosphere description they prepared as text while presenting their maps (Figure 3).

In this part of the study, students were expected to be able to establish the material-adjective-atmosphere relationship. In addition, it was an expectation of this step of the workshop that they sifted through the images in the row they were dealing with, being selective, and creating relationship diagrams while turning the images into a board. The material boards shown in the presentation were discussed in the studio, and the elements that should be included in a material board were also examined. The stages, content, and duration information of the second week of the workshop are summarized in Table 2. The details given to the students regarding the material board planned to be created are also given in the table.

The two-week workshop ended with the students presenting the boards they created. The aim of the study is to create a contemporary approach to the Construction and Materials course and an innovative environment where students can express themselves.

3. Findings

It was aimed to measure the effect of the workshop on the participants. In order to understand the effect of the workshop, the survey was prepared and asked to the participant students on a voluntary basis (Table 3). The total number of students participating in the survey was 43. While preparing the questions, the interaction of the workshop with the Construction and Materials course, the material-atmosphere relationship, the interior space-atmosphere relationship, the workshop-studio relationship, and its contribution in preparing the material board were taken into consideration. Since the mentioned criteria were effective during the preparation and implementation of the workshop, it was aimed to measure these criteria with the survey in the same direction. The survey questions are shown in Table 3.

The survey analysis based on the first 8 questions is shown in Figure 4. Question 1, 2 and 8 received highly positive answers. According to the survey results, the workshop has been a memorable practice. It has been memorable in examining the visuals of the interior and positive feedback has been received about the awareness that the student wants to create. In addition, it is concluded that it is a guide for the student in preparing a material board for studio lessons. The workshop was supportive in establishing the relationship between material and atmosphere. The adjectives used to describe the materials in the workshop were descriptive in the choice of the students to use the materials in the space design. The students increased the level of definition of the relation-

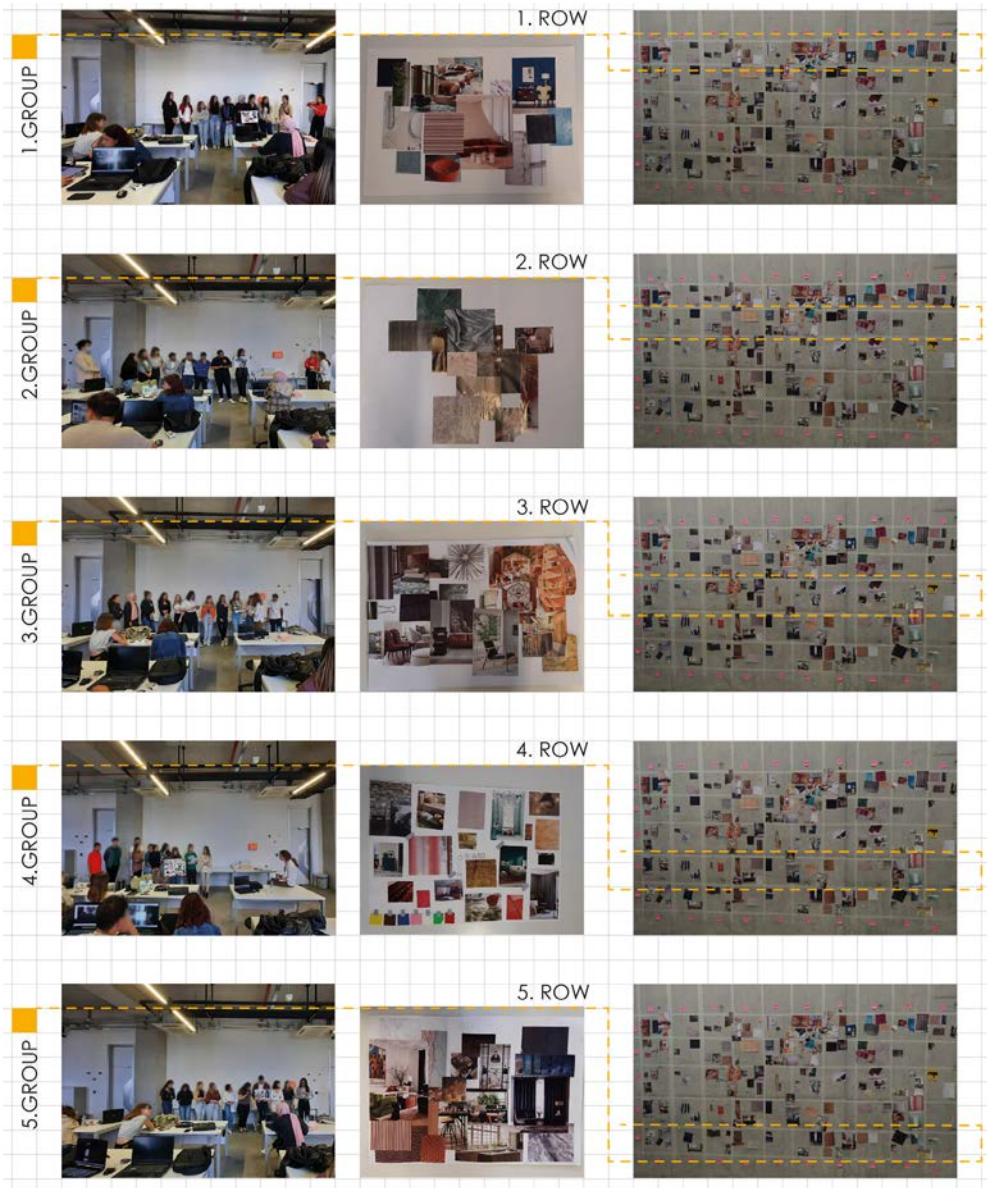

Figure 3. *Presentations and material boards (Prepared by Authors, 2022).*

ship between the given adjectives and the materials they used in their designs. It has helped them rethink the relationship of the materials to come together in terms of appearance. The workshop included in the course content contributed to the efficiency and clarity of the course for the students. When the students were asked their opinions about the application and reproduction of such workshop practices in the material course and in different courses, it was seen that they were willing. The answers to the 8 questions asked show that the workshop resulted in supportive and positive responses. When these 8 questions are evaluated by percentage, the results in Figure 4 emerge.

The ninth question in Table 3 was arranged to be open-ended. The question, which was based on getting help from the participants about the content of the study and how it could be improved, was also analyzed.

The ninth open-ended question of the research is as follows:

"Do you have any application suggestions that you think could be more effective within the scope of this course?"

The Participant 9 expressed his thoughts on questions as follows:

"To use more materials, to explain the difficulties and easiness of the example materials, and to give plenty of detailed trips. To go and look at more experience-oriented workspaces - ateliers specialized by materials."

Table 2. *Second phase of workshop (Prepared by Authors, 2022).*

	WORKSHOP: PATCH-MERGER		
	Stage	**Content**	**Time**
Second Phase of Workhop	**1**	Principles of material boards created by rows: -The images in the created material board will be evaluated with the adjectives (and degrees) in the columns they correspond to. -The concept/atmosphere of the material board created with the help of adjectives will be determined. -The materials(images) will be placed on the 35x50cm white drawing paper. -Cutting can be done on images according to the atmosphere and composition to be created.	1 hour
	2	Presentation	1 hour 15 min
			2 hour 15 min

Table 3. *Survey questions' result (Prepared by Authors, 2022).*

	WORKSHOP: PATCH-MERGER Survey Questions	Number of yes/no responses received from 43 respondents to the survey
Q1	Was the workshop memorable about the creation of the material board?	42/1
Q2	Did the workshop create awareness about examining materials and atmosphere while looking at various interior design visuals?	42/1
Q3	When looking at a new material, did the adjectives used in this workshop help you describe the material? (Hot - Cold / Heavy - Light / Moving - Stable / Soft - Hard / Controlled - Distracted / Artificial - Natural / Bright - Matte / Permeable - Opaque / Resistant - Fragile / Rough - Smooth)	41/2
Q4	Did this study help you establish the relationship between material and atmosphere?	41/2
Q5	Did this study help you perceive the visual combination of materials with different qualities?	41/2
Q6	Do you think this study contributed to the efficiency and clarity of the course?	41/2
Q7	Would you like such methods to be reproduced and applied in accordance with various course contents?	41/2
Q8	Did this study help you to prepare a material board for your project in the Interior Architectural Studio?	42/1
Q9	Do you have any application suggestions that you think could be more effective within the scope of this course? Can you share with us?	13 people out of 43 people made suggestions.

Similarly, Participant 21 and Participant 35 expressed their opinions as "Excursions can be organized" and "More workshop trips can increase the reinforcement of the course", respectively, by suggesting organizing trips to reinforce course knowledge in addition to the practice. Participant 41 expressed his suggestion for organizing trips in which the material-atmosphere relationship can be discussed, as "I strongly want space-atmosphere trips to be organized for this subject". Among the 13 suggestions received from the participants, the most emphasized subject was the trips.

Participant 22 suggested increasing the physical contact with the material and expressed his opinion as "It may be possible to get to know the materials more physically". With a similar view, Participant 28 suggested that "Making direct contact with the material by being in one-to-one application areas will support the acquisition of knowledge". Among the suggestions received from

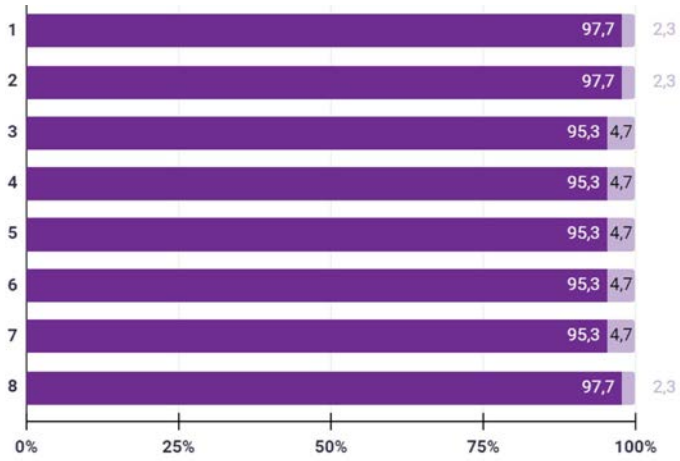

Figure 4. *Answers of Survey.*

the participants, the second most emphasized element was physical contact with the material.

Participant 38 suggested discussing the material comparatively and said, "Recognition of the material and its usage areas can be investigated further. For example, whether marble or porcelain is better on the kitchen counter, the advantages and disadvantages of the material use can be discussed". Participant 43 suggests reading the materials through the space-atmosphere relationship, in her opinion, which she expressed as "To examine the material through more space examples". The third issue emphasized by the participants was seeing and discussing the material in the interior space.

In the content analysis made on the answers given to the ninth question, it was seen that the suggestions given by the participants were gathered under the categories of trips, contact with the material/ direct relationship, and discussion / examination (Table 4).

At this point, the most emphasized elements are excursions (trips) , physical contact with the material, examining and discussing the material-atmosphere relationship over the product and interior space. When the suggestions from the participants are examined, it is marked that all the elements are gathered on the demand of physically encountering the material at one point. The workshop was organized on the basis of material / product images, considering the access to the physical example of material. This finding was noted as a suggestion to be evaluated within the scope of future studies. Upon the answers, it is seen that the workshop is successful in the subject of memorability, which it aims to bring to the student within the scope of the Construction and Materials course.

4. Conclusion

The workshop was designed to increase students' awareness of the relationship between material, product and atmosphere, to improve their visual

Table 4. *Participant opinions.*

Categories	Participant Opinions
Trip	**Participant 9:** *"To use more materials, to explain the difficulties and easiness of the example materials, and to give plenty of detailed trips. To go and look at more experience-oriented workspaces - ateliers specialized by materials. "* **Participant 21:** "*Excursions can be organized*" **Participant 35:** "*More workshop trips can increase the reinforcement of the course*" **Participant 41:** *"I strongly want space-atmosphere trips to be organized for this subject"* **Participant 29:** *''Trip''*
Contact with the material/ direct relationship	**Participant 22:** *"It may be possible to get to know the materials more physically"* **Participant 28:** *"Making direct contact with the material by being in one-to-one application areas will support the acquisition of knowledge"*
Discussion / examination	**Participant 38:** *"Recognition of the material and its usage areas can be investigated further. For example, whether marble or porcelain is better on the kitchen counter, the advantage and disadvantage of the material used can be discussed"* **Participant 43:** "*To examine the material through more space examples*" **Participant 19:** *"More detailed information can given about materials"*

reading skills and to support their ability to make quick decisions in the design process. The findings obtained from the questionnaire and open-ended question analyses reveal that the workshop enables students to reinforce theoretical knowledge with practical experience.

The survey results show that the students received positive feedback from the workshop process and that their understanding of the material-atmosphere relationship was strengthened. It was observed that the students were able to more consciously define the relationship between the materials and the space they used while preparing the material board and were able to make aesthetic and functional evaluations during the material selection process. In addition, the integration of the workshop into the course content increased the efficiency of the course and strengthened the interaction of the students with the course.

The findings from the qualitative data show that students offered important suggestions for improving the content of the workshop. In particular, the participants requested direct physical contact with the materials, the organization of hands-on field trips and the discussion of the material-atmosphere relationship through spatial examples. These demands, when evaluated in line with Kolb's (1984) experiential learning theory, once again reveal that concrete experiences play an important role in the learning process. Moreover, in line with Schön's (1983) "thinking in practice" approach, students' production of knowledge through direct observation and practice contributes to the achievement of permanent learning goals of design education.

The workshop also functioned as an important communication and development tool in the student-lecturer-course triangle. For the students, skills such as questioning the rela-

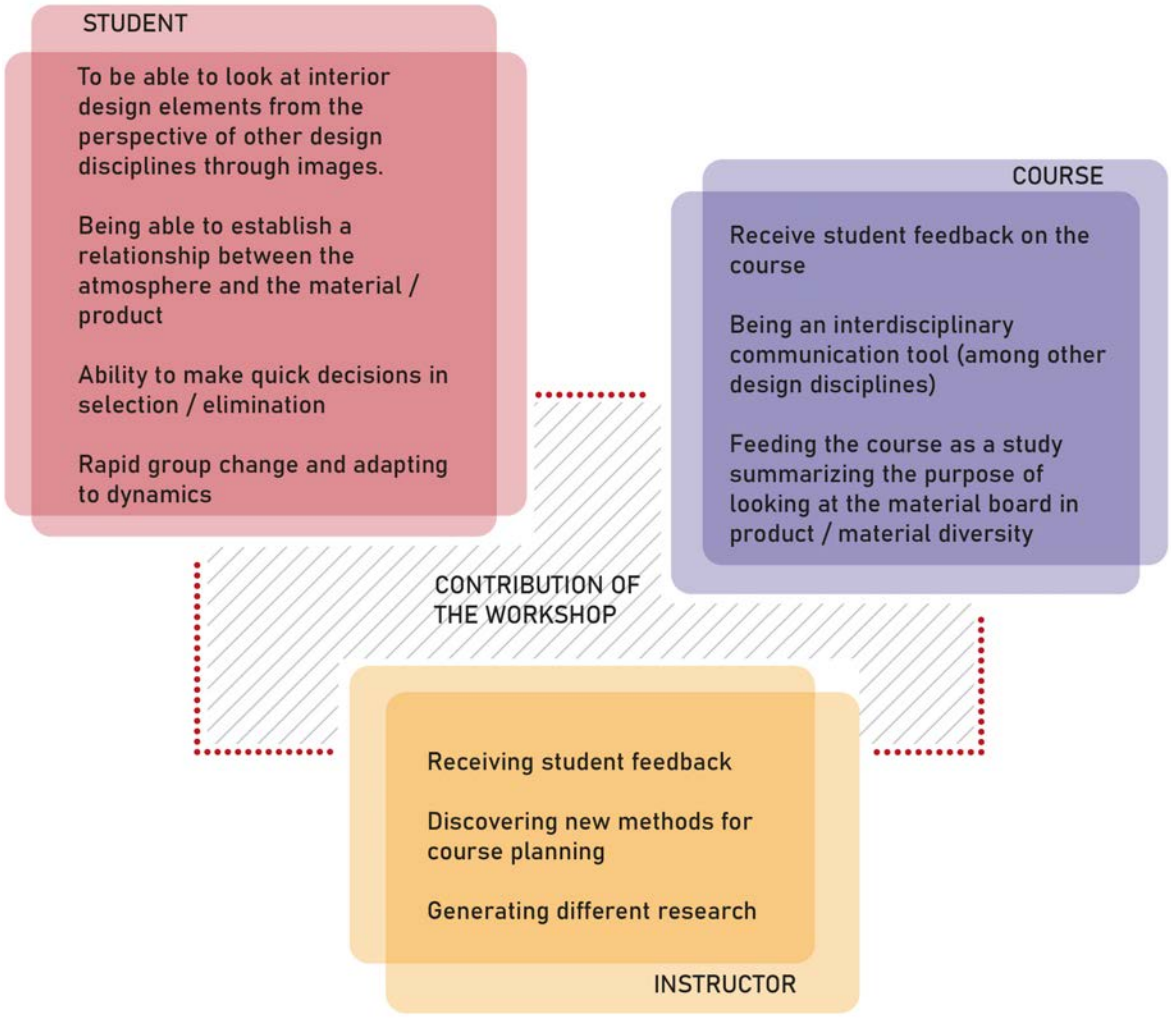

Figure 5. *Contribution of workshop to design education.*

tionship between materials and atmosphere, adapting to group dynamics and making quick decisions were supported, while for the instructor, it was an opportunity to develop new methods in course planning and generate different research topics in line with student feedback. In terms of course content, the variety and quality of the material boards prepared by the students provided important data for the evaluation of the learning outcomes of the course (Figure 5).

The observations and inferences made during the implementation of the study also reveal some areas for improvement in the workshop process. It was observed that students concentrated on certain adjective pairs, were not selective enough in the selection of visual materials and lacked oral expression skills. This situation points to the need to provide diversified vocabulary pools, to conduct sample studies on the selection of visual materials, and to add content that supports oral presentation skills during the workshop.

The hypotheses stated at the beginning of the study are discussed in Table 5. Accordingly, it is seen that H1, H2 and H4 are supported and H3 is partially supported due to the fact that although the students developed more definitions about material selection, deficiencies were found in visual material selection and verbal presentation skills.

As a result, the workshop realized within the scope of this study stands out as an effective tool for students to develop a holistic view of material knowledge, atmosphere perception and design process. It was emphasized by the students that the workshop should be enriched with more applica-

Table 5. *Hypothesis evaluation.*

	HYPOTHESIS	RESULT	SUPPORT STATUS	EXPLANATION
H1	Interactive workshops within the Construction and Materials course will positively impact students' ability to connect materials with the atmosphere of interior spaces.	Students have improved their understanding of the material-atmosphere relationship.	**SUPPORTED**	Survey results show that students have increased their awareness of the material-atmosphere relationship and are using materials more consciously in their designs.
H2	Student engagement in creative activities as part of the course will enhance the clarity and efficiency of learning, improving overall course comprehension.	The workshop has improved the efficiency of the course and the clarity of the learning process for students.	**SUPPORTED**	Students reported that the workshop strengthened their interaction with the course content and made their learning process more effective.
H3	Students involved in interactive workshops demonstrate greater self-efficacy in selecting and applying construction materials in their design projects.	Students have shown a more conscious approach to material selection, but there are still areas requiring development.	**PARTIALLY SUPPORTED**	Students have developed more definitions related to material selection, but deficiencies were observed in visual material selection and verbal presentation skills.
H4	The integration of material lessons with design studios through interactive methods will foster stronger connections, leading to more effective learning outcomes in interior architecture students.	The workshop has enriched students' learning experiences when integrated with the course content.	**SUPPORTED**	Students stated that the integration of the workshop into the course positively impacted their learning experience and strengthened their engagement with the course.

tions and field experiences in order to develop an educational model in which both theoretical and practical methods are used. In addition, diversifying and increasing the number of this workshop model by integrating it into different courses during the semester will create a sustainable development area in design education.

In future studies, in addition to applied studies that provide direct physical contact with the material, pre- and post-workshop measurements of the level of knowledge can be conducted, enabling a more detailed analysis of learning gains in quantitative and qualitative dimensions. Longitudinal studies can also be used to evaluate the sustainability of the impact of the workshop practices by monitoring how students' material use practices evolve during the design process. The workshop model developed in this study is considered to offer an important approach that supports experiential and multidimensional learning in the field of design education. However, testing and developing the model in different contexts will further deepen its contribution to learning processes.

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Sustainable management and climate adaptation in historic sites: Insights from Side Ancient City

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Abstract
Climate change presents an increasing threat to cultural heritage, causing direct physical damage and accelerated material deterioration. This study focuses on the Side Ancient City in Antalya, a culturally and archeologically significant site vulnerable to climate-induced risks. As a popular tourist destination, Side faces a complex blend of environmental, social, and economic challenges, requiring a nuanced understanding of climate impacts. The study aims to identify the risks posed by climate change in Side and to develop strategies for protection and adaptation. Using a qualitative research approach, the study combined a literature review and field analysis to assess the site's vulnerabilities. In the field analysis, historical structures and archaeological sites on the Side were observed within the scope of the impacts of climate change, and the necessary data were collected. Then, a SWOT analysis evaluated the Side's current condition and resilience against climate change. In the subsequent step, the adaptation strategies were formulated and a Matrix was developed to illustrate the connections between climate impacts, SWOT components, and the corresponding adaptation strategies. Based on these findings, the study proposed various adaptation strategies, including physical interventions, regulatory policies for development and tourism, and community-driven approaches for sustainable heritage management. These recommendations aim to protect Side's cultural heritage from ongoing and future climate-related threats and contribute to broader discussions on adapting historic sites to climate change.

Keywords
Adaptation, Climate change, Historic site, Side Ancient City.

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1. Introduction

Anthropogenic activities, primarily through the emission of greenhouse gases, have indisputably led to global warming, with the global surface temperature rising by 1.1°C above the 1850-1900 levels during the period 2011-2020. The increase in global greenhouse gas emissions has persisted, characterized by unequal historical and ongoing contributions resulting from unsustainable practices in energy use, land use and land-use changes, and various lifestyles and consumption and production patterns across different regions, between and within nations, and among individuals (IPCC, 2023). Climate change is increasingly recognized as a critical challenge that threatens not only natural ecosystems but also cultural heritage sites worldwide. Over the past 20 years, there has been growing concern about the climate change risks poses to cultural heritage. Various efforts have been made to evaluate its projected impacts on different heritage categories, addressing both outdoor and indoor environments (Bonazza & Sardella, 2023; Sesana et al., 2021). Climate change poses significant threats to historic sites around the world, impacting their preservation and the ability to maintain their cultural and historical significance. Historic sites are integral to our cultural identity and understanding of history, and the impacts of climate change pose a unique challenge to their preservation. Climate change impacts such as extreme weather events, changes in precipitation patterns and temperature, more intense rainfall and prolonged periods of drought, can damage or degrade historic materials (Fatorić & Seekamp, 2017; ICOMOS Climate Change and Heritage Working Group, 2019; Kapsomenakis et al., 2023; B. Prieto et al., 2020; Sabbioni et al., 2010; Sesana et al., 2021).

The Side Ancient City in Antalya, Türkiye, exemplifies a cultural heritage site at risk from climate change. Renowned for its archaeological significance and historical continuity, Side faces threats from natural and human-induced factors. The city's proximity to the Mediterranean coast makes it particularly susceptible to rising sea levels and coastal erosion, while increased temperatures and humidity pose additional risks to its ancient structures and artifacts. Additionally, tourism and urban development intensify these environmental challenges, necessitating comprehensive management strategies. This study investigates the specific impacts of climate change on Side and proposes adaptive strategies tailored to its circumstances. Employing a qualitative approach that includes a literature review and field analysis, the research explores global adaptation strategies to protect cultural heritage. Field-based research investigates climate risks on the Side and a SWOT analysis assesses the site's conditions, identifying challenges and opportunities for resilience. In the next step, adaptation strategies were identified and a matrix was developed that shows how climate impacts are linked to the SWOT components and subsequently to the adaptation strategies identified. Figure 1 shows the study framework.

The findings underscore the importance of integrating climate adaptation into heritage management to preserve Side's cultural assets for future generations.

2. Climate change impacts on historic sites

Climate change has emerged as a critical issue with significant environmental and social repercussions, leading to an unprecedented rise in mean surface air temperatures over the past 50 years. This phenomenon impacts all facets of human and natural systems, including World Heritage sites. Ensuring the protection and sustainable management of these invaluable sites should be a priority for governments. The effects of climate change on cultural heritage are complex, involving interactions between natural, cultural, and social systems. Historical and archaeological sites are increasingly vulnerable to environmental changes, with climate change exacerbating their degradation through intensified physical, chemical, and biological

processes. Climate change increases the frequency and severity of extreme events like droughts, floods, and landslides, further threatening cultural heritage. Cultural heritage, encompassing historical structures, subsurface archaeological sites, cultural landscapes, and traditional lifestyles, often comprises entities and communities that are particularly susceptible to threats (Fatorić & Seekamp, 2017; A. J. Prieto et al., 2020). In this context, the impacts of climate change on cultural heritage can be categorized and analysed under several critical thematic areas: Sea Level Rise, Flooding and Coastal Erosion (Carbognin et al., 2010; Daly et al., 2022; García Sánchez et al., 2020; Maragno et al., 2023; Marzeion & Levermann, 2014; Reimann et al., 2018), Sea Acidification (Harkin et al., 2020; Willems & Schaik, 2017), Sea-Temperature Change (Harkin et al., 2020; Isaak et al., 2012; Willems & Schaik, 2017), Impacts on Architectural Buildings and Biodeterioration (Bienvenido-Huertas et al., 2021; Dias et al., 2023; Hedayatnia et al., 2021; Pires et al., 2022; B. Prieto et al., 2020; Sabbioni et al., 2010; Silva et al., 2020; Sitzia et al., 2023), Soil Temperature (Asano et al., 2023; Bradford et al., 2019; Jackson et al., 2013; Menberg et al., 2014), Freeze-Thaw Cycle (Grossi et al., 2007; Sesana et al., 2018, 2021; UNESCO, 2007; Vyshkvarkova & Sukhonos, 2023), Salt weathering (Charlo, 2000; Menéndez, 2018; Ruiz-Agudo et al., 2011; Vyshkvarkova & Sukhonos, 2023), Extreme Weather Events (Sesana et al., 2018, 2021; UNESCO, 2007), Impact on Archaeological Sites (Daly, 2011; Heilen et al., 2018; Hollesen, 2022, 2023).

Gradual climate changes, such as shifts in temperature, precipitation, humidity, and wind intensity, contribute to the long-term degradation of cultural heritage materials by accelerating physical, chemical, and biological decay processes. Sudden events like floods, landslides, wildfires, and sea-level rise can cause immediate and severe damage or worsen existing deterioration (Sesana et al., 2021). Key strategies for protecting cultural heritage from climate change include securing adequate financial resources, improving knowledge of climate impacts, and effectively sharing this information. Engaging stakeholders, such as local communities and

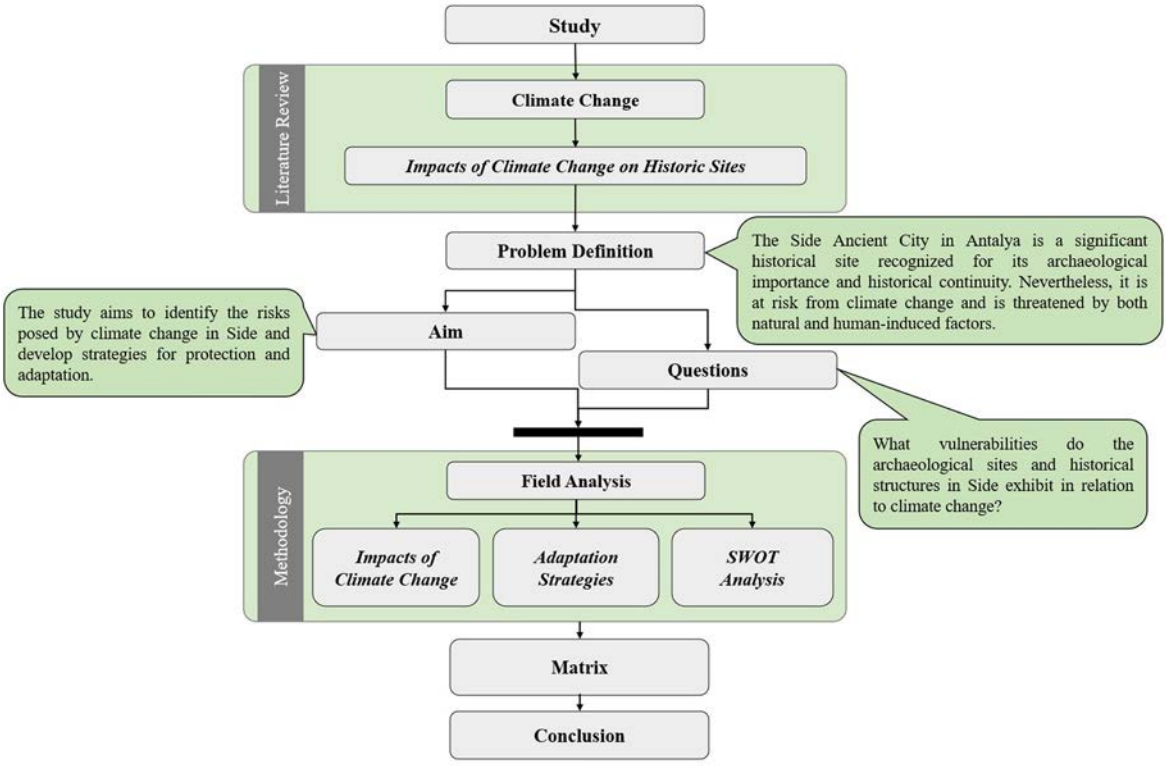

Figure 1. *Study framework.*

decision-makers, is essential, alongside integrating climate change considerations into management plans. Practical measures include building protective infrastructure (e.g., coastal defences), relocating sites when necessary, and avoiding maladaptive practices. Additionally, developing materials compatible with historic environments, enhancing monitoring efforts, and digitally recording heritage for future preservation are recommended. The factors for implementing these adaptation strategies, as detailed in Figure 2, are categorized into six groups (Sesana et al., 2018).

Since the Paris Agreement, UNESCO has aimed to support countries in managing climate change impacts on cultural heritage. Countries should collaborate and share adaptive measures, with more developed nations helping less fortunate ones. Dialogue is needed not only between governments but also among heritage organizations, institutions, site managers, and academics. There is a gap in transferring international knowledge to local levels. Mainstreaming climate change in cultural heritage management requires raising awareness and engaging local communities. Regulations, guidelines, financial incentives, and further research on adaptive measures and risk preparedness are also essential.

3. Method

3.1. Side Ancient City

The Mediterranean basin is a densely populated coastal area experiencing rapid demographic, social, economic, and environmental changes. Between 1960 and 2010, the urban population increased by 20%. Tourism also adds pressure, with Mediterranean countries accounting for about one-third of global tourist arrivals in 2011, a number expected to grow to 637 million annually by 2025 (Wolff et al., 2018). In addition to local human activity, the region faces global environmental challenges, particularly sea-level rise and related hazards, which are anticipated to impact Mediterranean nations throughout the 21st century significantly (Anzidei et al., 2020; Wolff et al., 2018). The Side Ancient City, a significant cultural heritage site featuring monuments from ancient Greek, Roman, and Byzantine civilizations, is the focus of this study, which examines the impacts of climate change, particularly in the Mediterranean basin. This assessment is essential for protecting the city's cultural heritage and formulating strategies for conservation, sustainable tourism, and adaptive management. Additionally, it aids in policy development and contributes to global efforts to safeguard cultural heritage from climate-related risks. Due to its Mediterranean coastal location, Side exemplifies the climatic vulnerabilities common to many classical-period ancient cities, making it an effective case to demonstrate adaptation strategies applicable to similar heritage sites throughout Türkiye and the broader Mediterranean basin.

3.2. Historical and cultural significance of the side

Asia Minor, a peninsular landmass covering approximately 756,103 square kilometres, constitutes a western subcontinent of Asia. Commonly referred to as Anatolia, this region encompasses a significant portion of present-day Türkiye.

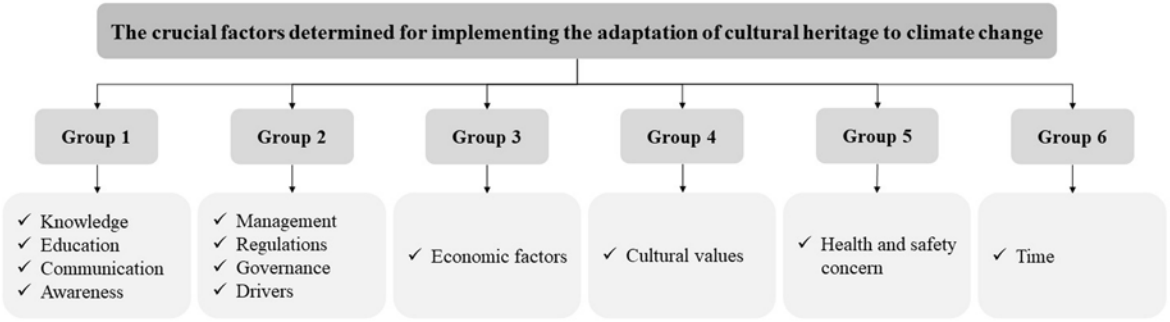

Figure 2. *The key factors for implementing the adaptation of cultural heritage to climate change.*

During the Greek and Roman periods, Asia Minor was home to several prominent Greek cities, particularly within the central western coastal area known as Ionia. The Romans adopted the name "Asia Minor" shortly before the birth of Jesus, while earlier Greeks referred to the region simply as "Asia." Following the decline of Mycenaean society in mainland Greece, the west coast of Asia Minor experienced a steady influx of Greek settlers. By 1000 B.C.E., Greeks of the Ionian ethnic group had established themselves in the region that came to be known as Ionia, with prominent city-states such as Miletus, Samos, Chios, and Ephesus. Greek colonization extended further during the great age of colonization (circa 750–550 B.C.E.), reaching the northern and southern coasts of Asia Minor. In the north, colonies such as Cyzicus on the Sea of Marmara and Sinope along the Black Sea coast were established by Miletus to secure control over trade routes. Key Greek cities on the southern coast included Phaselis, Perge, Aspendus, and Side, strategically positioned from west to east. The Greek settlements flourished due to their strategic positioning along sea and caravan trade routes (Sacks, 2005; p.51). Figure 3 shows the location of the Side settlement in northern Asia Minor.

According to Figure 3, the ancient city of Side, one of Pamphylia's most important port cities, is located in the south of the Asia Minor peninsula. Side is an Eastern Pamphylian city located between the Melas River and the Eurymedon River, closer to the Melas River. When examined etymologically, the name "Side" is found not only in the Pamphylia region but also in different regions such as Pontos, Thessalia, Lakonia, and Lycia. There are also areas in mainland Greece with names similar to Side. The name "Side" means Pomegranate in the local language (Alanyalı & Yurtsever, 2020; p.39). The exact foundation date of Side is not known. However, ancient writers mention that the city of Side was founded by the Cymeans who came from the Aeolia Region (Strabon, 2015; p.251). But, the decorated basalt crater, which was unearthed during excavations at the archaeological site and is thought to date back to the Late Hittite Period, is considered the oldest architectural remains of the

Figure 3. *Location of the Side settlement in northern Asia Minor (Sacks, 2005; p.52).*

city and dates the city's history back to the Late Hittite Period. However, ancient writers suggest a much earlier date for the city's foundation. According to Eusebius, the city of Side was founded in 1405 BC. (Alanyalı & Yurtsever, 2020; p.43). It is known that throughout history, there was no strong migration or colonial movement to Side and that local elements were much stronger in the city (Alanyalı, 2011).

Mansel (2020) notes that Side experienced its first golden age during the Hellenistic period when it had an autonomous structure. The city's second golden age occurred between the 2nd and 3rd centuries AD. (Mansel, 2020).

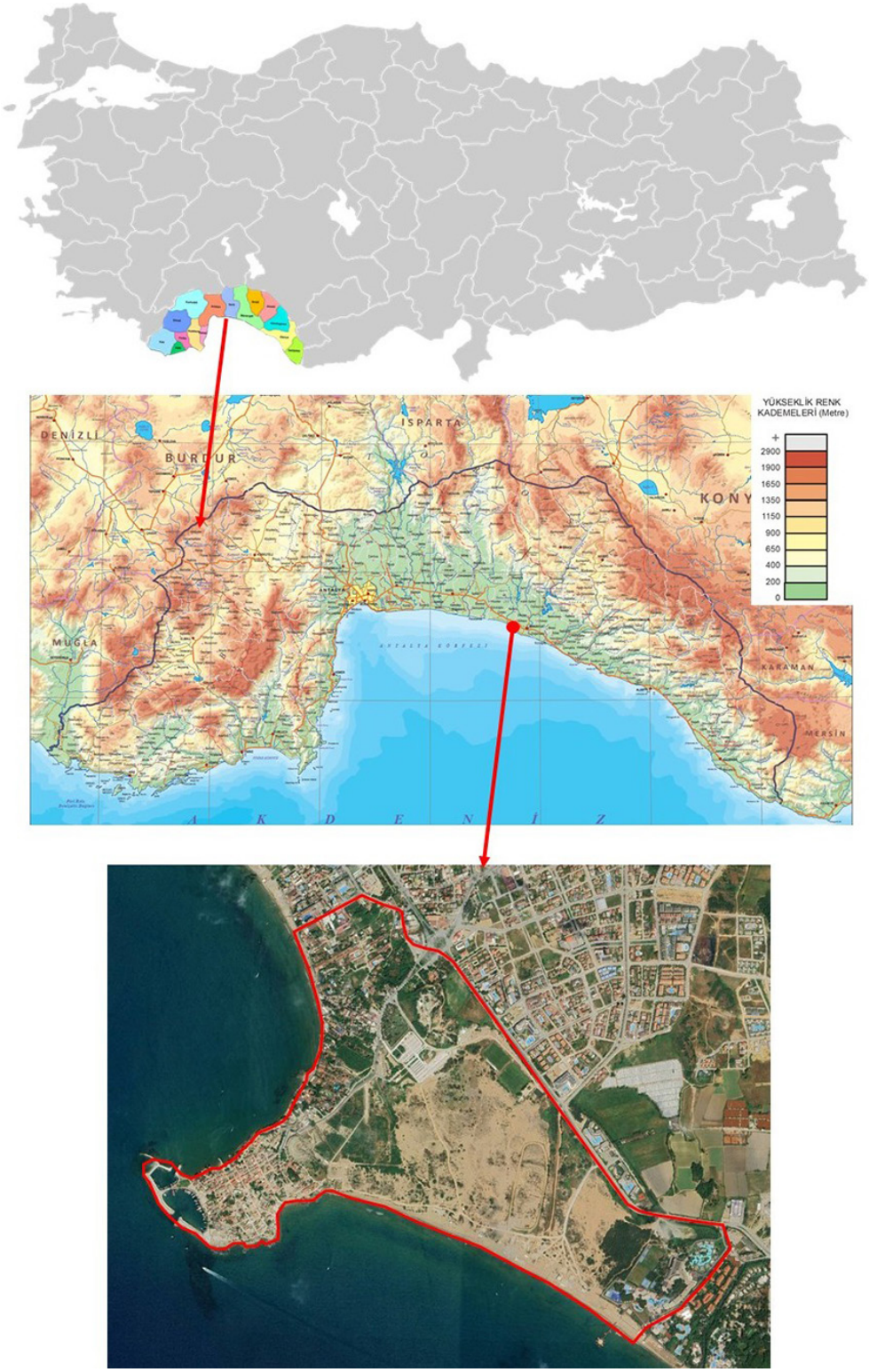

Figure 4. *Location of Side.*

The city's last golden age was during the 5th and 6th centuries AD. During this period, Side became a bishopric canter. It appears that Side was competing with Perge to become the religious canter of the region at that time (Alanyalı & Yurtsever, 2020: p.53; Mansel, 2020). Side gained independence in the late Hellenistic period after Persian and Macedonian rule. It later became a Roman administrative canter and a key naval base. The city flourished during the Early Byzantine period but declined in the 7th century due to Arab invasions (Altun, 2020; Elam, 2020). It was abandoned in the 13th century after the Seljuks took over the region. In the late 19th century, Turkish families from Crete resettled in Side, and the settlement was named Selimiye Village, later reverting to its ancient name (Altun, 2020). Settlement in Side resumed with the location of Cretan immigrants. Once a commercial, religious, and military hub that eventually became abandoned, Side was revived first as a centre for scientific research and then as a tourist destination following archaeologist Arif Müfid Mansel's Side excavations in 1947 (Soykal Alanyalı, 2017). The Pamphylian city of Side has been a focus of scientific research since the 1940s, with significant archaeological work conducted by Mansel from 1947 to 1975. Key monuments include early Christian churches, temples, the Episcopal Palace, colonnaded streets, bath complexes, and fortification walls, indicating Side's prosperity until the Late Antique and early Byzantine periods. Recent findings suggest the bishop's complex included a basilica, baptistry, palace, three Martyria, and other structures, along with a garden area. Ongoing investigations, which began in the last ten years by excavation director Feriştah Alanyalı and her team, aim to explore the architectural history and functions of these structures and examine the potential relationship between the bishop's complex and adjacent areas. The project also prioritizes studying Side's urban integration during the Byzantine periods and conducting comparative analyses with similar episcopal sites in the Balkans, Greece, and Asia Minor (ÖAW, n.d.). The archaeological excavations carried out meticulously by the excavation director and her team set a good example in terms of conservation and also shed light on Side's past with important clues. The efforts in Side are considered valuable for implementing a comprehensive and participatory process in a complex area, serving as a model for other sites in Anatolia. Figure 4 shows the national, regional, and local location of Side.

Figure 5. *Side Ancient City images (Leila Akbarishahabi, 2024).*

Figure 4 illustrates the location and context of the Ancient City of Side through national, regional and local maps, highlighting its location in Antalya, its topographical sea-level coastal settlement and its urban and archaeological layout. Some images from Side Ancient City are shown in Figure 5.

3.3. Urbanization and conservation efforts of the side

When Side's urbanization process is examined, new structures have emerged rapidly in the region in the last 70 years. The most important factor that triggered this situation is tourism. The Figure 6 shows the structures of the ancient city of Side in recent years.

According to Figure 6, black areas represent buildings. The number of buildings increased significantly between 1953 and 2010. Obviously, the negative environmental impacts of this rapid construction are inevitable today. The conservation efforts of the Ancient City of Side began with the "Side and Surroundings Tourism Planning International Project Competition" organized by the Ministry of Tourism and Promotion in 1969. However, over time, the area's natural, historical, and coastal values attracted attention, leading to the city being opened to tourism (Büyüksural & Sağıroğlu Demirci, 2023). Side Ancient City changes resulted in chaotic urban sprawl, further exacerbated by the "Tourism Incentive Law" of the 1980s, which allowed for taller buildings and accelerated the construction of unauthorized concrete structures. These developments severely compromised the archaeological and historical fabric of the city (Çubuk, 2013). Side was registered as a 1st-degree archaeological site in 1990 to protect and ensure the continuity of its cultural heritage. However, as tourism demands grew, the city underwent rapid and unplanned changes and transformations. During this process, delays in conservation decisions resulted in the deterioration of cultural assets and illegal construction related to tourism continued (Büyüksural & Sağıroğlu Demirci, 2023). In the following years, Side's preservation efforts included how to integrate the Ottoman rural architectural heritage with the archaeological sites. After many revisions, the Side Ancient City Conservation Plan was approved in 2014. This project aimed to protect the traditional and ancient fabric together, prevent illegal construction, and involve the public in the preservation process. The project also focused on mapping the ancient city through excavations, protecting both tangible and intangible heritage, and enhancing public spaces (Altun, 2020). The 2014 conservation plan comprises two areas: an urban site + 3rd-degree archaeological sites and 1rd-degree archaeological site. In 2016, the Antalya Regional Board for the Protection of Cultural Assets decided to revise the plan based on detailed analyses such as mass, building height, and materials, prompting Manavgat Municipality to initiate plan implementations through the Ancient Side Urban Design Project. However, the area known as the Western Necropolis and Megalopolitans neighbourhood, initially designated as a 1st-degree archaeological site in the 2014 conservation plan, was updated to a 3rd-degree archaeo-

Figure 6. *Urban development of Side between 1953 and 2010 (Güven Ulusoy, 2014: p.75).*

logical site by decision no. 8268 dated 18.10.2018 from the Antalya Regional Board for the Protection of Cultural Assets. Consequently, in compliance with Law No. 2863, a separate planning process was initiated for this area, and the plan was approved in 2022. Finally, the latest revised version of the conservation plan was approved by the T. C. Ministry of Environment, Urbanization, and Climate Change in 2024. Figure 7 shows the plans of 2014 and 2024.

Figure 7 represents Conservation Plans from 2014 (left) and 2024 (right). There are some key differences between the two plans. The 2024 plan shows an expansion of the conservation areas compared to the 2014 plan in the north-eastern region. This area is marked with grey striped texture and named a "Sensitive Area to Be Strictly Protected". However, in the 2014 plan, the northern part was a 1st degree archaeological site, while in the 2024 plan, this area was changed to a 3rd degree archaeological site and marked with a red striped texture. The area within the pink border in the 2014 plan and the blue border in the 2024 plan is an urban site and the 3rd degree archaeological site.

3.4. Climate change risks on the side

In the field analysis related to the impacts of climate change on cultural heritage, the current status of the site was examined and potential hazards such as air and soil temperature increases, erosion and water rise, structural weaknesses such as material decay, and other related issues that may be caused by climate change were evaluated. Images of the Ancient City of Side in terms of climate change impacts are included in Figure 8.

Upon examining Figure 8, various potential impacts of climate change on Side can be identified. These impacts are evaluated in 4 categories:

a. Physical Impacts on Structures

- Temperature Fluctuations: While the average temperature in Side was 17.1°C in 1979, it has increased to 18.5°C in 2023 (meteoblue, 2023a). Increased temperatures and more frequent heatwaves can cause materials such as stone, wood, and metal to expand and contract. This thermal stress leads to cracking, warping, and the weakening of structural integrity over time.
- Freeze-Thaw Cycles: In Side, temperatures normally range from 8°C to 32°C throughout the year, but in recent years temperatures have been below 4°C and above 37°C (MGM, n.d.). In Side, fluctuating temperatures around the freezing point can cause repeated freeze-thaw cycles, especially in porous materials such as stone. Water seeps into cracks, freezes and expands, leading to gradual deterioration.
- Increased Precipitation and Flooding: Higher rainfall and extreme weather events can lead to flooding, which threatens the founda-

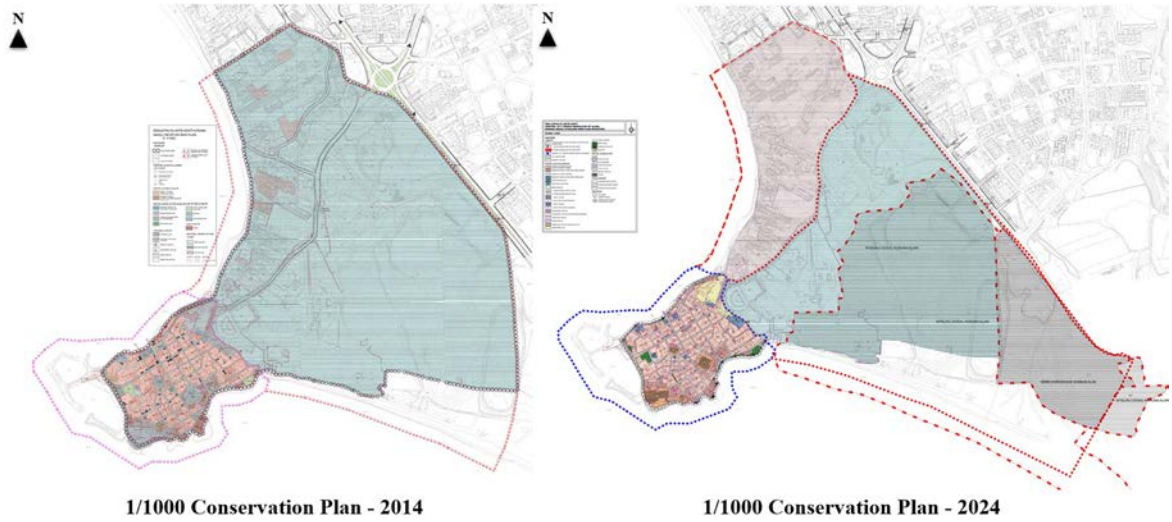

Figure 7. *Conservation Plans of 2014 and 2024.*

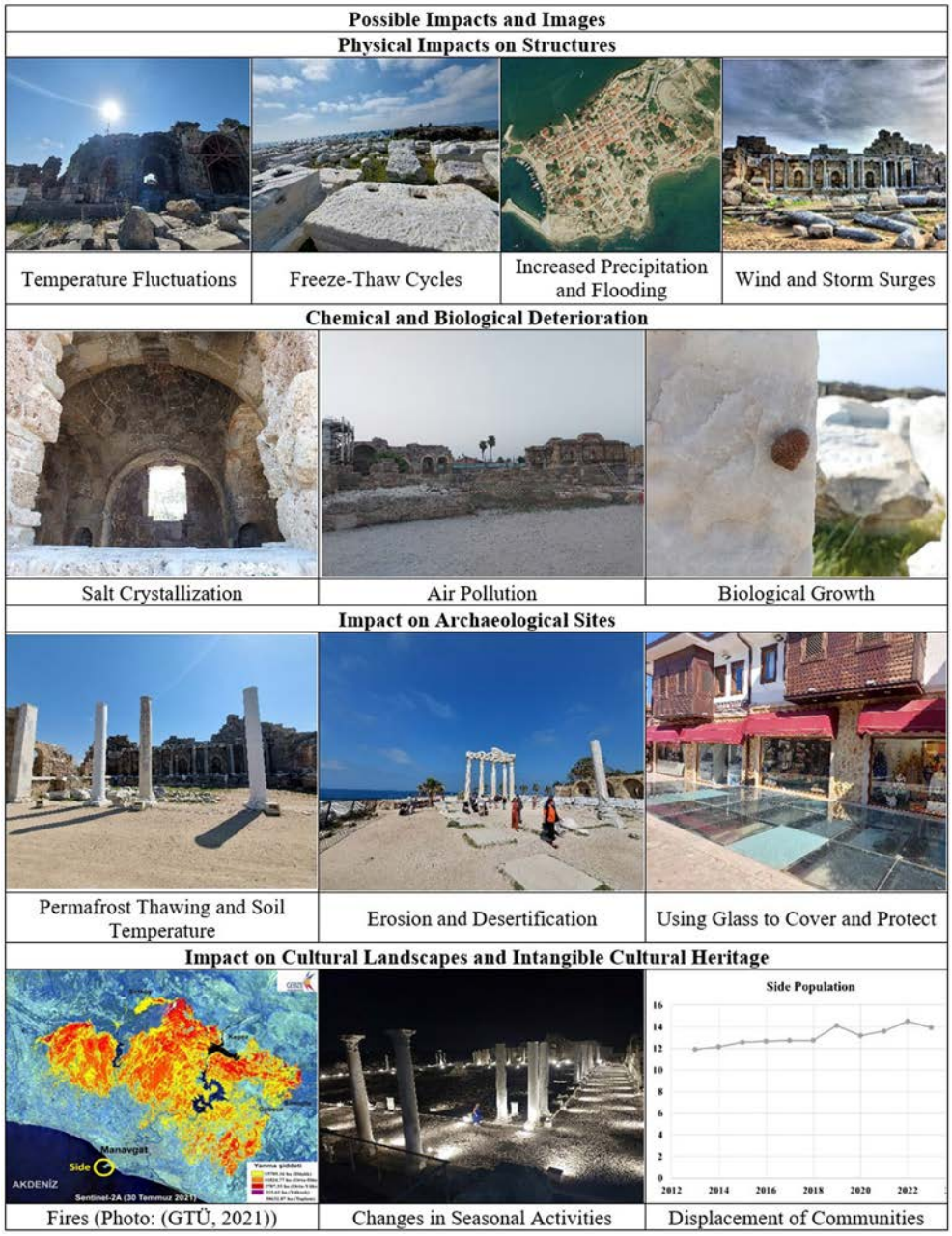

Figure 8. *Possible impacts and images.*

tions of historic structures. Side Ancient City is located almost at the seaside. Water saturation can cause subsidence, erosion, and structural collapse in Side.

- Wind and Storm Surges: While the average wind speed of Türkiye is 1.9 m/s, the wind speed of the Antalya region is 3.36 m/s (MGM, n.d.). In some extreme cases, stronger storms and hurricanes can cause significant physical damage. Coastal erosion due to storm surges can wash away or destabilize sites located near the shoreline.
- Tornados: In the Mediterranean region, which is vulnerable to the impacts of climate change, rising sea surface temperatures enhance atmospheric instability, thereby triggering and intensifying the development of severe storm cells and tornado-producing supercells. It is suggested that ongoing global warming will further increase sea surface temperatures values in the Mediterranean, potentially leading to a greater frequency and intensity of tornadoes in the future (Avolio & Miglietta, 2023; Gianfreda et al., 2005; Miglietta et al., 2017). Elevated sea surface temperatures

amplify atmospheric instability, heightening the likelihood of intense storms and tornadoes in Side.

b. Chemical and Biological Deterioration

- Salt Crystallization: Coastal sites are particularly vulnerable to salt crystallization, which is exacerbated by sea level rise and increased storm surges. In Side, in some historical structures, salt weathering was found on interior and exterior surfaces. Salt can penetrate into the porous materials and, upon crystallization, cause flaking and exfoliation of stone surfaces.
- Air Pollution: Climate change can exacerbate air pollution, particularly in urban areas. According to the 2022 Türkiye Air Pollution Report, the PM10 Annual Average Value (μg/m3) exceeds the WHO Annual Limit Value on 116 days of the year in the Manavgat district of Antalya (TMMOB, 2022). Increased levels of pollutants can accelerate the degradation of structure materials through chemical reactions, such as the formation of sulfuric acid, which corrodes stone and metal.
- Biological Growth: Warmer and wetter conditions favour the growth of biological organisms on structure surfaces. These organisms can cause staining, decay, and structural weakening, especially in organic materials like wood. Some biological organisms have been detected in Side historical structures.

c. Impact on Archaeological Sites

- Permafrost Thawing and Soil Temperature: The thawing of permafrost due to rising temperatures poses a risk to archaeological sites preserved in frozen ground. As the ground thaws, organic materials such as wood, bone, and textiles can rapidly decay upon exposure to air and microorganisms. No scientific research has been conducted on this subject in Side and therefore no data is available in this context. However, as an important archaeological site where excavations are still ongoing, it seems likely that Side will face such a danger. Also, in Side Ancient City, soil temperature can rise up to 30°C (meteoblue, 2023b), this event may damage underground movable cultural heritage.
- Erosion and Desertification: Side has a Mediterranean climate. Summers are hot and dry, and winters are cold and rainy (MGM, n.d.). Increased desertification in arid regions and coastal erosion threaten to bury or wash away archaeological sites. Wind erosion can uncover and then destroy fragile remains, while soil erosion can lead to the loss of stratigraphic integrity, making it difficult to interpret the archaeological record.
- Using Glass to Cover and Protect: Using glass coverings to protect archaeological sites has some drawbacks. The enclosed space can trap heat, creating a greenhouse effect that potentially damages the remains through thermal stress. Moisture accumulation due to condensation can accelerate the decay of organic materials. Exposure to UV light through the glass may further degrade exposed materials.

d. Impact on Cultural Landscapes and Intangible Cultural Heritage

- Fires: In recent years, there have been very devastating fires in the Manavgat district where Side is located (28 July 2021 Manavgat Fire). Increased frequency and intensity of wildfires, driven by higher temperatures and prolonged dry periods, threaten historic sites located in forested areas. Fires can destroy wooden structures, damage stone buildings, and obliterate archaeological evidence. Additionally, fires in the surrounding area cause air pollution in the historic site.
- Changes in Seasonal Activities: Many cultural practices are tied to specific seasons or natural cycles, such as festivals, agricultural practices, and religious observances. Climate change can disrupt these cycles, leading to the loss or alteration of traditional cultural practices.

- Displacement of Communities: Climate change can force the displacement of communities due to rising sea levels, desertification, or other environmental changes. When communities are displaced, intangible cultural heritage, such as traditional knowledge, languages, and customs, is at risk of being lost.

3.5. SWOT analysis of the Side

The SWOT analysis is an effective and suitable approach for developing adaptation strategies to address the impacts of climate change. By examining strengths (existing policies, technologies, and institutional capacities), weaknesses (gaps in resources, knowledge, or infrastructure), opportunities (emerging technologies, funding programs, and collaborations), and threats (climate risks, political instability, or economic challenges), the analysis provides a comprehensive framework for evaluating an organization's or community's climate resilience. This method supports strategic decision-making by identifying key areas for resource allocation and improvement. In the context of this research on Side Ancient City, the SWOT analysis method was selected because it allows for a comprehensive assessment of the city's climate vulnerabilities and resilience capacity by systematically categorizing key factors. The SWOT analysis for Side was performed through a combination of literature review and field investigations. The strengths were identified based on historical, cultural, and archaeological assets and resilience features; weaknesses considered existing vulnerabilities such as infrastructure deficiencies and susceptibility of ancient materials to environmental stressors; opportunities focused on potential resources, partnerships, and educational initiatives; while threats covered climate-induced hazards, urbanization pressures, and socio-economic challenges. The main advantage of SWOT analysis within this research is its comprehensive approach to understanding and addressing climate change impacts on heritage sites. By aligning adaptation strategies explicitly with identified SWOT components, the analysis helps prioritize and target interventions effectively, ensuring robust and adaptive management practices tailored specifically to Side and comparable historical coastal cities.

SWOT (Strengths)

- Historical, Cultural and Archaeological Significance: Side has a rich history involving multiple civilizations, including the Greeks, Lydians, Persians, Romans, Seljuks, and Ottomans. The city hosts a diverse range of ancient structures and artifacts, including Apollo and Athena Temples, Agoras, Ancient Theatre, Great Baths, Vespasian Fountains, and a well-preserved city Great Gate.
- Architectural Features: The Side Antique Theatre, with its Greek architectural style, is valuable in Anatolia due to its construction on a slope and use of vaults to support seating. This makes it an exceptional example of ancient engineering and design.
- Financial Foundation: Side Ancient City's strong financial foundation is driven by its status as a top tourist destination, attracting both government support and foreign investment. Additionally, local investors play a crucial role, contributing to the area's financial resilience and ensuring ongoing preservation and development efforts.
- Strategic Location: Located 80 km east of Antalya and 7 km southwest of Manavgat, Side is easily accessible to tourists visiting Türkiye's Mediterranean coast. Its coastal position also enhances its allure as a destination with both cultural and natural attractions. This situation also supports financial issues.
- Adaptability of Structures: Many of Side's ancient structures, such as stone-built temples, walls, and the theatre, have withstood centuries of weathering and climatic changes, showcasing a degree of resilience. This resilience can be

leveraged to promote Side as a site that has survived various natural challenges, appealing to visitors interested in history and climate studies.
- Existing Research and Knowledge: There is substantial historical and archaeological research on the materials and construction techniques used in Side, which can provide valuable insights into how these structures might withstand ongoing climate changes. This knowledge can inform current and future conservation efforts.
- Archaeological Excavations: In the archaeological site, excavations are carried out meticulously by the excavation director and her team with conservation concerns. This issue is important in terms of protection actions and cultural sustainability.

SWOT (Weaknesses)
- Vulnerability to Natural Disasters: Side has been historically affected by natural disasters, which have led to its decline and abandonment in various periods. The remaining structures are vulnerable to further damage from earthquakes, flooding, and other natural events.
- Maintenance and Preservation Challenges: The ancient structures and ruins require continuous maintenance and preservation efforts. Factors such as weathering, erosion, and potential vandalism pose ongoing challenges to the conservation of the site.
- Exposure to Climate Risks: The city is exposed to several climate-related risks, including increased temperatures, rising sea levels, and extreme weather events such as heavy rainfall and storms.
- Vulnerability of Ancient Materials: The building materials used in Side, such as stone and marble, are vulnerable to environmental changes. Acid rain, increased humidity, and temperature fluctuations can cause physical and chemical deterioration, leading to cracking, erosion, and weakening of the structures.
- Limited Resources for Climate Adaptation: There may be limited financial and technical resources dedicated specifically to adapting and preserving the site in response to climate change. This lack of resources could hamper effective conservation strategies, leaving the site more susceptible to climate-related damage.
- Information on Climate Change: It has been determined that there are no training and information programs, especially for local people, tradesmen, and business owners, about the impacts of climate change caused by human activities.
- Inadequate Modern Infrastructure for Climate Adaptation: The current infrastructure around the ancient city may not be adequately equipped to handle the challenges posed by climate change. For instance, drainage systems may be insufficient to cope with increased rainfall, leading to water accumulation and potential flooding of the ruins. Similarly, there may be a lack of barriers or protective measures to prevent wind and water erosion in vulnerable areas.
- Limited Financial and Human Resources: Managing and maintaining a large, exposed archaeological site like Side requires significant financial investment and specialized skills. There may be insufficient funding dedicated specifically to climate adaptation strategies, and a lack of trained personnel to implement these measures. This financial and skill gap could limit the effectiveness of preservation efforts, especially in the face of escalating climate threats.
- Lack of Tourism Activities Information: There is no more information on the tourist capacity, the regular determination of the number of tourists arriving, and the direct and indirect environmental and financial impacts of tourism on Side.

SWOT (Opportunities)
- Educational and Research Potential: The site provides vast opportunities for archaeological research, studies in ancient history, and educational tours. Collaborations with academic institutions can be fos-

tered to enhance knowledge and preservation techniques.
- Funding and Grants for Climate Resilience: Increasing global awareness of climate change impacts on cultural heritage sites presents opportunities to secure international funding and grants aimed at enhancing climate resilience. Side could benefit from such funding to implement advanced conservation technologies and materials that can withstand changing climate conditions.
- Climate Change Awareness and Education: Side can serve as a case study for the impacts of climate change on cultural heritage, attracting academics, researchers, and tourists interested in climate studies. Educational programs and exhibitions about the effects of climate change on ancient structures could raise awareness and promote sustainable tourism practices.
- Development of Climate-Resilient Tourism: There is potential to develop climate-resilient tourism strategies, such as controlled access during extreme weather, improved drainage systems to manage water flow, and the use of protective shelters or coverings for vulnerable areas. This could mitigate some of the impacts of climate change while still allowing for tourist engagement.
- International Collaboration and Funding: Organizations such as UNESCO, the World Monuments Fund (WMF), and various NGOs are increasingly focused on protecting heritage sites from climate impacts. Side could benefit from these initiatives by applying for grants and participating in international conservation programs that provide both financial resources and technical expertise.
- Development of Protective Infrastructure: Opportunities exist for investing in protective infrastructure to mitigate climate change impacts. This includes installing modern drainage systems to manage increased rainfall, building sea walls or natural barriers to counter rising sea levels, shade Structures and Windbreaks, and implementing climate-adaptive landscaping to prevent soil erosion. Such investments would not only preserve the site but also enhance visitor safety and accessibility.

SWOT (Threats)
- Increased Frequency and Intensity of Extreme Weather Events: Climate change is likely to increase the frequency and intensity of extreme weather events such as heavy rains, floods, and storms.
- Rising Sea Levels and Coastal Erosion: Rising sea levels due to climate change pose a direct threat to Side, particularly its coastal areas. As sea levels rise, the risk of coastal erosion increases, threatening the stability of nearby structures. Flooding could lead to the submersion of lower-lying parts of the city, causing irreversible damage to the ruins and potentially leading to the loss of valuable cultural artifacts.
- Increased Frequency of Extreme Weather Events: Climate change impacts could lead to further physical damage to the ruins through direct impact, flooding, or wind-driven erosion. For example, heavy rains could undermine the foundations of ancient structures, while high winds could cause more rapid erosion of exposed stone surfaces.
- Temperature Fluctuations and Drought: Higher temperatures and prolonged droughts can exacerbate the physical weathering of stone and other materials. Heat stress can cause expansion and contraction in building materials, leading to cracking and structural instability. Additionally, drought conditions can lead to increased soil erosion around foundational structures.
- Urban Development: Expansion of nearby urban areas or tourism-related development could threaten the integrity of the archaeological site, potentially leading to encroachment or loss of the historical context of the surroundings.
- Tourist Pressure: High volumes of tourists can cause physical wear and tear to the ruins. Unregulated tourism and inadequate visitor manage-

ment can lead to deterioration of the structures and the site's natural environment.

- Political and Economic Instability: Political instability or economic downturns in Türkiye could impact funding for the preservation of the site and reduce tourist numbers, which are vital for sustaining conservation efforts.
- Competing Destinations: There are many other ancient cities and heritage sites in Türkiye and around the Mediterranean that compete for tourists' attention. This competition can impact visitor numbers and the overall revenue generated from tourism.
- Conflict Between Economic Interests and Conservation Concerns: Economic interests often took precedence over conservation efforts.
- Year-Round Tourism: While year-round tourism activities have a positive impact on the socio-economic revitalization of the region, this can lead to environmental and cultural degradation of Side and make the region more vulnerable to the impacts of climate change.

4. Adaptation strategies

According to the impacts of climate change on Side and SWOT analysis, adaptation strategies were developed for the protection of Side in this section. Strategies focus on addressing material vulnerabilities with advanced technologies and reinforcing infrastructure. Opportunities from global awareness and new technologies can be utilized for innovative preservation methods, while threats like coastal erosion and wildfires are managed with proactive defences and adaptive design. This approach can integrate adaptation measures into preservation plans to protect

Table 1. *Adaptation strategies.*

Adaptation Strategies		
Implement Coastal Protection Measures	Sea Walls and Natural Barriers	To protect against rising sea levels and storm surges, it is essential to construct or reinforce sea walls. Additionally, implementing natural barriers, such as planting mangroves or building artificial reefs, can help reduce wave energy and minimize coastal erosion near the Apollon Temple and other coastal structures.
	Beach Nourishment	Regularly add sand or sediments to eroding beaches to maintain the shoreline and protect coastal ruins. This method can help mitigate the impacts of rising sea levels and coastal erosion on the city's coastal areas.
Improve Drainage and Water Management Systems	Enhanced Drainage Infrastructure	Install modern drainage systems throughout the site to manage increased rainfall and reduce flooding risks. These systems should include permeable surfaces, underground drainage channels, and retention basins to control water flow and prevent waterlogging around the ruins.
	Rainwater Harvesting and Management	Develop rainwater harvesting systems to capture and store rainwater, reducing runoff and providing a water source for landscape irrigation, especially during droughts. This would also prevent water from pooling around the ancient structures, reducing erosion and water damage.
Structural Reinforcement and Restoration	Use of Climate-Resilient Materials	In restoration projects, it is advisable to use modern materials that replicate the appearance of ancient stones while offering enhanced resistance to weathering and climate impacts. This approach may involve employing breathable, water-resistant mortars and stone consolidants designed to protect against moisture infiltration and freeze-thaw cycles.
	Regular Maintenance and Monitoring	Establish a comprehensive monitoring program to regularly assess the condition of the ruins and detect early signs of damage due to climate impacts. Implement preventive maintenance, such as sealing cracks and reinforcing weakened structures, to prevent further deterioration.
Protective Shelters and Coverings	Temporary or Permanent Shelters	Erect temporary or permanent protective shelters over particularly vulnerable ruins, such as the Temple of Apollon and other coastal structures. These shelters can help protect against direct rainfall, wind erosion, and intense sunlight, reducing the weathering process.
	Shade Structures and Windbreaks	Install shade structures or plant strategic vegetation to protect against extreme heat and wind. Vegetation can act as a natural windbreak, reducing wind speed and soil erosion, while shade structures can help prevent direct sun damage to delicate surfaces.
Enhanced Climate Monitoring and Early Warning Systems	Climate and Environmental Sensors	Deploy sensors around the site to monitor temperature, humidity, rainfall, and sea level changes in real-time. This data can help predict and prepare for extreme weather events, enabling timely protective measures, such as temporary closures or additional reinforcements.
	Early Warning Systems	Develop and implement early warning systems for extreme weather events such as storms or heatwaves. These systems can help manage visitor safety, allowing for timely evacuations or closures when necessary.
Landscape Management and Erosion Control	Erosion Control Techniques	Use erosion control measures such as terracing, planting native vegetation with deep root systems, and installing geotextiles to stabilize soil around archaeological features. This will help reduce the risk of soil erosion caused by heavy rainfall and wind.
	Sustainable Landscaping	Implement sustainable landscaping practices, including the use of drought-resistant plants and xeriscaping around the site. This can reduce water usage, prevent soil erosion, and enhance the natural protection of ruins.
Collaborations	National	During the strategy and policy-making process, securing support from state and local investors, fostering collaboration among various stakeholders, and implementing a public participatory process are essential components.
	International	Collaboration with organizations such as UNESCO, the World Monuments Fund (WMF), and various non-governmental organizations, along with participation in international conservation programs, could significantly benefit Side in this context.

Side's heritage from climate change impacts. Table 1 presents the strategies developed to protect the Side Ancient City against climate change impacts.

The adaptation strategies outlined for Side Ancient City provide a comprehensive framework for addressing the challenges posed by climate change while preserving its cultural heritage. The focus on coastal protection measures, such as constructing sea walls and implementing natural barriers, aims to mitigate the impacts of rising sea levels and storm surges, particularly around vulnerable structures like the Temple of Apollon. Beach nourishment is also highlighted as a critical approach to maintaining the shoreline, thus safeguarding archaeological sites from erosion. The strategies further emphasize the need to enhance drainage and water management systems. Installing modern drainage infrastructure and developing rainwater harvesting systems are essential for managing increased rainfall and reducing flooding risks. These measures not only protect the ruins but also improve the overall resilience of the site to climate impacts. Structural reinforcement through the use of climate-resilient materials is vital for restoration efforts. By employing modern materials that mimic ancient stones while providing better resistance to weathering, the integrity of historic structures can be preserved. Additionally, establishing a comprehensive monitoring program will allow for the early detection of damage, ensuring timely interventions to prevent further deterioration. The implementation of protective shelters and shade structures will help shield particularly vulnerable ruins from direct exposure to harsh weather conditions, thereby reducing weathering effects. Enhanced climate monitoring and early warning systems are also crucial; deploying environmental sensors will provide real-time data to inform protective measures during extreme weather events. Landscape management strategies, including erosion control techniques and sustainable landscaping practices, will further support the site's resilience. These practices not only mitigate soil erosion but also promote the growth of native vegetation that can protect archaeological features. Finally, fostering national and international collaborations is essential for the successful implementation of these strategies. Engaging local investors, state agencies, and global organizations like UNESCO and the World Monuments Fund will ensure a comprehensive, multifaceted approach to conserving Side Ancient City, enhancing its ability to withstand the impacts of climate change while preserving its invaluable cultural heritage for future generations.

5. Results

This section presents a matrix that systematically illustrates the connections between climate impacts, SWOT components, and the corresponding adaptation strategies identified (Table 2).

Table 2. *Matrix related to connections between climate impacts, SWOT components, and adaptation strategies.*

Climate Change Impacts	Strengths	Weaknesses	Opportunities	Threats	Adaptation Strategies	National and International Collaborations
Rising Sea Levels & Coastal Erosion	Coastal appeal for tourism and cultural significance	Vulnerable to coastal erosion and sea level rise	Increased national and internationa funding for resilience	Loss of coastal structures and artifacts	Construct sea walls, natural barriers, and implement beach nourishment	**National**: Partner with Turkish Ministry of Culture and Tourism; **International**: Collaborate with UNESCO and World Monuments Fund (WMF) for funding and technical support
Temperature Fluctuations	Resilience of some historic materials	Vulnerable materials (e.g., stone) to thermal stress	Develop climate-resistant materials with historic appearance	Cracking, warping, and structural weakening due to expansion	Use climate-resilient materials, add shading structures, and install vegetation	**National**: Collaborate with universities for material innovation; **International**: Partner with International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM) for best practices
Increased Precipitation and Flooding	Traditional water management knowledge	Inadequate modern drainage and water management systems	Opportunity to integrate sustainable water management	Foundation damage from waterlogging and soil saturation	Improve drainage systems, establish rainwater harvesting, and utilize permeable surfaces	**National**: Partner with local municipalities and agencies; **International**: Engage with the International Hydrology Program (UNESCO-IHP) for sustainable water management practices
Extreme Weather Events (Storms, Hurricanes)	Established resilience to past natural events	High exposure to storms due to coastal location	Leverage global climate awareness and funding	Potential destruction from high winds and storm	Erect windbreaks, strengthen structures, and develop early warning systems	**National**: Work with Turkish Disaster and Emergency Management Authority (AFAD); **International**: Seek support from UNESCO's World Heritage Risk Management Program
Air Pollution	Strong local and international awareness	Material degradation accelerated by pollution	Public-private partnerships for protective measures	Corrosion of stone, metal, and organic materials	Install air quality sensors, apply protective coatings, and establish clean air zones	**National**: Collaborate with Turkish Ministry of Environment, Urbanization and Climate Change; **International**: Partner with global air quality networks and ICCROM for protective technologies
Freeze-Thaw Cycles	Unique architectural techniques provide some resilience	Freeze-thaw damage to porous materials like stone	Research and funding opportunities for climate-resilient tech	Accelerated weathering and cracking of structures	Use breathable, water-resistant mortars, and conduct seasonal monitoring	**National**: Engage with preservation bodies for traditional techniques; **International**: Join European Union climate-resilient heritage research initiatives
Salt Crystallization	Presence of robust local materials that resist salt decay	Vulnerable to salt crystallization near coastal areas	Global awareness on protecting heritage from salt impacts	Flaking and exfoliation of stone and plaster surfaces	Apply salt-resistant treatments, create buffer zones, and monitor salinity levels	**National**: Collaborate with local preservation experts; **International**: Partner with heritage conservation councils such as Europa Nostra
Erosion and Desertification	Adaptive landscape with some natural windbreaks	Increased risk of desertification from regional climate	Opportunities for sustainable land and erosion management	Loss of soil stability around archaeological features	Implement erosion control techniques, use geotextiles, and plant deep-rooted vegetation	**National**: Partner with Turkey's General Directorate of Forestry; **International**: Participate in global erosion control programs through FAO, UNDP and UNEP
Biological Growth due to Humidity	Native vegetation can aid in natural humidity management	Biological growth on structures leading to material decay	Funding for biological research in preservation	Staining, decay, and weakening of structures from moss, algae	Regular cleaning protocols, use biocidal treatments, and control humidity through landscaping	**National**: Collaborate with Turkish botanical research centers; **International**: Partner with ICOMOS for international bio-conservation projects
Soil Temperature Increases	-	Risk of damage to subsurface archaeological features	Study soil-temperature effects on buried artifacts	Increased decay rates for organic materials in soil	Install soil temperature sensors, conduct controlled excavations, and adjust conservation techniques	**National**: Work with archaeological research institutes in Türkiye; **International**: Consult with UNESCO and ICCROM on best preservation practices
Fire Risks (Wildfires)	Cultural significance may attract fire management support	Close proximity to high-risk wildfire zones	Increased funding and collaboration for fire prevention	Potential destruction of wooden or organic structures	Create firebreaks, use fire-resistant materials, and establish monitoring and early warning systems	**National**: Collaborate with Turkish Forestry Directorate for fire prevention; **International**: Seek support from UNESCO and ICOMOS for heritage-focused fire management strategies
Impact on Cultural and Intangible Heritage	Strong tradition of community and cultural practices	Climate change altering cultural practices and landscapes	Raise awareness of intangible heritage risks	Loss of traditional practices and intangible heritage	Develop adaptive programs for seasonal practices, and document intangible heritage through digital archives	**National**: Partner with Ministry of Culture and Tourism for documentation; **International**: Work with UNESCO's Intangible Cultural Heritage section for global support and guidance

The matrix presents a comprehensive approach to addressing climate change impacts on Side Ancient City, integrating strengths, weaknesses, opportunities, and threats into targeted adaptation strategies with relevant national and international collaborations. For each impact, the matrix aligns Side's strengths (such as established resilience in materials and historical appeal) with its vulnerabilities, such as the risk of erosion, flooding, or salt crystallization. Adaptation strategies are tailored to address these weaknesses while utilizing local knowledge and landscape features, such as using traditional water management techniques and resilient architectural methods. Collaborative efforts are strategically recommended based on Side's unique SWOT analysis, leveraging national partnerships (e.g., Türkiye Ministry of Culture and Tourism, universities, environmental agencies) to support local expertise, infrastructure, and resource mobilization. International partnerships (e.g., with UNESCO, ICCROM, ICOMOS, and World Monuments Fund) offer essential funding, technical expertise, and access to global heritage conservation practices. For instance, collaborating with UNESCO's World Heritage Risk Management Program can enhance resilience against extreme weather, while partnerships with ICCROM support material conservation under temperature fluctuations and air pollution conditions. Additionally, global air quality networks and conservation councils like Europa Nostra are engaged to address environmental threats like air pollution and erosion. In summary, this matrix strategically addresses each climate impact with targeted adaptation strategies, supported by relevant collaborations to enhance the resilience of Side Ancient City. The combined use of national and international resources strengthens Side's ability to preserve its cultural heritage against evolving climate threats.

6. Conclusion

Climate change increasingly threatens historic sites and cultural heritage globally, causing significant and growing risks. Side Ancient City faces numerous challenges, particularly from environmental factors like coastal erosion, sea level rise, and extreme weather events, as well as human factors such as urban development and tourism pressures. Effective management and conservation strategies are critical to ensuring that Side's ancient heritage is preserved for future generations. Key factors for successful conservation and adaptation strategies include access to information, technical expertise, leadership, and stakeholder engagement. While the concepts of adaptation, adaptive capacity, and vulnerability are well established, there is still a need for more practical applications to reduce vulnerabilities to climate change. Successful adaptation requires integrating climate change considerations into broader decision-making frameworks and recognizing the role of social, economic, and political forces in shaping local vulnerabilities. The IPCC Sixth Assessment Report highlights that while cultural policies remain limited, integrating culture into policy and planning is crucial for developing sustainable and resilient cities (IPCC, 2022). Safeguarding cultural heritage, including historic buildings and archaeological sites, requires a multidisciplinary approach to address climate change and environmental risks. Heritage managers and non-experts need to understand the vulnerability of these assets. All findings related to cultural heritage vulnerability should be translated into practical guidelines for stakeholders, such as urban planners and conservationists, to prioritize protection efforts and improve the use of climate impact data.

Beyond its contributions to Side Ancient City, this study provides a replicable methodological framework for identifying climate risks and formulating effective adaptation strategies in culturally similar ancient sites across Türkiye and neighbouring regions. By applying the integrated SWOT-based analysis and strategic adaptation matrix proposed here, heritage managers and planners at other classical-period archaeological sites can proactively ad-

dress climate-related vulnerabilities. Thus, this research not only informs local conservation practices but also supports broader regional efforts aimed at safeguarding cultural heritage from the impacts of climate change.

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Acoustic design approach for ensuring low frequency balance in musical instrument study rooms: A case study

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Abstract
In musical instrument study classes, it is important to establish a balance between frequency bands to ensure acoustic comfort. Porous absorbers generally used in the room, air absorption also shorten the reverberation time in the mid and high frequency bands, but the reverberation time in the lower frequency bands is usually longer compared to mid and high frequencies. In order to balance the lower frequency band, the reverberation time values should be reduced; Helmholtz resonator panels may be preferred to increase the absorption at low frequency bands. The room's eigenvalues and eigenfunctions were determined by the aid of a computer software (ANSYS 2023 R1 Modal Acoustic Module) that uses the finite element method. Helmholtz panels suitable for the mode frequencies have been designed and mounted in the high-pressure regions seen in the mode shapes. In order to determine the success dimension of the design, ISO 3382-1 parameters, ISO 18233 room response curves and FEM simulation results obtained as a result of measurements made at 26 measurement points before and after the arrangement were compared. It was found that the use of panels provided optimum reverberation time values in the 125 Hz and 250 Hz octave bands according to the BS EN ISO 23591 standard, and that there was a significant improvement in the 63 Hz octave band. Hence, the distribution of sound in the space was improved according to the results obtained for the 26 measurement points.

Keywords
Architectural acoustic, FEM, Helmholtz resonator, Low frequency, Room response.

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1. Introduction

Music study classes have a very important function as musical instrument study environments. Students who receive conservatory education work in these classes for many years. At the same time, instructors use these classes for many years. Individuals who are trained to specialize in a certain musical instrument from a young age need to establish a good relationship with the musical instrument. If the sound of the instrument that is practiced for long hours a day is disturbed by the acoustics of the room, problems such as rapid fatigue and the disturbing effects of noise after a certain point can be encountered. It is important that the acoustic character of the rooms to be used as musical study environments meet the criteria determined by international standards.

The BS EN ISO 23591:2021 "Acoustic quality criteria for music rehearsal rooms and spaces" standard, which shows the acoustic criteria for music study environments, divides study rooms into four groups according to size and number of people. The study environments, which are divided into four as personal, small, medium and large study classes, were examined in 3 different groups according to music sound levels as low sound, high sound and reinforced sound. As a result of these classifications, the optimum acoustic criteria deemed necessary were determined based on room dimensions, reverberation time and background noise level values. This standard shaped the study environments based on this parameter depending on the sound power levels of musical instruments (British Standards Institution, 2021).

The most frequently used parameter when evaluating the acoustics of music practice environments is the reverberation time (Sinal & Yilmazer, 2018; Tămaş-Gavrea et al., 2019). The desired result is that the reverberation time values are at the optimum values. (Katunský et al., 2016). The perceived reverberation time can vary depending on the sound source (Vechi et al., 2020). Therefore, when measuring reverberation time values, one of the phenomena examined is that the signal used consists of musical sounds (Kendrick et al., 2006, 2008). The sound emission patterns, sound fields and sound power levels of musical instruments can change the reverberation time values (Shabtai et al., 2017). The acoustic properties of music rooms are decisive in the emergence of the sound character of the instruments as it should be.

Determination of room modes in small rectangular rooms can be done with simple calculation methods (Bistafa & Morrissey, 2003; Jian et al., 2022). It is seen that computer software is used because more complex calculations are required in non-rectangular rooms (Bai, 1992; Kelle & Yılmaz Demirkale, 2022). This software using the finite element method are less accessible due to high license fees and hardware requirements (Mehra et al., 2012). FEM is preferred for room acoustic simulations due to its extraordinary potential in accurately modeling irregularly shaped rooms and various acoustic materials (Yoshida et al., 2021). ANSYS APDL software can determine room eigenvalues (natural frequencies) and eigenfunctions (mode shape), sound pressure levels in the lower frequency bands using the finite element method. (Lau et al., 2017).There are differences between the methods used in the geometric acoustic model and the methods used in the wave model. While the scattering coefficients of the surfaces are used in software using the geometric ray tracing method, the scattering surface is provided by 3D modeling of the geometric form in FEM software using the wave-based method (Aretz & Vorländer, 2014).

Since resonance effects such as standing waves that affect the reverberation time and sound timbre are particularly effective in the lower frequency band, it is necessary to intervene with special acoustic tools in this frequency band (Panteghini et al., 2008). These acoustic materials can be bass trap, diaphragmatic absorbers, polycylindrical absorbers, membrane absorbers, Helmholtz panel absorbers. (Everest, 2001). The design of these panels is changeable and important in terms of controlling the absorption effects required in the lower frequency band

(Yang et al., 2024). The positions of the acoustic materials designed for the lower frequency band can change both the modal reverberation times and the reverberation time values of the octave band (Meissner, 2008). Calculations should be made by considering the frequency domains of the acoustic materials to be used in order to regulate the room acoustics. Special acoustic absorbers and diffusers should be used in order to intervene in the lower frequency bands in a controlled manner (Kleiner & Tichy, 2014). Lower frequency band absorbers are absorbers that work based on resonance (Jun et al., 2021). The use of these panels in places such as sound recording studios and music study classes where sound quality is important ensures that the bass ratio is at optimum values (Panteghini et al., 2008). The positions of the resonator panels should be determined in a way that can reduce the effects of room resonances. On walls where room resonances show maximum pressure, more balanced room conditions will be created as a result of positioning panels calculated to affect resonance frequencies (Kanev, 2020). Porous absorbers that will affect medium and high frequencies and will be applied together with low frequency sound absorbing panels should be used in a quantity that will not disrupt the room balance and in positions that will eliminate acoustic defects.

Low-frequency sound waves have more energy and longer wavelengths than high-frequency sound waves. Therefore, it is quite difficult to absorb and attenuate low-frequency sound waves (Tıraş&İlgürel, 2025). Impractical thick applications arise in arrangements made with porous materials. To overcome this problem, resonator absorbers are used as low-frequency sound absorbers (Jun et al., 2021; Lai, 2024). Helmholtz resonator panels can be applied to points where room modes have high pressure, reducing the reverberation time in the low-frequency region (Tıraş&Akdağ, 2024; Inacio et al., 2005). The most common problem in the acoustic design of small rooms that are important in terms of sound design, such as sound recording studios and rehearsal rooms, is the inability to provide the necessary absorption at low frequencies (Tıraş&Akdağ, 2024; Gilford, 1952). In this study, the hypothesis was determined as "Helmholtz resonator panels applied to areas where room modes are pressurized in order to provide optimum reverberation time in music study classes provide improvement in reverberation time for low frequency sounds". In order to test this hypothesis, room acoustic measurements were made in the music study class located in ITU Music Advanced Research Center, optimum conditions were evaluated according to BS EN ISO 23591 standard, room modes and shapes were determined by performing modal acoustic analysis. The required Helmholtz resonator panels were calculated, application points were determined and assembly was carried out. After the arrangement, field measurements were made and the success dimension of the design was determined (Figure 1).

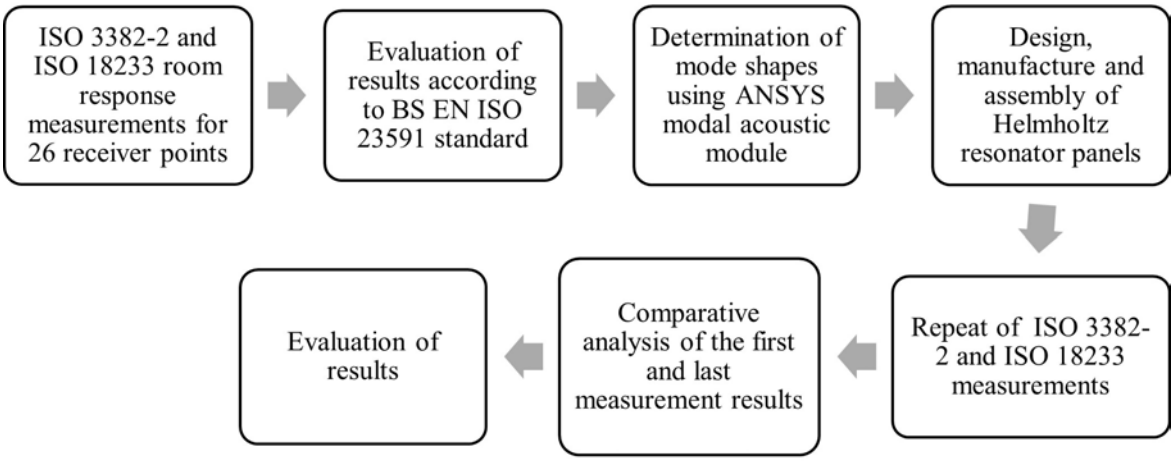

Figure 1. *Steps of the method followed.*

2. Method

In this study, the acoustic design criteria of a fan-shaped room with an area of 30.78 m^2 and a volume of 86.8 m^3 (Figure 2), used as a piano practice classroom at the ITU (Istanbul Technical University) Center for Advanced Music Studies, were determined. In the room where the study was conducted, 26 receivers and 1 source position were determined, ISO 3382-1 "Acoustics — Measurement of room acoustic parameters Part 1: Performance spaces" acoustic parameters were measured and room response measurements were made according to the ISO 18233-SS "Acoustics — Application of new measurement methods in building and room acoustics" standard. The reason for determining 1 corner as the source position is to determine the change of peak responses at each measurement point by reducing the variables. The measurement results taken at 26 points were compared with each other, the averages and standard deviations of T30, EDT, C80 values were found, and the distribution of the sound was examined. The optimum value range of the musical instrument study class was determined according to BS EN ISO 23591 standard and compared with the measurement results (British Standards Institution, 2021) . The Q quality factor and Tmodal values of the peak points from the room response curves were found and analyzed. The room eigenfunctions resulting from the placement of rigid and absorber elements were determined using the ANSYS 2023 R1 Modal Acoustic module. As a result of these analyses, the acoustic materials to be used in the room walls were determined and their manufacturing and assembly were carried out. The initial measurements were repeated and the success of the design was evaluated.

2.1. Evaluation of existing acoustic conditions by measurement

Measurements were carried out in accordance with the ISO 3382-2 "Acoustics — Measurement of room acoustic parameters Part 2: Reverberation time in ordinary rooms" standard to determine the current acoustic conditions of the music instrument study class. 1 source and 26 receiver points were selected (Figure 2), the source position was 150 cm above the floor, and the receiver points were positioned 120 cm above the floor. In the measurements, Bruel-Kjaer 12-sided speaker, Behringer ECM 8000 measurement microphone, microphone tripod, Audio Real Time Analysis (ARTA 1.9.4.1) software, microphone calibrator was used. ISO 3382-1 acoustic parameters T30, EDT and C80 were measured at 26 receiver points in accordance with ISO 18233-SS standard. Sweep signal, which usually gives more accurate results for room response measurements was also used in this study. (Lim et al., 2016; Prato et al., 2016).

Based on the formulas and graphs in the BS EN ISO 23591 standard, the optimum ranges of the optimum reverberation time according to the frequencies were determined and the measurement results were evaluated. As can be seen in Figure 6, which presents the average of the measurement results determined at the receiver points, the T30 values are above the limit values in the 63 Hz, 125 Hz and 250 Hz center octave frequency bands. The EDT values are above the limit values in the 63 Hz and 125 Hz octave bands. Since carpets and curtains are in the class of porous absorbers, they show a very high absorption coefficient at 500 Hz and above compared to the lower frequency region (AFMG Ease 4.4, 2024). The fact that the floor is carpeted and that thin curtains are used in the glass section ensures that the T30 and EDT parameters remain within the limit values at 500 Hz octave band and above.

The change of T30 value according to the receiver points is the greatest in the 63 Hz octave band. The T30 values measured at 26 receiver points having a standard deviation value of 0.39 were the lowest at receiver 20 with 1.35, and the highest at receiver 21 with 2.84. The standard deviation was 0.09 in the 125 Hz octave band. The highest value for 125 Hz was found as 1.28 at receiver 12, and the lowest value as 0.99 at receivers 7 and 21. In the 250 Hz octave band, the standard deviation was 0.07,

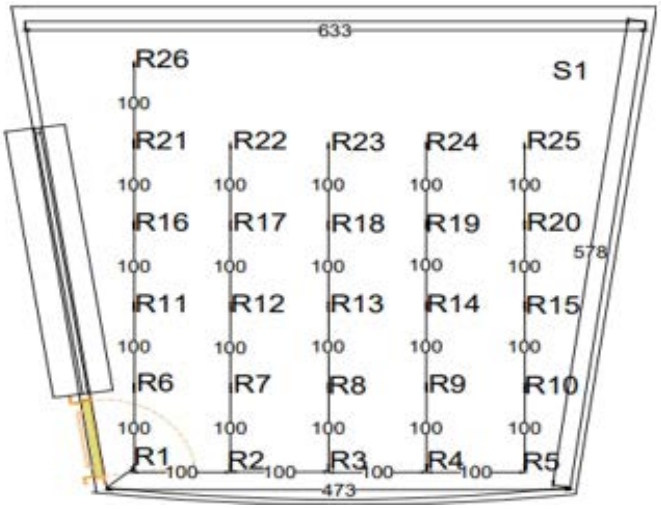

Figure 2. *Measurement layout.*

the lowest value as 0.75 at receivers 13 and 15, and the highest value as 1.03 at receiver 3. The standard deviation values decreased at 500 Hz and above and varied between 0.03 and 0.01. Evaluation of these results show that, in the pre-editing situation, a diffuse sound field of 500 Hz and above was formed in the room.

2.2. Evaluation in terms of room mode distributions

When making acoustic arrangements in small rooms, the determination of room modes becomes important. The effects of room modes are felt more in the lower frequency bands. In the lower frequency bands where the diffuse sound field is not formed, some frequencies can create more effective sensations than others due to the effect of standing waves (Beaton & Xiang, 2017). Since these frequencies are heard more than others, problems called coloration can occur (Bonello, 1981; Louden, 1971). While room modes can be determined with simple calculation tools in rectangular rooms, FEM solutions are needed in more complex geometries. The resonance peaks of some low-frequency room modes below the Schroder frequency are defined as frequency range where room modes are effective.

ANSYS Modal acoustic module was used to determine the modes of the fan-shaped room where the study was conducted. Before the treatment, the wall absorption properties were defined in the program and the eigenvalues and eigenfunctions were determined. At the same time, the room response was determined for 26 separate measurement points according to the ISO18233 SS standard and the peak frequencies were analyzed. As a result of these analyses, the frequencies that peaked at the highest measurement points and the total peak numbers in the 1/3 octave bands were revealed. The simulation results and the measurement results were compared.

The axial room mode shapes and frequencies obtained with the ANSYS Modal Acoustic module using the finite element method are shown in Figure 8. It was determined that room modes created high pressure points at wall-ceiling junctions and corners. It was observed that tangential and oblique modes also created high pressure in these areas.

The room mode frequencies below the Schroder frequency and the difference values between them are shown in Table 1. The 3 largest differences were determined to be between 30.8 Hz-44.3 Hz, 44.3 Hz-59.1 Hz, and 75.9-85.3 Hz. It is anticipated that there will be dips in the room response curve in these frequency ranges. The resulting dips will occur as a result of large gaps between the room resonance frequencies (Kleiner & Tichy, 2014; Kuttruf, 2001).

3. Improvement studies

Improvement studies were carried out in the musical instrument study class to bring the room acoustic parameters within the standard value range. First of all, the required acoustic materials were determined by calculation and then they have been positioned by considering the reverberation time and room modes.

In order for the reverberation time values of the room designed as an music instrument study class to reach the optimum value range, Helmholtz resonator panels with replaceable front plates were designed. These resonator panels were created using the formula that determines the frequency band in which the panels will be effective (Equation 1). In this formula, p represents the hole percentage, d represents the depth, and t represents the effective hole depth. Since sound absorbing foams are placed behind the

front perforated face of the resonator panels created according to the formula, the effective frequency band is expanded (Kleiner & Tichy, 2014). For this reason, the resonance frequencies were determined in a way that would be closest to the problematic frequency band. A 1 mm change in the hole diameter can change the resonance frequency by around 20 Hz. However, the effective bandwidth is increased by using sound absorbing porous materials behind the perforated front section of the panels.

Figure 3 shows the parts of the panels and the process of joining them. Figure 3a shows the structure of the wooden box. Wooden slats were placed in the middle of the edges to ensure that the foam to be placed later would be close to the perforated front surface. Metals were placed on the parts of these slats close to the edges to ensure that the magnets that would hold the front cover would work. Foams measuring 60 cm-60 cm-4 cm were placed on the slats inside the box (a) and the required front panel would be placed on the slats (b). The front panels would be fixed with the help of magnets (c). The resonators whose dimensions are given in Table 2 were used in positions where room modes were active.

Table 1. *Room mode frequencies and mode ranges.*

Mode Frequency (Hz)	(x,y ,z) mode	Difference (Hz)
29.9	1,0,0	
30.8	0,1,0	0.9
44.3	1,1,0	13.5
59.1	2,0,0	14.8
60.4	0,2,0	1.3
61.6	0,0,1	1.2
67.8	2,1,0	6.2
68.5	1,0,1	0.7
68.9	0,1,1	0.4
72.3	1,2,0	3.4
75.9	1,1,1	3.6
85.3	2,0,1	9.6
86.2	2,2,0	0.9
86.3	2,0,1	0.1
88.2	0,3,0	1.9
90.8	3,0,0	2.6
91.6	2,1,1	0.8
95	1,2,1	3.4
95.1	3,1,0	0.1
102.6	1,3,0	7.5
106	2,2,1	3.4
107.6	0,3,1	1.6
109.1	3,2,0	1.5

The walls where the room modes occur were determined and resonator panels were placed on the surfaces where the pressure points of these modes were maximum. While determining the panel positions, ANSYS Modal Acoustic program was used and room mode shapes were taken into consideration. Figure 8 includes images showing the pressure points of axial room modes. It was determined that room modes created maximum pressure points at corners and wall-ceiling junctions, and it was observed that the pressures of axial, tangential and oblique modes were common at corners. Considering that Helmholtz resonator panels, which were designed to be effective in the lower frequency band, gained broadband efficiency thanks to the porous sound absorbing foam used behind them, these panels were placed in corner positions to both reduce the coloration caused by room modes and to reduce the reverberation time values, which are excessive in the lower frequency bands. As seen in Figure 4, the resonator panels coded as 1, 2, 3 were placed at the ceiling-wall junctions. Panels numbered 1, 2, 3 and 4 were placed in other corners where the pressure points of room modes were dense. These resonator panels are tuned to frequencies of 69.4 Hz, 86.75 Hz, 120.1 Hz and 140.12 Hz, and sound absorbing foam is placed behind the holes. It is envisaged that the panel will be effective in a wider band as a result of the use of sound absorbing material inside. At the same time, it is frequency aimed to provide faster sound absorption by reducing the Q value of the resonator panel and as a result, to prevent sounds that will be distributed to the environment by the resonator panel for a longer time than the reverberation time (Biswas & Agrawal, 2013).

The axial modes at frequencies of 59.1 Hz, 60.4 Hz and 61.6 Hz are very

$$f_0 = 200.\sqrt{\frac{p}{(d).(t)}}$$

Equation 1.

close to each other, and the presence of two axial modes around 90 Hz may create a coloration problem in the room. When we look at the shapes of these room modes (Figure 8), it is seen that they create high pressure in the corners and upper corners opposite the piano. For this reason, Type 1 and Type 2 resonator panels were placed in these sections. It was expected that these panels would both reduce the coloration that is the modal effect and ensure that the reverberation time values in these frequency bands would approach the optimum value range. After the production of the panels, the panels were assembled in accordance with the layout plan seen in Figure 4.

4. Comparison of results before and after improvement

After the panels were applied, the T30, EDT, C80 and room response measurements were repeated to evaluate the success of the design. In addition, the frequencies and shapes of the new room modes that will occur as a result of the design were revealed using the ANSYS Modal acoustic module. Post-editing room photos are shown in Figure 5.

4.1. T30 comparison

In the measurements made before the acoustic treatment, T30 values were above the optimum limit value ranges determined according to BS EN ISO 23591 standard in the 63 Hz, 125 Hz and 250 Hz octave bands. They were within the limit value range at 500 Hz and above. It was determined that the Resonator panels used for the acoustic treatment provided improvement in the lower frequency bands where they were effective. While they were within the optimum limit value range in the 125 Hz and 250 Hz octave bands, they were below the 63 Hz octave band (Table 3). It was found that the reverberation time, which was 2.28 seconds, was reduced to 1.33 seconds. Although a significant improvement was achieved, it remained above the limit value. Due to the working mechanisms of the panels, it did not affect frequencies of 500 Hz and above as expected before the regulation, and these frequency bands, which were within the limit value range before the acoustic treatment, maintained their status.

a b c

Figure 3. *The process of assembling the parts.*

Table 2. *Dimensions of Helmholtz Resonator panels.*

Helmholtz Resonator Design	Type 1 (16 holes with 10 mm diameter)	Type 2 (25 holes with 10 mm diameter)	Type 3 (36 holes with 12 mm diameter)	Type 4 (49 holes with 12 mm diameter)
Hole depth (cm)	1.2	1.2	1.2	1.2
Effective hole depth (cm)	2	2	2.15	2.15
Hole diameter (cm)	1	1	1.2	1.2
Percentage of holes	0.44	0.69	1.44	1.96
Depth (cm)	10	10	10	10
Resonance frequency (Hz)	69.40	86.75	120.10	140.12

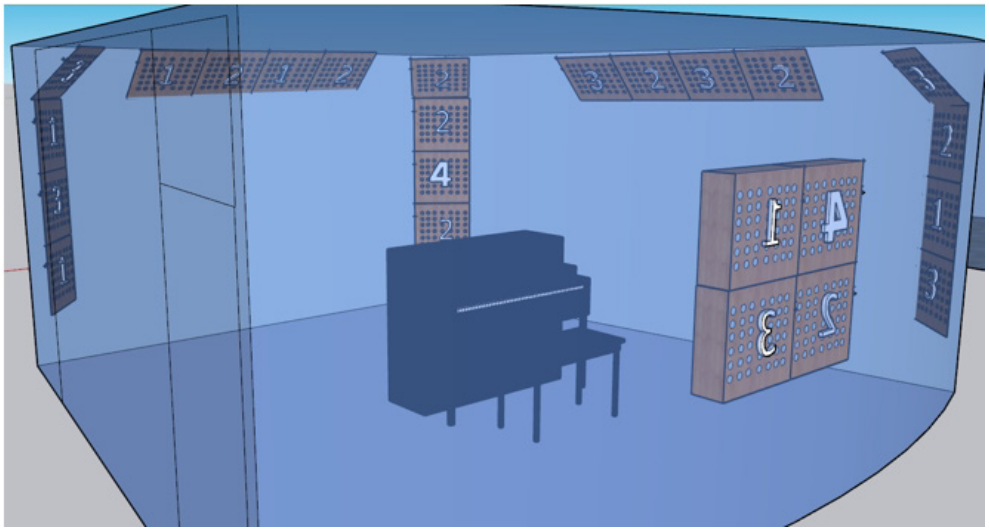

Figure 4. *Room acoustics design of the musical instrument study class.*

Figure 5. *Room photos after treatment.*

Standard deviation values were found to determine how much T30 values differ from each other according to 26 measurement points. The standard deviation, which was 0.39 before the adjustment in the 63 Hz center octave frequency band, decreased to 0.24. It was observed that the panels used for the lower frequency band provided benefits in terms of equal distribution of sound in the 63 Hz frequency band. The standard deviation values of 0.09 at 125 Hz, 0.06 at 250 Hz, 0.03 at 500 Hz; 0.02 in the 1000 Hz, 2000 Hz, 4000 Hz frequency regions did not change before and after the adjustment.

4.2. EDT comparison

Before the acoustic treatment, EDT values were above the limit values at the center octave frequencies of 63 Hz and 125 Hz. After the acoustic treatment, 125 Hz entered the limit value range, while 63 Hz remained slightly above the limit value. At 63 Hz It decreased from 1.73 seconds to 1.15 seconds, and from 1.02 seconds to 0.54 seconds at 125 Hz. The limit value range was maintained in the 250 Hz and 500 Hz octave band. Although there was no change at 1000 Hz, 2000 Hz and 4000 Hz, it remained slightly below the limit value before and after the acoustic treatment (Figure 6).

When we compare the EDT values according to 26 measurement points, there is a significant decrease in the 63 Hz octave band and a decrease in the 125 Hz octave band. While the standard deviation value in the 63 Hz octave band was 0.5 before the acoustic treatment, it decreased to 0.18 after acoustic treatment. It also decreased from 0.19 to 0.16 for 125 Hz octave band. There was no significant change in the other frequency octave bands. Evaluation of these results show that, the distribution of the EDT value, where the effect of early reflections is seen, has improved at the 26 measurement points.

4.3. C80 comparison

C80 values increased between 63 Hz and 500 Hz compared to the before acoustic treatment state. The increase in the C80 values in these frequency bands indicates that the energy rate

in the first 80 ms has increased. It was determined that the highest increase was in the 125 Hz octave band. There was no change in the 1000 Hz, 2000 Hz and 4000 Hz octave bands. The clarity parameter varies according to the volume for music study classes, but it has been found to be around 15 dB in volumes below 100 m^3 (Cabrera, 2007).

The changes in the standard deviation values, where changes are observed according to 26 measurement points which was determined that the standard deviation value decreased from 2.02 to 1.48 in the 63 Hz octave band, while it increased from 1.32 to 2.95 in the 125 Hz octave band (Table 3).

4.4. Comparison of room response

According to the room response measurements made at 26 measurement points, 223 peaks were formed acoustic conditions before treatment while 220 peaks were detected after acoustic treatment. 13 peaks were formed in the 80 Hz 1/3 octave frequency band before the editing, while 1 peak was formed after the editing. In the 100 Hz 1/3 octave frequency band, there were 4 peaks before the acoustic treatment while this increased to 12 after the acoustic treatment. It can be said that there is a shift from 80 Hz to 100 Hz. A similar situation is seen between 160 Hz and 200 Hz. While there were 22 peaks at 160 Hz before the acoustic treatment, this decreased to 9. At 200 Hz , while there were 11 peaks before the acoustic treatment, this increased to 22. Evaluation of these results show that, the acoustic treatment created an effect on the 63 Hz and 125 Hz center octave frequency bands.

The peaks in the 80 Hz 1/3 octave band before the editing decreased after the editing and shifted to the 100 Hz one-third octave band. Evaluation of these results show that, there is a similar transition between 160 Hz and 200 Hz one-third octave bands.

Table 3. *C80, EDT and T30 values before and after editing.*

	Frequency (Hz)	63	125	250	500	1000	2000	4000
BS EN ISO 23591	Lower limit	0.37	0.40	0.42	0.44	0.44	0.40	0.35
	Upper limit	0.92	0.79	0.72	0.69	0.69	0.69	0.69
T30	Before treatment	2.28	1.14	0.87	0.61	0.48	0.44	0.43
	Std deviation	0.39	0.09	0.07	0.03	0.01	0.02	0.02
	After treatment	1.33	0.73	0.72	0.58	0.45	0.43	0.41
	Std. deviation	0.24	0.09	0.06	0.03	0.01	0.02	0.02
EDT	Before treatment	1.73	1.02	0.71	0.59	0.41	0.38	0.34
	Std deviation	0.5	0.19	0.12	0.06	0.05	0.05	0.03
	After treatment	1.15	0.54	0.66	0.54	0.41	0.37	0.34
	Std deviation	0.18	0.16	0.12	0.08	0.05	0.06	0.04
C80	Before treatment	2.37	5.43	6.49	8.32	11.98	12.98	13.97
	Std deviation	2.02	1.32	1.55	1.75	1.35	1.13	1.00
	After treatment	3.42	8.43	7.71	9.74	11.95	12.81	14.09
	Std deviation	1.48	2.95	1.95	1.52	1.19	0.94	1.03

As a result of the room response measurements made at 26 measurement points before the acoustic treatment, the repetition frequency of the frequencies forming the peak was analyzed. The frequencies that are effective in the room were determined. The frequency with the most frequent peak formation was found to be 86.6 Hz. It formed a peak at measurement points numbered 5, 12, 16, 22 and 24. At the same time, 83.9 Hz formed a peak at number 3, 84.8 Hz at numbers 10 and 15, 85.7 Hz at numbers 23,25 and 26, and 87.5 Hz at measurement points numbered 8 and 18. After the acoustic treatment, only 90.4 Hz formed a peak at measurement point numbered 18 between 75.5 Hz and 97.3 Hz. The frequency that formed the highest peak after the acoustic treatment, 97.3 Hz, peaked at a total of 8 measurement points. This situation was evaluated as a result of the shift of the room modes from the 80 Hz 1/3 octave band to the 100 Hz 1/3 octave band. The graph in Figure 6 shows how many measurement points the peaks formed at.

4.5. Comparison of room modes

Before the treatment, the room modes were simulated and the eigenvalues and eigenfunctions were determined. According to these mode shapes and other acoustic measurement results, Helmholtz resonator panel placements were made. In order to determine the change that will occur in the room modes as a result of the design, the panels to be placed in the room were drawn in the ANSYS modal acoustic module and the absorption coefficients were defined. This coefficient was used assuming that the panels would have an absorption of 0.9 in the 63 Hz and 125 Hz frequency bands (Tıraş&Akdağ, 2024).

The room modes formed in the frequency range below the Schroder frequency after the adjustment are shown in Figure 7. There have been changes in both mode shapes and mode frequencies compared to the room modes before the acoustic treatment. The first axial mode, 29.9 Hz, shifted to 30.4 Hz after the acoustic treatment and the high-pressure points came to the corner. The panels placed on the inclined wall shifted the high-pressure region, which appears red, towards the corner. In the 010 mode, the red and blue pressure regions seen in two adjacent corners shifted to opposite corners, and the green zero pressure line inclined and went towards the corner. The frequency of this mode shifted from 30.8 Hz to 31.6 Hz. When we examine the other mode shapes, we see that there are such frequency and pressure region shift.

5. Discussion

In order to define the acoustic character of the room where the study was conducted, 26 measurement points

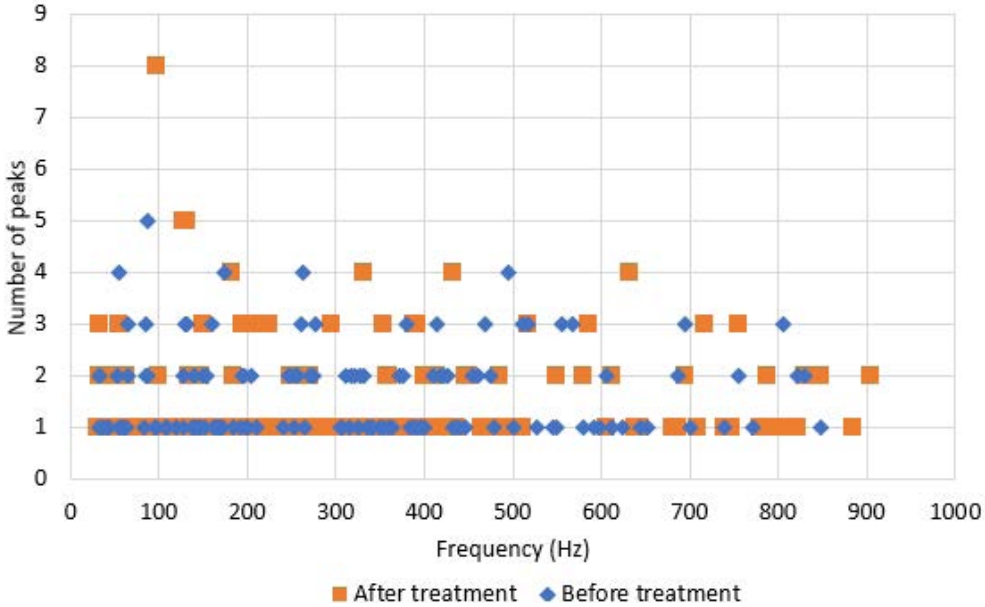

Figure 6. *Number of repetitions of peaks at measurement points according to frequencies before and after treatment.*

were determined, the distribution of sound in the room and the optimum values of acoustic parameters were examined. As a result of the ISO 3382-1 measurements, T30, EDT and clarity (C80) values were measured before the treatment. T30 and EDT values were determined to be within the limit values of 500 Hz and above according to the BS EN ISO 23591 standard. They were measured to be above the limit values at frequencies of 250 Hz, 125 Hz and 63 Hz. It was seen that there was a need for an improvement for these frequency bands. In order to evaluate the effectiveness of the panels to be used in the acoustic design after their production and assembly, ANSYS Modal acoustic simulation and room response measurements were made in accordance with ISO 18233 standard. By looking at the eigenfunctions and eigenvalues obtained from the modal simulation, the hole diameters and numbers of Helmholtz resonator panels, the depth of the box forming the panel and the thickness of the front panel were decided and 4 different panel front faces were manufactured. Since the perforated front part of the designed panel was connected to the panel with a magnet, the front perforated covers of the panels were produced as interchangeable. ANSYS simulation data was used to mount these panels, which were specially designed to reduce the reverberation time in the 63 Hz, 125 Hz and 250 Hz octave bands, in the correct positions. Since Helmholtz panels work with the resonance effect, they were used in regions where high pressure occurs. After the assembly of the design was completed, ISO 3382-1 acoustic parameters and ISO 18233 room response measurements were repeated. In order to determine the

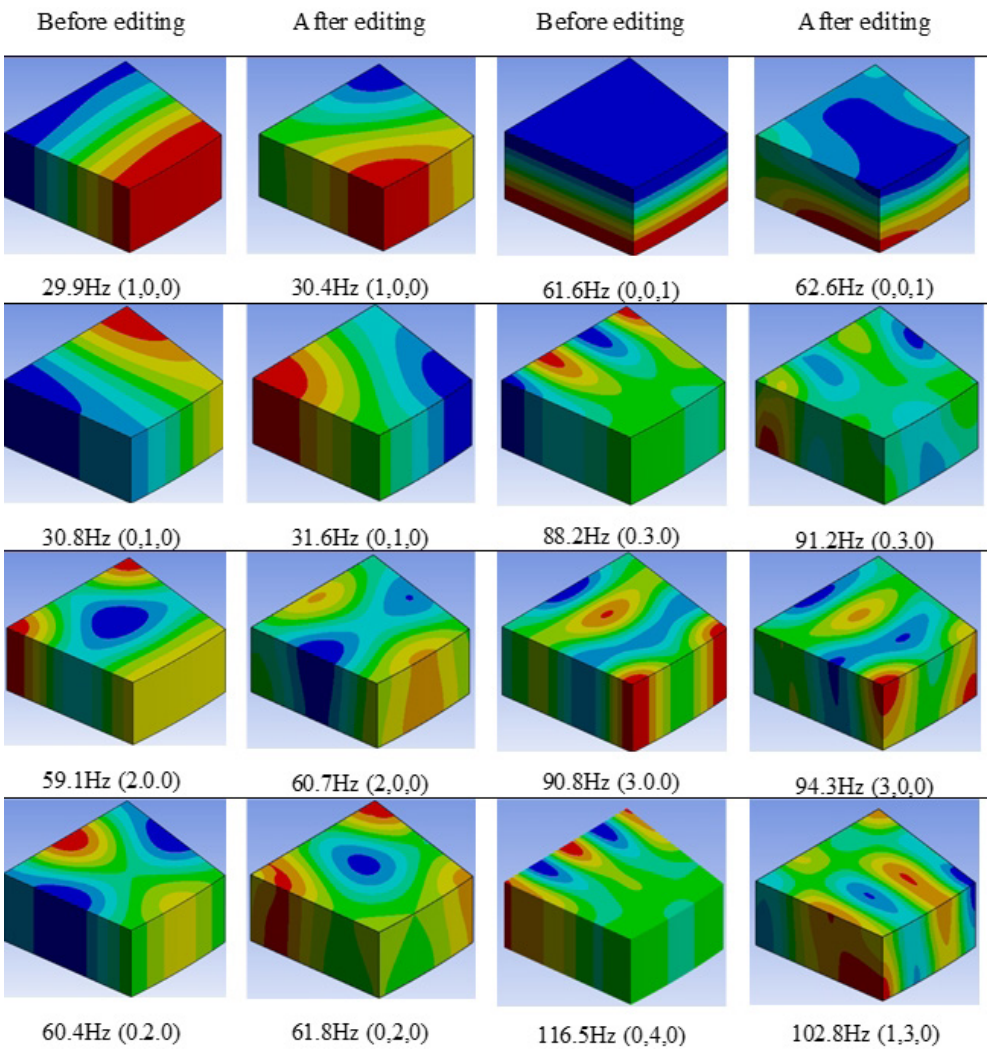

Figure 7. *Room mode shapes and frequencies before and after editing.*

new modal status of the room, ANSYS simulations were repeated by placing the resonator panels used in the room.

The most frequently used parameter in the acoustic evaluation of music practice rooms is the reverberation time (Katunský et al., 2016; Sinal & Yilmazer, 2018; Tămaş-Gavrea et al., 2019) When we look at the reverberation time T30 values, it is seen that the limit value range given for loud music according to the BS EN ISO 23591 standard is entered after the improvement at the center octave frequencies of 125 Hz and 250 Hz. It was determined that it decreased from 2.28 seconds to 1.33 seconds for the 63 Hz octave band and at the same time, the standard deviation value showing the differentiation of the T30 values at 26 measurement points in this frequency band decreased from 0.39 to 0.24. EDT values also gave similar results and the standard deviation value of 63 Hz decreased from 0.5 to 0.19. As a result of the adjustment, significant improvements were made in the lower frequency band and no change occurred in the middle and upper frequency bands. It has been found in previous studies that by using absorber elements that will be effective in the lower frequency region in rehearsal rooms, improvements in reflection time and clarity parameters occur and as a result, communication between musicians increases (Shearer et al., 2021; Zha et al., 2002).Before the treatment, an acoustic design that would affect the 63 Hz, 125 Hz and 250 Hz octave bands was targeted as the basis of the improvement and since the middle and upper frequencies were located in a position close to the lower limit value, it was desired that the absorption in these frequency bands be close to zero. This goal has been largely achieved.

As a result of the effectiveness of room modes, the peaks occurring in the room response can both decrease the Q values and shift towards the upper frequency region by being divided by the absorber elements used in the lower frequency regions (Kleiner & Tichy, 2014; Lai, 2024).In the room response measurements made to observe the effects created by room modes, it was observed that there were changes between the before-after treatment conditions. It was observed that the peaks at 80 Hz and 160 Hz shifted to the upper 1/3 octave and Q values decreased. Similar findings were encountered in the simulation studies, and it was observed that the room modes changed both in frequency and shape. It is important to prepare and position the absorber elements properly that would affect the lower frequency band. These absorbers, which work based on resonance, will not show any effect if they are not positioned correctly (Inacio et al., 2005). The design was carried out by evaluating the reverberation time, room response and modal simulation results together. It was seen that the results were close to the desired measurement. The reverberation time values were slightly higher at 63 Hz, but there was an improvement of about 1 second.

6. Conclusion

When the success of the acoustic design is evaluated, it is seen that the reverberation time values come within the targeted limit value range in the 125 Hz and 250 Hz octave bands, and although they cannot enter the limit value range in the 63 Hz octave band, a significant improvement is achieved. This study gains importance in terms of revealing the method of creating balance between frequency bands by creating absorption in the lower frequency band without affecting the middle and high frequencies. The fact that the room to be used as a musical instrument study class, as in many classes, shows high absorption in the middle and high frequencies due to the use of curtains and carpets, but does not create an effect in the lower frequency bands, and the failure to provide balance between frequencies and the emergence of acoustic defects such as distortion are the findings obtained at the beginning of this study. In accordance with these findings, the acoustic materials that will provide absorption only in the lower frequency band were manufactured and assembled. The mode shapes and the standing waves that will occur in the lower frequency band will create have gained importance in this manufacturing and assembly process. It was ensured that the front panels of the manufactured resonator panels only

affect high pressure points and that the front panels can be changed in order to make fine adjustments. The front faces of the 24 panels used were prepared with 4 different perforations to create effects in different sub-frequency bands. It was observed that the distribution of sound within the space was improved as a result of the use of panels. As a result of the acoustic arrangement, it was found that the standard deviation values of the reverberation time values measured at 26 measurement points decreased and the spatial distribution of the sound was balanced.

The data obtained as a result of this study show that acceptable frequency balance can be achieved in the rooms with the method used. It is seen that replaceable Helmholtz panels can be used to provide effective balance. Future studies may investigate the use of interchangeable Helmholtz panels for musical instrument-specific room design. Perception of changes in room response may be investigated through survey studies in which subjective perceptions can be observed. The effect of room geometry on modal change may be investigated by comparing modal changes and room response changes as a result of improvement studies of rooms with multiple different geometries. Simulation effectiveness may be investigated by measuring sound intensity at several points within the room where white noise is given through modal simulation.

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Reassessing educational strategies: Direct instruction outperforms information search process for novice students in architectural design studios

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Abstract
This study investigates the effectiveness of Direct Instruction (DI) compared to the Information Search Process (ISP) in architectural studio education for novice learners. While design education often favours constructivist approaches like ISP—where students construct knowledge through self-directed exploration—such minimally guided methods may overwhelm beginners who lack foundational knowledge, leading to cognitive overload and limited learning gains. This research evaluates whether structured instruction that explicitly conveys core architectural concepts can better support novice students in solving design problems. A controlled experimental study was conducted with 72 third-semester architecture students, randomly assigned to either the DI group (n = 41) or the ISP group (n = 31). The DI group received a concise, targeted presentation on the concept of human scale in architecture, while the ISP group engaged with printed materials simulating an authentic information search process. Following the instructional sessions, all participants completed a design task. Their work was evaluated by a jury, and cognitive load was measured using a standardized self-report scale. Findings revealed that a significantly higher number of students in the DI group successfully applied the targeted concepts in their design proposals and experienced lower cognitive load during the task. However, no significant difference was observed between the groups in overall design quality scores. These results suggest that DI offers substantial advantages for novice learners by providing essential conceptual scaffolding and reducing mental effort during complex tasks. The study recommends aligning instructional strategies with students' expertise levels—prioritizing DI in early semesters and progressively incorporating constructivist methods as learners gain experience and cognitive readiness.

Keywords
Architecture education, Constructivism, Design studio, Direct instruction, Information search process.

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1. Introduction

Design education has traditionally relied on a master-apprentice model, where experienced educators guide students through ongoing design problems. Studios—educational environments that trace their origins to the École des Beaux-Arts system, where students presented their work in a structured yet critique-driven setting—remain the core environments in which students develop their design skills through presenting and defending proposals in front of instructors and peers (Oh et al., 2013). Rather than employing direct teaching methods such as lectures, studio education emphasizes learning by doing, through critique, iteration, and tacit knowledge transfer. Informal peer critique and tutor–student role constructions have been discussed in the literature as influential dimensions of studio learning (Belluigi, 2016; Gray, 2013), though these studies are primarily conceptual or interpretive in nature, rather than experimental.

This practice-based approach is particularly effective for conveying the experiential and procedural knowledge of design. However, it assumes that students already possess foundational knowledge—ostensibly delivered through supporting courses such as design theory, structures, and materials—and are capable of integrating diverse concepts such as form, scale, culture, and construction into design solutions. In studio settings, mentors often take these competencies for granted and expect students to apply them fluidly in complex design tasks. In reality, novice students in early semesters frequently lack the integrated cognitive schemas—mental structures that organize knowledge in long-term memory—required to interpret critiques, structure design logic, or navigate ambiguous project briefs effectively. This disconnect between the compartmentalised delivery of foundational content and the integrative demands of studio work creates a cognitive gap that many beginners are unprepared to bridge. For instance, students may excel in isolated coursework on structural systems but fail to integrate that knowledge into spatial layouts when designing a building.

The open-ended and loosely structured nature of design studios, while intended to simulate professional practice, can overwhelm beginners. Many first- and second-year architecture students struggle not because they lack creativity, but because they are exposed to complex problem-solving tasks without sufficient cognitive scaffolding. Instructors, assuming students have absorbed knowledge implicitly, often provide feedback that is too abstract or context-dependent for novices to apply. As Oh et al. (2013) argue, these practices—though central to studio culture—are rarely grounded in formal pedagogical frameworks, and are instead guided by intuition and inherited conventions. Our study addresses a complementary dimension by testing an instructional method that explicitly targets cognitive readiness for such critique-based learning.

We explore the potential of a contrasting approach: Direct Instruction (DI), which offers clearly structured guidance and worked examples to reduce cognitive load. Rather than equating instruction with learning, we adopt a cognitive perspective in which learning is defined as a durable change in long-term memory (LTM) (Mayer, 2009; Sweller, 1988). According to this view, information must be processed in working memory (WM)—a system with highly limited capacity—before it can be encoded into LTM. If cognitive load exceeds this capacity, no learning occurs. This risk is especially high for novice learners, who lack robust pre-existing schemas and are thus more susceptible to WM overload even with moderately complex material. Instructional effectiveness, therefore, depends not only on what is taught, but on how it is structured, paced, and cognitively managed to support meaningful schema construction. The DI condition in our study was designed with these constraints in mind.

1.1. Instructional challenges for novice students in studio-based education

Constructivist strategies are often cited as effective in contexts where learners have prior knowledge and are actively involved in constructing

understanding through complex challenges. While these strategies have been highlighted for fostering creativity, critical thinking, and the integration of complex concepts into problem-solving (Philips, 1995), their application to design education, particularly in early stages, requires careful consideration. In advanced design studios, students with foundational knowledge are expected to apply these strategies to engage with intricate design problems, integrating their prior learning into novel solutions. This perspective aligns with Jonassen's (1991) model of knowledge acquisition, which outlines three stages: introductory, advanced, and expert. He argues that constructivist environments are most effective during the advanced stage, when learners already possess sufficient domain knowledge. In this study, we interpret his framework within the design studio context and suggest that constructivist strategies are best suited for students at this advanced stage, where structured conceptual understanding is already in place.

However, in introductory studios, where students lack foundational knowledge and structured cognitive schemas, such methods can create significant learning barriers. Novice students often misinterpret implicit feedback, replicate solutions uncritically, and spread misconceptions among peers. These challenges stem from the constructivist model's reliance on tacit guidance and self-directed discovery. Instructors typically avoid explicit teaching, expecting students to conduct independent research using design precedents, site visits, supporting courses, or open-ended resources such as the internet and libraries. This aligns with Kuhlthau's (1991) Information Search Process (ISP), where learners move through stages of uncertainty, exploration, and formulation. Yet without the cognitive structures to process and apply complex information, novices often become overwhelmed.

Jonassen (1991) argues that guided instruction is more appropriate for learners in the introductory phase to help them establish a foundational knowledge base. Similarly, Ertmer and Newby (2013) suggest that behaviorist and cognitivist strategies—featuring clear explanations, structured tasks, and modeled thinking—are better suited for early-stage learners.

Despite the dominance of constructivist practice in studio culture, there is little clarity on how novices should acquire foundational knowledge. Without explicit guidance, students must not only identify relevant information but also figure out how to apply it meaningfully. A more balanced instructional approach—combining structured guidance with opportunities for creative exploration—can reduce cognitive overload and support more effective learning in early architectural education.

1.2. Dominant pedagogical paradigms in architectural studio education

Direct or explicit instruction—where knowledge is clearly transmitted by the instructor—is typically minimized in studio settings due to concerns that it may limit creativity or reduce students to passive recipients of information. Schön (1985) associates design learning with reflective practice and tacit knowledge, implicitly favouring open-ended and self-directed learning environments. Lord (1999) and Webster (2008) caution that teacher-centred approaches may suppress originality and discourage critical engagement. Dutton (1987) frames the studio as a site of cultural ritual, where hierarchical instruction may reinforce conformity. Morgado (2010) similarly argues that direct teaching methods are incompatible with the exploratory and iterative nature of design thinking. However, these concerns are primarily theoretical, philosophical, or cultural critiques. Despite their influence in architectural education discourse, they are not grounded in empirical evidence. To date, few studies have systematically tested whether direct instruction genuinely suppresses creativity, autonomy, or engagement in studio-based learning environments.

Instead, feedback in studio environments is largely implicit, prompting students to derive meaning and direction through critique sessions, self-re-

flection, and independent research. During this process, learners explore relevant concepts and apply them to design proposals using sources such as precedents, site visits, libraries, and internet-based materials—often with encouragement from instructors.

Schön (1987) conceptualizes the studio as a setting for situated learning through individual or collaborative projects. He introduces *reflection-in-action*—real-time problem-solving and adaptation during the design process—and *reflection-on-action*, which involves post-hoc analysis to inform future performance. Both are central to the constructivist model, contributing to ongoing professional development.

Despite its pedagogical appeal, constructivist theory often lacks specificity regarding how learners acquire, process, and store information (Ertmer & Newby, 2013). Kirschner et al. (2006) criticize minimally guided instruction—including discovery, problem-based, and inquiry learning—for misaligning with cognitive architecture. Drawing on Cognitive Load Theory (Sweller, 1988), they argue that such methods can overload working memory, especially in novice learners who lack prior knowledge. However, while studio education rightly values exploration and autonomy, the near-absence of explicit instruction raises concerns about the cognitive demands placed on beginners.

1.3. Theoretical framework

1.3.1. Constructivist learning theory

Constructivist learning theory posits that individuals actively construct knowledge based on their experiences and internal cognitive structures. Rather than passively receiving information, learners generate meaning by engaging with their environment and interpreting new information through their existing mental frameworks (Bednar et al., 2013; Jonassen, 1991). Learning, in this view, is not simply the acquisition of facts but the result of an active process of understanding.

Piaget (1952) introduced two core mechanisms underlying this process: assimilation, where new information is integrated into existing schemas, and accommodation, where schemas are modified or newly created to fit unfamiliar data. Through the dynamic interplay of these processes, learners achieve equilibration—a balance between internal cognitive structures and external experience—resulting in increasingly complex knowledge structures.

Vygotsky and Cole (1978) expanded this perspective by emphasizing the social and cultural dimensions of learning. They introduced the concept of the Zone of Proximal Development (ZPD), which defines the distance between what learners can achieve on their own and what they can accomplish with support. Learning is maximized within this zone when scaffolding is provided by more knowledgeable individuals, enabling learners to internalize complex skills and concepts.

Constructivist theory has influenced various pedagogical strategies including discovery learning, problem-based learning, inquiry learning, experiential learning, and project-based learning (Kirschner et al., 2006; Kokotsaki et al., 2016). These methods encourage learners to engage actively, explore ideas independently, and derive personal meaning from learning experiences.

However, critics argue that constructivism often downplays the importance of structured guidance. Some scholars contend that the theoretical foundations of constructivism are primarily ideological rather than empirically validated (Phillips, 1995), and caution that minimising the teacher's role can be detrimental—especially when learners are faced with novel or cognitively demanding content (Kirschner et al., 2006). While constructivism supports autonomy and engagement, its effectiveness for novice learners—who lack prior schemas—remains contested.

1.3.2. Information search process

In studio-based learning, students are frequently expected to identify, locate, and evaluate relevant information to support their design decisions. This process, often referred to as the information search process, requires learners to engage with a range

of resources such as architectural precedents, site analyses, literature, and internet-based sources. While this approach fosters autonomy and inquiry, it can be cognitively and emotionally demanding—particularly for novice learners.

To better understand the nature of these demands, Kuhlthau (1991; Kuhlthau et al., 2008) developed the Information Search Process (ISP) model, which outlines six stages that individuals typically experience when seeking information. These stages are:

(i) *Initiation* – recognizing the need for information, often accompanied by uncertainty;

(ii) *Selection* – choosing a general topic and experiencing optimism;

(iii) *Exploration* – encountering confusion and doubt as initial information proves inconsistent;

(iv) *Formulation* – gradually identifying a clear focus, increasing confidence;

(v) *Collection* – gathering targeted information with greater direction and clarity;

(vi) *Presentation* – organizing and using the information, often with a sense of relief or satisfaction.

A key contribution of Kuhlthau's model is its emphasis on the affective dimension of information seeking. Learners do not simply process information rationally; they also navigate emotional responses such as uncertainty, frustration, or confidence as they progress through each stage. This interplay of cognition and emotion has significant implications for studio-based education, where the research process is rarely linear or fully supported.

For novice learners, these stages may amplify cognitive load, particularly if they lack guidance in filtering, organizing, or applying the information they gather. Without structured support, the information search process can become a source of confusion rather than a pathway to insight.

1.3.3. Information processing theory

While constructivist learning theory offers valuable insights into how learners engage with experience and construct meaning, it does not clearly articulate the cognitive mechanisms by which information is processed, stored, or retrieved. In contrast, information processing theory provides a structured framework for understanding learning as the transformation of information into long-term memory (Atkinson & Shiffrin, 1968; Kirschner et al., 2006; Ofsted, 2023, paragraph 251). Central to this theory is the dynamic interaction between working memory and long-term memory, and the cognitive processes that facilitate the transfer between them.

Working memory, as conceptualized by Baddeley and Hitch (1974), is a limited-capacity system responsible for holding and manipulating information over short periods. Research has shown that this capacity is highly constrained—typically allowing only a few discrete units of information, or *chunks*, to be processed simultaneously (Cowan, 2001; Miller, 1994). When instructional content exceeds this capacity, learning is likely to be impeded.

Cognitive Load Theory (Sweller, 1988; Sweller et al., 1998) builds on this model by identifying three types of load imposed on working memory:

Intrinsic Load, which stems from the complexity of the material itself;

Extraneous Load, which results from poor instructional design and hinders learning;

Germane Load, which refers to the mental effort dedicated to processing and integrating information into existing schemas.

Effective instruction aims to reduce extraneous load while promoting germane load, thereby enabling working memory to operate efficiently. Instructional strategies that optimize this balance are more likely to facilitate meaningful learning and support the transfer of knowledge to new contexts. This framework is particularly important for novice learners, who lack robust schemas and are therefore more vulnerable to overload. In design education, which involves complex and interrelated information, managing cognitive load is essential for enabling learners to internalize and apply knowledge effectively.

1.3.4. Limitations of constructivist strategies for novice learners

While constructivist approaches emphasize learner autonomy and open-ended exploration, research in cognitive science suggests that such methods may not be equally effective for all learners. One critical factor is the learner's level of prior knowledge, which influences how they process feedback, engage with information, and construct new understanding. This point has been emphasized by Kirschner, Sweller, and Clark (2006), who argue that minimal guidance during instruction places unnecessary cognitive demands on novice learners, often hindering rather than facilitating learning. Similarly, Tobias and Duffy (2009) present a balanced yet critical examination of constructivist instruction, concluding that its success is highly dependent on learner expertise and the nature of the task.

Shute (2008), in a comprehensive review of feedback in education, emphasizes that the effectiveness of feedback is highly dependent on its type, specificity, and degree of explicitness. For novice learners, who often lack structured schemas and problem-solving strategies, explicit and detailed feedback is generally more beneficial (Knoblauch & Brannon, 1981; Moreno, 2004). It helps identify knowledge gaps, clarify misunderstandings, and direct learners toward relevant concepts. In contrast, advanced learners may benefit more from implicit feedback, such as prompts or reflective questions, which challenge them to apply and extend their existing knowledge (Vygotsky, 1987).

This divergence creates a practical dilemma in educational settings, particularly in design studios where students with varying experience levels often coexist. Relying solely on one instructional approach—whether purely constructivist or instructivist—can result in ineffective learning experiences for some students. Rather than adhering rigidly to a single method, educators must be able to adapt their strategies based on the learner's current level of expertise and the nature of the task.

Such adaptability aligns with the principle of systematic eclecticism (Snelbecker, 1974), which advocates for drawing upon multiple instructional theories and methods as needed. This perspective acknowledges that no single instructional approach is universally effective. Instead, effective teaching requires a flexible and evidence-informed combination of strategies to address learners' varying cognitive needs. In the context of architectural design education, this means integrating explicit instruction where foundational knowledge is lacking, while preserving constructivist elements that promote higher-order thinking and creativity as learners advance.

Furthermore, design tasks in architectural studios are often classified as "wicked problems"—ill-defined, open-ended, and without clear solutions. Coyne (2004) contends that such complexity is the norm rather than the exception in design practice, while Casakin (2008) provides empirical evidence linking students' creative performance to their ability to cognitively restructure these problem spaces—an ability that itself depends on prior schema development (Sweller et al., 1998).

1.3.5. Direct istruction: principles and cognitive foundations

Direct instruction (DI), also referred to as explicit instruction, is an instructional approach grounded in cognitivist and information processing theories. Unlike constructivist methods that emphasize learner-driven discovery, direct instruction involves the structured transmission of clearly defined knowledge, skills, and procedures from teacher to student—conceptually grounded in cognitivist theory (Jonassen, 1991), aligned with the information-processing model of memory (Atkinson & Shiffrin, 1968), and informed by the working memory framework (Baddeley & Hitch, 1974). This approach assumes that objective knowledge exists independently of the learner and can be taught effectively through well-organized, incremental instruction aligned with the learner's cognitive capacity.

Kirschner et al. (2006) define direct instruction as the provision of information that fully explains concepts

and procedures, supported by learning strategies consistent with human cognitive architecture. Effective implementation of DI reduces extraneous cognitive load while enhancing germane load, allowing learners to process and internalize information more efficiently—especially critical for novices lacking prior schemas.

Despite its strong empirical support, the term "direct instruction" (DI) is frequently misunderstood and inconsistently used in the literature. In some cases, it is reductively equated with passive, lecture-based teaching or rote memorization—leading to negative connotations that overshadow its research-based effectiveness. Rosenshine (2008) critically examines this confusion and identifies five distinct uses of the term "direct instruction" in educational discourse:

(1) teaching delivered by a teacher, regardless of method quality;

(2) instructional behaviors observed in effective teachers;

(3) strategies for teaching cognitive skills;

(4) the structured and scripted DISTAR program developed by Engelmann; and

(5) a negatively framed stereotype of teacher-centred lecturing with passive students.

This conceptual ambiguity has led to frequent mischaracterization of DI, particularly in fields like design education where student autonomy and open-ended exploration are valued. However, as Rosenshine emphasizes, properly implemented direct instruction—especially as defined in the second and third senses above—does not inhibit critical thinking or creativity. On the contrary, it provides explicit guidance, scaffolded practice, and cognitive structure, enabling learners to engage more meaningfully with complex material. Rather than replacing student agency, effective DI builds the foundational knowledge and mental frameworks that support higher-order learning and independent application.

Rosenshine (2008) outlines nine key features of effective direct instruction, including: review of prior knowledge, clear articulation of objectives, segmented delivery of new content, frequent student practice, concise explanations, continuous questioning, active monitoring, timely feedback, and structured guidance during independent work.

In design education, these principles can be applied to scaffold studio processes for novice learners. Breaking complex tasks into cognitively manageable steps and providing clear feedback and modeling during mentorship sessions can help students build a more stable foundation of design knowledge—enabling them to engage in higher-level creative processes with greater competence and confidence.

1.3.6. Applying direct instruction to studio education: Cognitive and pedagogical implications

Direct instruction holds significant potential for supporting novice students in architectural design studios, particularly by addressing common cognitive challenges such as overload, fragmented knowledge, and weak schema development. Unlike minimally guided approaches, which assume that learners can independently construct complex design knowledge, direct instruction offers structured support to build the foundational knowledge base necessary for design problem-solving.

First, DI helps reduce extraneous cognitive load, especially in domains like architecture where element interactivity is high. Design tasks require the integration of multiple variables—such as structure, function, materiality, spatial perception, and human scale—which can easily overwhelm working memory if not sequenced and contextualized effectively (Kirschner et al., 2006; Sweller et al., 2019). By providing clear explanations and worked examples, DI allows students to focus on understanding core concepts rather than navigating ambiguity.

Second, DI facilitates the construction of cognitive schemas. These schemas help students recognize patterns, connect related concepts, and transfer learning across different contexts. For instance, a lesson on "public-private spatial transitions" can explicitly link concepts like thresholds, circulation, social interaction, and form, enabling

students to see how these ideas interrelate.

Third, DI ensures that novice learners receive the essential building blocks—factual knowledge, procedural strategies, and domain-specific rules—that underpin problem-solving and creative ideation. According to cognitive research, these elements form the basis of expertise and can be taught directly, while skill development emerges through guided practice.

Finally, by aligning instructional design with cognitive load theory, DI can accelerate the development of expertise. Techniques such as worked examples, process worksheets, and completion tasks provide scaffolding that supports efficient schema construction and gradual cognitive automation.

While hands-on experience and creative exploration remain vital, the structured guidance provided by direct instruction plays a critical role in equipping novice students with the knowledge, confidence, and cognitive readiness required for deeper engagement in design practice. For example, students who first learn the structured principles of spatial hierarchy through DI are later better equipped to manipulate these principles creatively in open-ended projects.

1.4. Empirical gaps in the literature on instructional strategies in design education

Despite the widespread adoption of constructivist pedagogy in architectural education, empirical evidence comparing alternative instructional strategies remains limited. The existing literature is heavily dominated by case studies that apply constructivist methods in various studio contexts. While such studies are valuable for exploring teaching practices in complex settings, they offer limited generalisability and methodological rigour. This reveals a significant empirical gap in our understanding of which instructional strategies most effectively support student learning—particularly for novices working in cognitively demanding environments.

A systematic review conducted by Sawyer (2017) examined 45 English-language empirical studies on architecture and art education published between 1984 and 2017. The review found that most studies characterised studio education as constructivist, open-ended, and student-centred. However, only two of the reviewed studies (Andjomshoaa et al., 2011; Vanada, 2016) directly compared constructivist and direct instruction approaches. Among them, only one (Andjomshoaa et al., 2011) used a controlled pretest–posttest design—highlighting how rarely experimental methods are applied in this field, despite their stronger evidential weight compared to case studies.

In that study, 32 second-year architecture students were divided into two groups. The constructivist group engaged in experiential activities, including site visits and sensory exercises, while the control group received direct instruction. A follow-up design task showed better performance in the constructivist group. However, the instructional content, duration, and engagement were disproportionately richer in the constructivist group, raising concerns about the comparability of the two conditions. This design imbalance implies that the apparent superiority of the constructivist group may not stem from the instructional model per se, but from the richer, multisensory, and social learning environment provided. For instance, the direct instruction group was merely told that a bedroom's location was incorrect due to noise, while the constructivist group conducted environmental recordings, shared findings with peers, and reflected on the design implications. As Rosenshine (2008) emphasizes, effective direct instruction requires structured, explicit, and detailed guidance—conditions that were not met in this study. The imbalance weakens the validity of any claim regarding the superiority of the constructivist approach and instead demonstrates the limitations of superficial feedback in both methods.

Additional support for structured instruction comes from Al-Sayed et al. (2010), who found that architects with explicit spatial-configuration knowledge outperformed those with implicit understanding in solving design problems. This distinction reinforces the

argument that certain types of knowledge—especially procedural and relational—should be explicitly taught, particularly to novice learners. According to Sweller (1988), effective problem-solving relies on four key components: domain-specific knowledge, procedural strategies, problem-solving methods, and skill. The first three can be directly taught, while skill develops through practice under guided supervision.

Constructivist theorists, such as Schön (1987), argue that learning should mirror real-world complexity and promote reflection through project-based engagement. According to Kirschner et al. (2006), such models are typically based on two assumptions: that students learn best by constructing their own solutions, and that instruction should emulate professional practice. However, these assumptions have been criticised for lacking empirical support and for misaligning with cognitive architecture. In contrast to Schön's theoretical model, Kirschner et al. (2006) and Chi et al. (1981) present experimental findings showing that novices approach problems fundamentally differently from experts—relying on surface features, trial-and-error, and unguided exploration, often with poor learning transfer.

This body of evidence underscores the need for controlled comparative studies that assess the impact of instructional strategies under equivalent conditions. The current literature lacks such studies, which limits educators' ability to make informed decisions about how to support learners at different stages of expertise. The resulting gap has contributed to an uncritical dichotomy between constructivist and direct instruction models, often ignoring contextual variables such as learners' prior knowledge, cognitive capacity, and instructional design.

Recent research outside the design domain (e.g., de Jong et al., 2023) suggests that combining direct instruction with inquiry-based learning produces the most effective outcomes. These findings imply that architectural studios—particularly in the early years—could benefit from the structured delivery of foundational knowledge, followed by opportunities for open-ended exploration. Integrating direct instruction in studio-based learning has the potential to reduce cognitive overload, strengthen conceptual understanding, and enhance problem-solving capacity.

By addressing this gap through a controlled experimental design, the present study aims to provide much-needed empirical insight into the instructional needs of novice architecture students and to contribute to a more evidence-based discourse in design education.

1.5. Research questions and hypotheses

Focusing on the research phase of the studio process for novice architecture students, this study compares two approaches to delivering foundational design knowledge: DI, which involves structured, explicit teaching aligned with Rosenshine's (2008) principles, and the ISP model (Kuhlthau, 1991), in which students independently seek out knowledge as part of their learning journey—a common practice in design education. The investigation centres on the acquisition and application of a core design concept: human scale. Building upon the empirical gap identified in the literature, the study employs a mixed-methods design to evaluate both the instructional effectiveness and the cognitive impact of each approach. Accordingly, the following research questions and hypotheses were formulated:

RQ1: What is the impact of using Direct Instruction (DI; Rosenshine, 2008) versus the Information Search Process (ISP; Kuhlthau, 1991) for teaching foundational design concepts, on the number of novice architecture students who successfully apply targeted spatial behaviors (variables 3DR1–3) in their design proposals? (Mixed-methods approach.)

H1: There is a statistically significant difference between instructional methods (DI vs. ISP) in the proportion of novice students who demonstrate application of targeted 3D design behaviors (3DR1–3) in their design proposals (two-tailed).

RQ2: How do DI and ISP approaches impact students' cognitive load during

instructional and design processes? (Quantitative approach.)

H2: There is a statistically significant difference in perceived cognitive load between students instructed via DI and those taught through the ISP (two-tailed).

RQ3: How do students perceive and evaluate the two instructional approaches—DI and ISP—specifically in the context of learning about human scale in architecture? How do these methods influence their engagement during design sessions? (Qualitative approach.)

2. Method

This study employed a post-test-only control group design to manage instructional variables and reduce external confounds within the studio environment. The controlled design enabled consistent treatment conditions and minimized distractions across sessions. While data collection was designed to be efficient, the full implementation spanned two consecutive days to accommodate participant availability and logistical constraints.

2.1. Participants

Participants were third-semester architecture students from Yıldız Technical University, İstanbul, Türkiye. Only students taking the course for the first time were eligible. This criterion ensured that all participants had comparable levels of prior exposure to studio instruction. Participation was voluntary, and those who completed the study received bonus credit toward their studio course. A total of 72 students participated and were randomly assigned to either the Direct Instruction (DI) group (n = 41) or the Information Search Process (ISP) group (n = 31).

To accommodate classroom capacity, both groups were divided into two subgroups, each undergoing the same instructional procedure on different days. Statistical tests revealed no significant differences between these subgroups in terms of key outcome measures, confirming consistency across sessions.

2.2. Variables

The independent variable was the instructional method, with participants assigned to either the Information Search Process (ISP, control) or Direct Instruction (DI, experimental) group. The dependent variables included cognitive load and post-instruction design behaviour, grouped under five categories comprising 12 items in total (Table 1): three-dimensional relations (3DR1–6); creativity (CR1–2); flexibility (FLX); circulation (CIR1–2); and overall evaluation. These categories were derived from recurring evaluation criteria used in architectural studio critiques and refined through consultation with expert jurors to align with pedagogical priorities.

These variables were defined prior to the study by the authors in consultation with the jury. Among them, 3DR1–3 were directly targeted by the instructional content, while 3DR4–5 were designed to assess knowledge transfer to untaught but related design behaviours. The final item, 3DR6, reflected the jury's holistic judgment based on their usual evaluation practices.

The 3DR variables were assessed on two levels: a categorical score (present/absent), indicating whether the relevant design feature was attempted (serving as a proxy for long-term retention), and a continuous quality score (1–10), reflecting the contextual and effective use of that knowledge. The same quality scoring was also applied to six additional variables. The presence score was treated as a proxy for long-term retention, based on the assumption that design features not reinforced through memory would likely be omitted.

2.3. Content of the instructional material

The instructional content addressed the effect of spatial height on the perception of human scale in architecture. Materials were intentionally generic and excluded best-practice examples to prevent design bias. Concepts were presented through simple 2D drawings and 3D visualizations accompanied by concise definitions.

Table 1. *Abbreviations and data types of dependent variables.*

Dependent Variable	Abbreviation	Data Type	
		Categorical	Continuous
Three-Dimensional Relations (3DR)		Present/Absent	
Presence of a gallery/atrium in the design (target variable)	3DR1	P/A	1-10
Variation in ceiling height within the space (target variable)	3DR2	P/A	1-10
Variation in ceiling height across consecutive spaces (target variable)	3DR3	P/A	1-10
Changes in floor levels within the same space	3DR4	P/A	1-10
Changes in floor levels across consecutive spaces	3DR5	P/A	1-10
Overall evaluation of three-dimensional relationships	3DR6		1-10
Creativity			
Creativity in the approach to the space	CR1		1-10
Creativity in the approach to the exhibition	CR2		1-10
Flexibility			
Adaptability to various exhibition configurations	FLX		1-10
Circulation			
Planning exhibition spaces in a way that can tell a coherent story	CIR1		1-10
Efficient visitor circulation throughout the exhibition spaces	CIR2		1-10
Overall			
The jury's overall evaluation	Overall		1-10

The ISP group received five printed booklets (10 pages each); only one, "Human Scale in Architecture," was relevant and identical in content to the DI group's presentation. The remaining four, adapted from Ching (2023), were included to simulate the expansive and ambiguous search space that students typically encounter in real-world design research contexts.

The DI group watched a 14-minute narrated slide presentation aligned with Rosenshine's (2008) explicit instruction principles and followed by a recall test to reinforce learning (Roediger & Butler, 2011). To manage cognitive load (Cowan, 2001; Miller, 1994), content focused only on 3DR1–3 variables.

Of the 33 visuals, 2 targeted 3DR1 and 15 addressed 3DR2–3. Nineteen included the phrase "human scale." No material was provided for 3DR4–5 to assess whether knowledge transfer would occur. The visuals in the relevant ISP handout—the one titled *Human Scale in Architecture*—were identical to those used in the DI group's slides, while the remaining four booklets featured unrelated content. This ensured that any observed differences could be attributed to the instructional method, not the content itself.

2.4. Design problem

Participants were tasked with producing conceptual sketches for an exhibition space designed to showcase student work from a fictional fine arts university. The design was constrained to fit within a 20×20×20 meter volume. A design programme was provided, requiring participants to accommodate artworks of varying scales—from very large pieces (up to 6 meters) to small objects (as small as 0.5 meters)—thus encouraging the creation of spaces with diverse ceiling heights and spatial configurations.

2.5. Procedure

All sessions were conducted at 1 p.m., in separate workshop spaces to prevent interference between groups. Upon arrival, participants received information sheets, and the design brief was distributed on A4 paper and read aloud by the facilitator. All students were instructed not to use mobile phones or communicate during the session. Materials provided included grid paper (1:100 scale), and students were asked to produce freehand sketches including plans, sections, and perspectives as needed.

ISP Group (n = 31) received a 50-page A4 handout containing five topics (10 pages each), only one of which was relevant to the design task (*Human Scale in Architecture*). The remaining four were randomly selected and unrelated, simulating an authentic information search process. Participants studied individually for 40 minutes without interaction. The Cognitive Load Scale (Paas & Van Merrienboer, 1994; Turkish version by Kılıç & Karadeniz, 2004) was administered twice: once after the

search task and again following the 90-minute design session. This single-item instrument has been validated for capturing subjective mental effort across varied instructional contexts and is widely used due to its simplicity and sensitivity (Paas et al., 2003). The scale was used to assess perceived mental effort during both the instructional phase and the subsequent design task. Afterwards, participants wrote a half-page reflection report and completed post-task surveys. A supervisor ensured adherence to the instructions, and all materials were collected at the end (Figure 1).

DI Group (n = 41) received a 14-minute slide-based presentation titled *Human Scale in Architecture*, projected on a 240 × 200 cm screen. The slides were purely visual and narrated by an instructor—who was also a professional voice actor—reading aloud from the same text provided in the relevant section of the handouts used in the ISP group. This choice ensured clear pacing and professional clarity in delivery, reducing extraneous auditory load (Sweller et al., 1998). Each slide advanced after a five-second pause to control pacing. Following the presentation, students completed a 10-minute ungraded recall test and then rewatched the presentation to verify their answers. The instructional session lasted 40 minutes. The Cognitive Load Scale was again administered twice—after the presentation and after the design task—mirroring the ISP group. The session concluded with the same reflection report and post-task surveys. A supervisor monitored compliance, and all materials were collected at the end (Figure 1).

2.6. Data analysis

Design sketches were evaluated online by a jury of three full-time architecture professors from different universities. The five variables in the 3DR1–5 group were coded categorically (1 = present, 0 = absent). In cases of disagreement, the majority decision (two out of three jurors) was taken. To ensure scoring consistency, the authors provided a schematic evaluation form outlining how each spatial relationship should be assessed (Prior to the main evaluation, two independent experts reviewed the form for clarity and relevance). When present, jurors also rated the quality on a 1–10 scale. Jurors were not guided on how to interpret quality scores. This approach preserved the natural judgment of each juror, in line with authentic studio assessment practices. To reduce the impact of individual subjectivity, we calculated the mean of the three scores for each item rather than relying on a single rating. The remaining seven variables were evaluated on quality only.

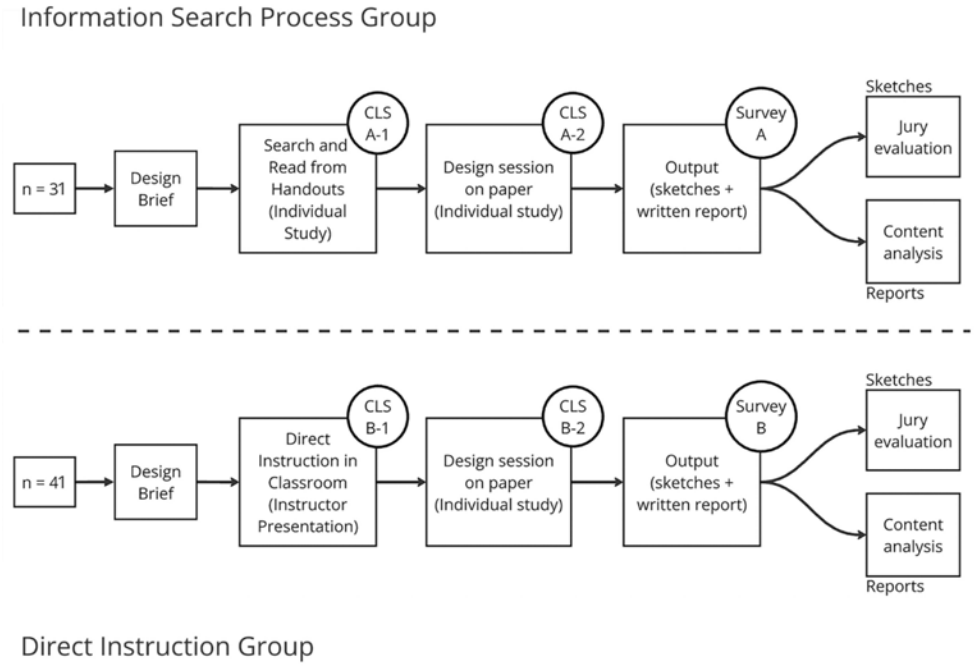

Figure 1. *Experiment design.*

Qualitative content analysis was conducted on both design reports and open-ended survey responses by a second jury composed of three trained research assistants. For the design reports, each assistant independently coded references to the 3DR variable set, then met to reconcile discrepancies and reach consensus. Themes were grouped, counted, and categorized per report. The presence of at least one relevant theme indicated retention of targeted knowledge; blank responses were coded as no long-term retention.

For the surveys, participants answered open-ended questions about how the instructional content and medium affected their learning and design process. The survey was administered in paper format immediately after the final design task, and was designed to elicit post-task reflections aligned with the pedagogical dimensions outlined in Tables 8 and 9. It consisted of two parts: one focusing on the instructional experience and one on the design process. Questions were formulated to explore how the materials supported or hindered understanding, and how they influenced participants' design performance and experience (see Appendix A for full question set).

Responses were analysed using a directed content analysis approach (Hsieh & Shannon, 2005). Each answer was categorized under predefined thematic headings corresponding to the study's instructional framework. The research assistants coded the responses independently and reached consensus through discussion. Two metrics were calculated to summarize results: (i) the percentage of participants mentioning each theme and (ii) the average number of distinct theme mentions per participant, indicating depth of engagement.

3. Findings

This section reports the outcomes of the experimental comparison between Direct Instruction (DI) and the Information Search Process (ISP) regarding novice students' application of foundational design behaviors. The primary focus was on the categorical presence of three explicitly taught variables (3DR1–3), as identified in student design proposals. Two additional spatial variables (3DR4–5), although not included in the instructional material, were also examined to explore the potential transfer of knowledge. Other design dimensions—such as circulation, flexibility, creativity, and overall design quality—were not central to the research questions but were analyzed descriptively to provide broader context and identify possible secondary effects of instructional strategy.

Each of the 3DR1–5 variables was assessed categorically as either present or absent in student work. If a behavior was observed, a quality score between 1 and 10 was also assigned. Table 2 presents interrater reliability values for the categorical evaluations, calculated using Fleiss' Kappa (κ). The results demonstrate high agreement among jury members ($\kappa = 0.865–1.0$, all $p < .000$), indicating strong consistency in the evaluation process. For interpretation of κ values, see Landis and Koch (1977).

3.1. Evaluation of sesign proposals

Participants' design proposals were assessed for the presence of 3DR1–5 variables. One incomplete submission from each group was excluded, resulting in a final sample of 70 students. No statistically significant difference was found between groups in the use of 3DR1.

Table 2. *Interrater agreement for present/absent ratings of targeted design behaviors (3DR1–5) using fleiss' kappa.*

	3DR1	3DR2	3DR3	3DR4	3DR5
Fleiss' Kappa (k)	.982	1.0	.963	.886	.858
p	<.000	<.000	<.000	<.000	<.000
***Interpretation**	* Almost Perfect Agreement	* Perfect Agreement	* Almost Perfect Agreement	* Almost Perfect Agreement	* Almost Perfect Agreement

* Agreement interpreted using Landis and Koch (1977).

Since 3DR2 and 3DR3 both assess manipulation of spatial height—either through floor depth or ceiling elevation—they were combined for analysis. These variables were observed more frequently in the DI group compared to the ISP group (Table 3). A chi-square test confirmed a significant association between instructional method and the application of the combined 3DR2–3 variables, $\chi^2(1, n = 70) = 5.31$, $p = .021$, with a moderate effect size, $\varphi = .275$ (Kim, 2017). This suggests that the teaching method had a meaningful influence on participants' ability to apply height-related spatial strategies in their designs.

3.2. Cognitive load scale results

Independent samples t-tests compared Cognitive Load Scale scores between the DI and ISP groups after both the instruction and design sessions. Levene's tests confirmed equal variances. No significant difference was found following the instruction phase (small effect size, d=0.14). However, after the design session, the ISP group reported significantly higher cognitive load than the DI group, with a moderate effect size (d=0.55). This suggests that DI may reduce cognitive load during the design process (Table 4).

3.3. Qualitative analysis of design reports

Forty participants from the DI group and 30 from the ISP group submitted design reports. A jury of three trained research assistants conducted a qualitative content analysis to identify references to the 3DR1–5 variables, counting each variable at most once per report. The coders first analyzed the reports independently, then convened to resolve discrepancies and reach full consensus (See Appendix B for qualitative content analysis of student design reports). An independent samples t-test showed that the DI group mentioned significantly more distinct learning outcomes than the ISP group, with a moderate effect size (Table 5). Here, "distinct" refers to the number of different learning outcomes mentioned per report, regardless of how many times each was repeated.

3.4. Quality assessment of design proposals

Although not directly tied to the study's main research questions, quality scores were examined for exploratory purposes. No statistically significant differences were found between the DI and ISP groups for the quality of 3DR1 and 3DR3, as shown in Table 6. Quality scores for 3DR2, 3DR4, and 3DR5 were not analyzed due to insufficient data.

Additional comparisons were made for creativity, flexibility, circulation, and overall design quality. Again, no significant differences emerged between the instructional groups. Levene's tests confirmed equal variances across all variables (Table 7), suggesting that both groups performed similarly across these secondary measures.

3.5. Perceived facilitation of learning

In the DI group, 74% of participants reported that the instructional content facilitated their learning, with an average of 0.9 theme mentions per participant (mpp). A similar rate was observed in the ISP group (77.7%, 1.0 mpp), which is consistent with the fact that the DI content was replicated in one of the ISP group's handouts, and the others followed a comparable instructional format (Table 8).

Among DI participants, 54% described the content as highly informative, 13% highlighted the clarity of explicit instruction (via narrated text), 10% noted improved comprehension through repeated viewing, and 5% found the recall test between presentations helpful. ISP participants reported similar experiences: 59.3% found the visuals informative, 14.8% said the handouts helped them recall forgotten knowledge, 7.4% appreciated the introduction of new information, and another 7.4% praised the clarity of the examples.

3.6. Perceived challenges in learning

Despite generally positive perceptions, 23.1% of DI participants reported learning-related challenges (0.26 mpp). These included difficulty understanding the topic (7.7%), struggling with nuanced or unfamiliar concepts (7.7%), and the need for additional examples to aid comprehension (5.1%).

Table 3. *2x2 contingency table for 3DR_2-3 combined.*

		3DR2_3 Variables Combined			
		Never Used		Used At Least Once	
		n	%	n	%
Groups	**DI (*n*=40)**	23	47.9%	17	77.3%
	ISP (*n*=30)	25	52.1%	5	22.7%
Total *(n=70)*		48	100%	22	100%

Chi-square test: $\chi^2(1, N = 70) = 5.31$, $p = .021$, $\phi = .275$, (small to moderate effect)

Table 4. *Comparison of cognitive load scale means, independent samples t-tests, and Levene's test results for DI and ISP groups.*

Test	Information Search Process Group Mean (SD)	Direct Instruction Group Mean (SD)	t(df)	p-value	Levene's F (df1,df2)	Levene's p-value	Interpretation
After Instruction Session	4.87 (1.36)	4.68 (1.40)	0.570 (70)	.570	0.545 (1, 70)	.463	No significant difference; Cohen's d = 0.14
After Design Session	6.87 (1.71)	5.93 (1.75)	2.289 (70)	.025*	0.010 (1, 70)	.922	Significant difference; Cohen's d = 0.55

**Note. The p-values for t-tests were considered significant at p < .05. Levene's test p-values (p>.05) indicate the assumption of equal variances has been met.*

Table 5. *Independent samples T-Test for the number of unique learning outcomes mentioned in report.*

Parameter	Direct Instruction Group Mean (SD) n=40	Information Search Process Group Mean (SD) n=30	t(df)	p-value	Levene's F (df1,df2)	Levene's p-value
The Number of Unique Learning Outcomes Mentioned in Reports	1.73 (1.18)	1.33(1.01)	2.21 (68)	.030*	0.43 (1, 68)	.516
Effect Size Cohen's d = 0.53, 95% CI [0.05, 1.00] (Moderate Effect)						

**Note. The p-values for t-tests were considered significant at p < .05. Levene's test p-values indicate whether the assumption of equal variances was met.*

Table 6. *Independent-samples mann–whitney U tests of quality scores.*

Variable	n	U	z	*p* (Exact, 2-tailed)	Decision
3DR1	DI 15 ISP 11	74.50	-0.417	.683	Retain the null hypothesis.
3DR2	DI 4 ISP 0				Insufficient data for analysis
3DR3	DI 16 ISP 5	140.50	0.561	.575	Retain the null hypothesis.
3DR4	DI 5 ISP 4				Insufficient data for analysis
3DR5	DI 2 ISP 2				Insufficient data for analysis

*The significance level used was .050.

In contrast, 55.6% of ISP participants reported challenges (0.59 mpp). Common issues included insufficient time to read lengthy texts (22.2%), low-quality visuals (11.1%)—with some participants specifically interpreting Francis Ching's hand-drawn illustrations as unclear—and underdeveloped examples that hindered comprehension of complex concepts (7.4%) (see Table 8).

Table 7. *Comparison of means, independent samples t-tests, and Levene's test results for DI and ISP groups across various parameters.*

Parameter	Direct Instruction Group Mean (SD)	Search Process Group Mean (SD)	t(df)	p-value	Levene's F (df1,df2)	Levene's p-value
3DR6General	3.83 (1.39)	3.38 (1.55)	1.26 (68)	.212	1.79 (1, 68)	.185
Creativity 1	2.69 (1.22)	2.66 (1.16)	0.09 (68)	.930	0.00 (1, 68)	.991
Creativity 2	2.72 (1.25)	2.45 (1.24)	0.87 (68)	.389	0.05 (1, 68)	.821
Flexibility	2.74 (0.96)	2.57 (0.89)	0.72 (68)	.474	0.33 (1, 68)	.567
Circulation 1	2.84 (1.12)	2.76 (1.25)	0.29 (68)	.772	0.04 (1, 68)	.852
Circulation 2	1.41 (1.07)	3.04 (1.40)	-0.12 (68)	.901	1.77 (1, 68)	.188
Overall	3.87 (1.20)	3.64 (1.41)	0.77 (68)	.466	1.89 (1, 68)	.173

Note. The p-values for t-tests were considered significant at p < .05. Levene's test p-values (p>.05) indicate the assumption of equal variances has been met.

Table 8. *Participants' perceptions of how instructional content in slide presentations and handouts facilitates / challenges learning.*

Concepts and Themes (Respondents: n)	Participants mentioned (% of Participants Mentioning)	Total Mentions (Mentions per Participant)
How instructional content in slide presentation facilitates learning (n=39)	29 (74%)	35 (0.9)
Highly informative (no further details provided)	21 (54%)	21 (0.54)
Information was explicitly conveyed (clear explanations and definitons)	5 (13%)	5 (0.13)
Watching twice made understanding easier	4 (10%)	4 (0.1)
The recall-test between presentations	2 (5%)	2 (0.05)
How instructional content in handouts facilitates learning (n=27)	21 (77.7%)	27 (1.0)
Very informative illustrations	16 (59.26 %)	16 (0.59)
Handouts helped recalling fotgotton knowledge	4 (14.81 %)	4 (0.15)
I got information about the subject thanks to the handouts	2 (7.41 %)	2 (0.074)
Some examples were explained clearly	2 (7.41 %)	2 (0.074)
Short and effective explanations	1 (3.7 %)	1 (0.037)
Instruction helped me to understand size and shapes of spaces	1 (3.7 %)	1 (0.037)
Simple visuals and texts	1 (3.7 %)	1 (0.037)
How instructional content in slide presentation challenges learning (n=39)	9 (23.07 %)	10 (0.26)
Hard to understand the subject	3 (7.69 %)	3 (0.077)
New and nuanced concepts	3 (7.69 %)	3 (0.077)
More examples needed	2 (5.13 %)	2 (0.05)
Short instruction	1 (2.56 %)	1 (0.026)
Gray tone visuals	1 (2.56 %)	1 (0.026)
How instructional content in handouts challenges learning (n=27)	15 (55.55 %)	16 (0.59)
Hard to read long texts	6 (22.22 %)	6 (0.22)
Low quality visuals	3 (11.11 %)	3 (0.11)
Some examples were not explained in detail	2 (7.41 %)	2 (0.07)
Too theoretical explanations	1 (3.7 %)	1 (0.037)
More examples needed	1 (3.7 %)	1 (0.037)
Different fonts across different subjects	1 (3.7 %)	1 (0.037)
Monotonious text and visuals	1 (3.7 %)	1 (0.037)
Hard to understand the subject	1 (3.7 %)	1 (0.037)

3.7. Perceived facilitation of design

A majority of students in both groups found the instructional material helpful for the design task: 79% in the DI group and 82.1% in the ISP group (0.97 and 1.04 mpp, respectively), consistent with the shared content delivered through slides or handouts (Table 9).

Table 9. *Participants' perceptions of how instructional content in slide presentations and handouts facilitates/ challenges design.*

Concepts and Themes (Respondents: n)	Participants mentioned (% of Participants Mentioning)	Total Mentions (Mentions per Participant)
How / Which instructional content in slides facilitates design (n=39)	31 (79%)	38 (0.97)
Knowledge on human scale / space scale / scale / height / width / size	22 (56%)	22 (0.56)
Highly informative (no further details provided)	11 (28 %)	11 (0.28)
Learned about the psychological effects of building scale on humans	3 (7.5%)	3 (0.075)
How / Which Instructional content in handouts facilitates design (n=28)	23 (82.14 %)	29 (1.035)
Positive / Knowledgable (no details given)	14 (50.0 %)	14 (0.5)
Instructional material supports inspiration	5 (17.86 %)	5 (0.18)
I learned how should I approach design	3 (10.71 %)	3 (0.107)
Knowledge on human scale / space scale / scale / height / width / size	2 (7.14 %)	2 (0.072)
Helped designing staircases	1 (3.57 %)	1 (0.036)
Helped shaping spaces	1 (3.57 %)	1 (0.036)
Helped me to design circulation	1 (3.57 %)	1 (0.036)
Designing just after reading	1 (3.57 %)	1 (0.036)
Knowledge of human/space scale helped design decisions	1 (3.57 %)	1 (0.036)

In the DI group, 56% noted that concepts such as human scale, space dimensions, and proportions directly informed their design decisions. Another 28% found the content broadly informative, while 7.5% valued insights into psychological effects of scale, citing benefits for user experience. Although mentioned by a minority, such insights indicate that some students began to link spatial strategies with user-centred thinking—an indicator of higher-level conceptual engagement.

Among ISP participants, 50% offered general positive comments. In addition, 17.9% reported being inspired by the material, and 10.7% said they learned new design strategies. A smaller portion (7.1%) mentioned that knowledge of human scale and spatial dimensions contributed to their design thinking—echoing themes from the DI group.

4. Discussion

4.1. Summary of key findings

This study examined whether Direct Instruction (DI), designed according to principles of cognitive load theory and structured delivery (Rosenshine, 2008), outperforms the widely adopted Information Search Process (ISP) approach (Kuhlthau, 1991) in helping novice architecture students learn and apply fundamental spatial design knowledge—specifically regarding human scale. The results provide empirical support for DI in this context, showing both a higher rate of knowledge application in design tasks and reduced cognitive load during the problem-solving phase.

The strongest behavioral outcome was observed in the application of spatial concepts related to ceiling height (3DR2–3), with 17 out of 40 DI participants incorporating these strategies versus only 5 out of 30 in the ISP group. This difference was statistically significant ($\phi = .275$), representing a moderate effect size (Kim, 2017) and indicating a meaningful practical impact, particularly given the short duration and narrow instructional focus of the intervention. In contrast, no significant difference emerged for 3DR1, which was likely a result of prior exposure in earlier courses. This distinction suggests that the impact of instructional method is more visible when students are introduced to new, unfamiliar content—supporting Sweller's (1988) claim that guidance is most beneficial when prior knowledge is low.

Cognitive load measured after the design session was significantly lower for DI participants (Cohen's $d = 0.545$), despite no meaningful difference immediately after instruction. This supports the interpretation that DI helped

students store information in long-term memory in a well-structured format, enabling easier retrieval during problem-solving tasks.

4.2. Theoretical implications

These findings are consistent with information processing theory (Atkinson & Shiffrin, 1968; Baddeley & Hitch, 1974), which emphasizes the role of well-organized long-term memory in supporting cognitive efficiency. The DI group's ability to retrieve and apply information more effectively suggests that the structure and clarity of instruction played a key role in reducing cognitive load during the task. In contrast, ISP participants had to simultaneously search, select, and integrate relevant information—placing higher demands on their limited working memory capacity.

Our results also align with Jonassen's (1991) staged model of learning, which proposes that direct instruction is most effective in early learning phases, while constructivist strategies become more appropriate as expertise grows. In this case, the benefits of DI stemmed not from its structure alone, but from its ability to reduce working memory demands and allow students to focus their cognitive resources on problem-solving.

While the superior performance of the DI group may appear theoretically predictable under Cognitive Load Theory, it is important to note that this expectation had not been empirically tested within the context of early-stage architectural design education. Our study addresses this gap by showing that DI—when focused narrowly on a single concept and supported with worked examples and a recall test—can promote schema acquisition without relying on rote memorization. The findings suggest that DI serves not merely as a delivery method, but as a cognitively optimized learning process, enabling novices to apply knowledge under complex representational demands.

4.3. Positioning within the literature

To our knowledge, no prior studies have employed a similar post-test controlled experimental design to directly compare DI and ISP in architectural design education. For instance, Andjomshoaa et al. (2011) compared direct instruction and constructivist approaches in terms of retention, but their study lacked details on instructional content or implementation, making it unclear whether differences were attributable to teaching methods or other variables. Al-Sayed et al. (2010) reported that explicit knowledge of spatial configurations enhanced problem-solving more effectively than implicit knowledge, though their participants were experienced architects. Since experts and novices differ significantly in how they approach problems (Chi et al., 1981), direct comparisons are limited.

Nevertheless, our findings reinforce that clearly structured, explicit knowledge supports better outcomes in architectural design tasks, especially for beginners. Casakin (2008) also investigated the link between design problem-solving strategies and creativity in architecture students. However, the study did not employ a controlled instructional intervention. Instead, it used exploratory factor analysis—a method designed to identify latent variables rather than test causal effects of instruction—and applied regression analysis within a single-group setting. These methodological choices make it difficult to draw robust conclusions about the impact of any specific instructional strategy. These results add to critiques of minimally guided instruction in cognitive science (Kirschner et al., 2006), which argue that novice learners often lack the schemas necessary for organizing and integrating complex new information. Our findings show that constructivist exploration, while philosophically appealing, may not provide sufficient cognitive scaffolding in early-stage design education.

4.4. Knowledge application vs. skill integration

While DI participants mentioned significantly more target concepts in their reports (Cohen's $d = 0.53$), indicating long-term retention, no group differences emerged in overall quality scores of design proposals. This

discrepancy highlights an important point: conceptual knowledge is necessary but insufficient for high-quality design performance. Although students retained key concepts, they may not have developed sufficient procedural strategies to translate them into integrated design decisions.

This finding echoes Sweller's (1988) view that four types of knowledge—factual, procedural, strategic, and skill—must interact for successful problem-solving. Future instruction might benefit from techniques like worked examples and completion problems (Sweller et al., 1998), which promote the transfer of conceptual knowledge into skill through guided, contextualized practice.

4.5. Student perceptions and cognitive experience

Qualitative feedback from participants further substantiates the findings. DI participants articulated more specific takeaways from the instruction, such as the relationship between space height and human experience, whereas ISP participants offered more general or vague comments. Additionally, the ISP group more frequently reported cognitive fatigue and difficulty parsing lengthy texts, confirming the hypothesis that unstructured research tasks may overburden novice learners.

Both groups acknowledged that the instructional content was useful, but the DI group's ability to name specific concepts suggests a stronger internalization of learning objectives—likely aided by the focused scope and structured delivery of the material.

4.6. Limitations and future research

It is important to note that this study was limited to a single design session and a narrowly defined instructional topic. Broader generalizations should be avoided without further studies exploring a range of content areas, durations, and student levels. While categorical design behaviors were assessed with high interrater reliability, the quality scores—though analyzed—were explored for secondary insights but were not central to the study's hypotheses or statistical power considerations. Their fair-to-moderate consistency reflects the subjective nature of jury-based assessments and limits the strength of any conclusions regarding creativity or execution quality.

Future work should explore whether integrating direct instruction with worked examples, studio critiques, or media-rich simulations can further enhance transfer of knowledge and skill development. Longitudinal studies could examine the durability of learning and its application across design problems and semesters.

4.7. Toward systematic eclecticism in studio pedagogy

The findings of this study point to the limitations of relying solely on either constructivist or instructivist approaches in early design education. Snelbecker's (1974) systematic eclecticism offers a pragmatic solution by advocating for the deliberate integration of strategies from multiple learning theories based on learners' needs and objectives. Rather than rigidly adhering to a single paradigm, instructors can flexibly combine direct instruction, scaffolding, and exploratory methods to support novices while gradually fostering independence.

Empirical observations from studio settings support this hybrid approach. For example, Sawyer (2022) found that even in ostensibly constructivist studio environments, instructors frequently reverted to direct explanations of their own design reasoning—revealing a tacit form of eclecticism already at play. While this can support struggling students, it is often subjective and inconsistent. Complementing this, de Jong et al. (2023) demonstrated in broader instructional contexts that combining guided instruction with exploratory learning yields more effective outcomes than relying on either method alone.

To reduce dependence on idiosyncratic instructional delivery and better support student learning, foundational design knowledge—such as scale, material, structure, and form—should be conveyed through structured methods aligned with cognitive load theory (Sweller et al., 2019). This

ensures that students acquire the cognitive frameworks necessary for informed creative exploration. As a result, a better balance can be achieved between instructional guidance and learner autonomy.

5. Conclusion

This study investigated the effectiveness of Direct Instruction (DI) versus an Information Search Process (ISP) approach—commonly used in constructivist architectural education—for teaching the concept of "human scale" to novice architecture students. Addressing three research questions through a mixed-methods post-test control group design, the study produced three key findings:

- First (RQ1), significantly more students in the DI group applied the targeted spatial design strategies (3DR2–3) in their proposals compared to those in the ISP group. This indicates that DI was more effective in promoting the application of foundational concepts among novice learners. These findings support the conclusion that explicitly taught and well-sequenced knowledge enhances the accessibility and usability of foundational concepts in applied design contexts.
- Second (RQ2), cognitive load scores collected after the design session revealed a significant difference between groups: DI students experienced lower cognitive load, suggesting they were cognitively more efficient during the design process. This aligns with cognitive load theory (Sweller et al., 1998), which argues that clear instruction frees up working memory resources for active problem-solving.
- Third (RQ3), while both groups perceived the instructional content as helpful for learning and design, DI students more frequently and specifically articulated how the material supported their design decisions—explicitly naming *human scale* and related spatial concepts. In contrast, ISP participants offered more general or vague statements. This suggests that DI not only improved information retention but also supported metacognitive awareness, as reflected in students' ability to identify and articulate specific design principles guiding their decisions.

However, no significant difference emerged between groups in terms of design quality scores. This may be attributed to the basic nature of the instructional content and the limited design experience of the participants, which likely constrained their ability to translate retained knowledge into high-quality spatial compositions. This reinforces the need to distinguish between knowing what to apply and knowing how and when to apply it.

To bridge this gap, future studies should explore worked examples and expert modelling, which may help students internalize not just principles but also their application. As students build fluency, more complex and open-ended problems can be introduced, gradually transitioning toward constructivist approaches.

This study advocates for systematic instructional alignment with student expertise levels. For novice learners, DI aligned with cognitive architecture offers clear benefits in efficiency and retention. As learners progress, constructivist methods can play a greater role. We argue for systematic eclecticism—the deliberate combination of methods based on learning goals and cognitive readiness—as a productive strategy in architectural studio education.

Finally, this study underscores the urgent need for more controlled experimental research in architectural education. The field remains dominated by case studies, which, while valuable for exploratory insights, rank low in the hierarchy of evidence. Case studies alone cannot generate reliable or generalisable knowledge about instructional effectiveness. To advance architectural pedagogy as a scientific discipline, controlled designs—capable of testing causal relationships and minimizing bias—are essential. Only through such methods can we move beyond anecdotal accounts and establish evidence-based, transferable instructional strategies.

Appendix.

Appendix A

Open-Ended Survey Questions

The following open-ended questions were administered immediately after the final design session. They were structured to capture participants' reflections on the instructional and design phases of the study. Each question corresponds to specific thematic clusters reported in the qualitative analysis tables.

Part 1 – Reflections on the Instructional Phase

(Targets: "How/Which instructional content in slides/handouts facilitates learning/design" and "...challenges learning/design")

- *Can you describe your overall experience during the instructional phase of the study?*
  (General input – provides context for perceived instructional impact)
- *What aspects of the instructional content helped you better understand the subject matter?*
  (Feeds into: "How instructional content in [slides/handouts] facilitates learning")
- *What aspects of the instructional content made it difficult for you to understand the subject matter?*
  (Feeds into: "How instructional content in [slides/handouts] challenges learning")

Part 2 – Reflections on the Design Phase

(Targets: "How/Which instructional content in slides/handouts facilitates design" and "...challenges design")

- *Can you describe your overall experience during the design phase of the study?*
  (General input – used to assess student engagement and perceived fluency)
- *What aspects of the design process did you find challenging?*
  (Feeds into: "...challenges design" themes, both instructional and contextual)
- *What aspects of the design process did you find supportive or helpful?*
  (Feeds into: "...facilitates design" themes)
- *In your opinion, how did the instructional material (i.e. the worksheet / slide presentation) positively or negatively affect your design process and final output?*
  (Feeds into: overall perceived instructional impact on design — cross-validates themes from Q2 and Q6)

Appendix B

Thematic Coding Results from Design Reports

The list below presents the themes identified during the qualitative content analysis of student design reports, along with their frequencies in each group.

- Statements discussing the spatial relationship between the height of exhibited artworks and the height of the space:
  9 (ISP), 23 (DI)
- Statements referencing the presence of vertical voids:
  10 (ISP), 15 (DI)
- Statements about ceiling height and floor level differences:
  5 (ISP), 11 (DI)
- Statements expressing emotional responses to vertical spaciousness or compression:
  6 (ISP), 10 (DI)
- Statements explicitly referring to human scale:
  3 (ISP), 10 (DI)
- Statements referencing vertically moving structural elements:
  1 (ISP), 0 (DI)

Total frequency count: 34 (ISP n:30), 69 (DI n:40)

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Displaying the Turkish History Thesis & dealing with antiquity, its art and architecture in the early Turkish Republic

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Abstract
The Republic of Türkiye, founded in 1923 after a long series of wars, promoted cultural activities concentrating on the history of the state and nation in order to secure its authority both within and outside the country. An effective and significant element of these cultural activities was the conception and teaching of the Turkish History Thesis, claiming the continuity of the Turkish dominion of Anatolian and Eastern Thracian lands since prehistory.
This paper studies the Turkish History Thesis's perception of classical antiquity with a special focus on its material display at the exhibition held at Dolmabahçe Palace in 1937, on the occasion of the Second Congress of Turkish History organized by the Turkish Historical Society.

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Keywords
Antiquity, Classical, Exhibition, Turkish History Thesis.

1. Introduction

Formed after a period of wars (1914-1923), the young Republic of Türkiye faced many claims on its land from neighboring cultures based on historical bonds. In order to refute these demands while strengthening the identity of the citizens of the new country, the Turkish History Thesis (*Türk Tarih Tezi*, "Thesis" hereafter) was put forth. It was shaped under the politically guided environment of the 1930s, affected by the prevailing European trends in the study of the pasts of nations. The Thesis considered Turkish people as the inhabitants of Anatolia since prehistory, a continuous population who lived under different names. According to the Thesis, Turks migrated from Central Asia in prehistoric periods, and in addition to Anatolia, settled in various lands in China, India, Mesopotamia, Syria, Palestine, Egypt, Aegean Islands, Thrace, and Greece whilst introducing their culture and technical knowledge to peoples of those lands. By underlining the perceived similarities in different aspects of anthropology, linguistics, religion, and arts, the Thesis established a strong relationship between Turkish and Chinese, Indian, Sumerian, Babylonian, Median, Persian, Parthian, Sasanian, Egyptian, Hittite, Minoan, Mycenaean, Etruscan, Phrygian, and Lydian cultures. In line with the affinities found in these areas of study, the Thesis considered Sumerian, Hittite, Median, and Etruscan civilizations to be of Turkish origin while attributing certain levels of Turkishness to Minoans, Mycenaeans, Greeks, and Romans, which were regarded as shaped under the influence of the former civilizations mentioned. Thus, the Thesis presented a rather ambiguous accommodation to antiquity or classical antiquity within Turkish history. The earliest examples of this tendency can be seen in some of the cultural activities of the young Turkish Republic. The most symbolic among these can be deemed classical antiquity's inclusion to Turkish history exhibition held at Dolmabahçe Palace which was organized to accompany the Second Congress of Turkish History in 1937. A highly important event visualizing the claims of the Thesis for both scholars and the public, the exhibition's section of classical antiquity will be the focus of the following essay with original archival documents after brief information on the Thesis's approach to the period.

2. Perception of history in the period

As great empires dissolved, and nation states emerged in the late 19th-early 20th century, archaeology, anthropology, and linguistics served as a motivator in the search of the origins of nations. Cultures were deemed continuous within the borders of a state since prehistory and cultural assets unearthed were regarded as materials from a predecessor. These links with prehistoric communities gained significance after World War I, and in extreme cases, they were used as pretexts for occupations (McCann, 1994; Anthony, 2000; Arnold & Hassmann, 2000; for a compilation of different European national discourses which were influential until 1940's, see Ersoy, et al., 2010).

As it is well known, several neighboring nations demanded land from Türkiye in the early years of the republic (a phenomenon accented since the Ottoman Empire was marked as "the sick man of Europe" in the middle of 19th century). The issues faced by the republic can be summarized as following; Syria was under French mandate in the 1930s with borders officially determined in 1921 but the province of Hatay remained as an issue until 1939 (Khoury, 1987), Armenian policy on "Greater Armenia" emerging in the 19th century was resolved in 1923 with Treaty of Lausanne (for Nerses Varjabedian's visit to British ambassador Henry Lanyard in 1878 on the matter, see British Foreign Office Archive FO 424/68, no. 639) but the debates continued. Possibly the most well-known case belongs to Greece who sought to revive the former Byzantine Empire and form a state encompassing Western Anatolia, Crete, and Cyprus with Constantinople as the capital since 19th century and with the Asia Minor Expedition occupied Izmir in 1919 (Hamilakis, 2007, p. 53, 107). In the Treaty of Sèvres in 1920, Greece gained

some portions of Thrace and Western Anatolia (Erim, 1953, pp. 554-558) and after several battles had to leave Anatolia and Turkish Thrace following the Armistice of Mudanya in 1922 and the relations between two countries only began to normalize after the Greco-Turkish Treaty of Friendship in 1930.

All these occurrences pressured Türkiye to address the subject of legitimacy of the young state while citizens of the former empire were to be solidly reunited around a new national identity to prevent further conflicts. Within this context, Turkish History Thesis asserting that Anatolia had always been a "Turkish homeland" is widely related with the political and cultural issues of the era.

Different scholars explained the grounds for this new ideal with several prominent phenomena: asserting a deeply rooted presence of Turks in Anatolia against the demands of Greece, Syria, and Armenia, providing Turkish origins for the European norms and thus naturalizing their adoption in Türkiye, claiming that all citizens of the country were once Turks who forgot their mother tongue over time (Eissenstat, 2007, pp. 49-50); attributing a civilizing role to Turks in response to philhellenism that emerged in 18th century Europe (Copeaux, 2008, pp. 48-49); and proving the existence of Turks in Anatolia via modern scientific methods as a reaction against the contemporary Western thought which considered the Ottoman Turks non-natives in the country (Toprak, 2012, p. 204). The secularizing aspect of the Thesis has also been noted repeatedly since the Thesis evaluated Turkish history and identity separate from religion. Nevertheless, the variety of studies on Anatolian civilizations perceived as Turkish in the early years of the republic has been evaluated as the foundations for later research in archaeology, history of art, and architecture in Türkiye. The reflection of these diverse studies is found in the current tradition of site works undiscriminating towards different cultural layers (Özdoğan, 1998, p. 117, 2006a, p. 55; Ergin, 2010, p. 42; Güven, 2010, p. 52).

2.1. *Türk Tarihinin Ana Hatları* [Outlines of Turkish History]

Firstly, it would be appropriate to take a brief look at the narrative of the Thesis regarding classical antiquity in a schoolbook: *Türk Tarihinin Ana Hatları*. This book, which can be considered the most comprehensive manifestation of the Thesis, was prepared by the Turkish Historical Society's (Türk Tarih Kurumu, then known as Türk Tarihi Tedkik Heyeti) members, Afet [İnan], Mehmet Tevfik [Bıyıklıoğlu], Samih Rifat [Yalnızgil], Yusuf [Akçura], Reşit Galip [Baydur], Hasan Cemil [Çambel], Sadri Maksudî [Arsal], Şemsettin [Günaltay], Vasıf [Çınar] and Yusuf Ziya [Özer] in 1930 and printed hundred copies for revision by historians and intellectuals. It was widely criticized, generally based on the briefness of the section on Ottomans (Uzunçarşılı, 1939, p. 349). However, thirty thousand copies of its "Türk Tarihine Methal [Introduction to Turkish History]" and "Orta Asya [Central Asia]" chapters were published in 1931 and distributed to schools (İğdemir, 1973, p. 5) under the name *Türk Tarihinin Ana Hatları*: *Methal Kısmı*. [1]

The book highlighted that the first great civilization of Anatolia was Turkish: the Hittites, considered one of the main sources of classical antiquity, were regarded Turkish based on the era's archaeological data (*Türk Tarihinin Ana Hatları*, pp. 229-247). The collective work asserted that "the people of Asia Minor are Turks known under the names like Hittites…They are related to Sumerians and Elamites, the autochthon peoples of Mesopotamia. Indeed, the islands and the continent west of them, even Thrace, were initially populated with the same race [Turkish]" (p. 231) [2]. The Hittites were followed by the Phrygians and then the Lydians who influenced the Etruscans via linguistics and arts (pp. 247-254). The book considered the Aegean Basin in general to be of Turkish origin with a claim for the word "Ion" being derived from Turkish "iye", while regarding "Euboea" as derived from "oba" (pp. 265-266). The Thesis deemed the Cycladic culture of having Asian Turkish roots, while putting forward the idea that Mycenaean state was established by Turks (pp. 275-281).

According to the *Türk Tarihinin Ana Hatları*, which had a section titled "Yunan Medeniyetinin Doğduğu Yer Anadoludur [Greek Civilization Originated in Anatolia]", the Achaeans and Aegeans were Turks that built Minoan and Mycenaean civilizations, migrated to Anatolia during the Doric invasions and in turn, exported their culture to Greece (p. 285). As the chronology moves forward, the archaic and classical periods of Greek culture were explained with a strong emphasis on the contributions of Western Anatolia (pp. 293-304).

The Etruscans constituted another important section of the book, which described them as civilizers, animal domesticators, and pottery makers of prehistoric Italy (pp. 311-312). They were also considered to have been introduced to the Bronze Age culture via Asia Minor's influence, settling in Italy later. An inscription on the Lemnos Stele was used as further evidence for Lydian and Etruscan relations and to support the claim that Etruscans were one of the older Turkish nations (pp. 317-318).

Türk Tarihinin Ana Hatları mostly consulted the toponyms to relate them with Turkish identities, especially for Bronze Age cultures that were studied on the basis of phonetic similarities between languages. The target audience here was the pupils. The adults, teachers, and scientists were brought closer to the Thesis through a series of cultural events that will be detailed below.

3. First Congress of Turkish History: Dealing with antiquity or classical antiquity

One of the most important events in this regard was certainly the First Congress of Turkish History, which was organized by the Turkish Historical Society and held at Ankara Halkevi on July 2-11, 1932. The congress was the place where the Turkish History Thesis was proposed and discussed, although the main aim of the event was to inform history teachers about the new curriculum based on the Thesis ([Sagay], 2010, pp. 5-14). There was only a single paper on classical antiquity during this event, which was delivered by Hasan Cemil Bey [received the last name Çambel after 1934's Surname Law], the director of the Turkish Historical Society and a member of the national parliament, the conference was titled "Ege Medeniyetinin Menşeine Umumî bir Bakış [A General Overview of the Origins of the Aegean Civilization]". This contribution summarized the notions on how the Aegean civilization was shaped by the Hittites; the Minoans, Mycenaeans and Ionians, and how they were of the same roots (Turkish). He noted the brachycephalic nature of human remains in Crete and the skeleton attributed to Socrates as further proof for racial affinity [3]. According to Hasan Cemil Bey, classical Greek antiquity constituted only a small branch of Turkish History (pp. 199-214).

The first congress witnessed several objections towards the book *Türk Tarihininin Ana Hatları: Methal Kısmı,* and in turn, the Thesis. Most famous objections were raised by Zeki Velidi [Togan] Bey, titled "Ortaasiya'da Kuraklık Meselesi [The Issue of Drought in Central Asia]", questioning the official reasoning behind the Turkic migrations (2010, pp. 167-193) upon Reşit Galip [Baydur] Bey's paper "Türk Irk ve Medeniyet Tarihine Umumî bir Bakış [A General Overview of the History of Turkish Race and Civilization]" (2010, pp. 99-161). Zeki Velidi Bey's reviews were followed by a heated discussion between Zeki Velidi Bey and Reşit Galip [Baydur] Bey. It should be noted that after the first congress, all debates were included in the proceedings as discussions after the related presentations.

However, in the context of classical antiquity, Istanbul University's faculty member Fazıl Nazmi [Örkün] Bey's criticisms are significant. These were printed under the title "Liselerle Ortamektepler İçin Teklif Edilen Tarih Kitabında Nazarı Tenkidimi Celbeden Noktalar [Some Points Which Caught My Attention in the Proposed Book for High Schools and Middle Schools]" after Hasan Cemil Bey's presentation. While he mostly addressed the choice of words along with transliteration and typing errors in the schoolbook, his most detailed objections were re-

garding the identifications of Greek toponyms with Turkish words (2010, pp. 215-221). On behalf of the Turkish Historical Society, his criticisms were replied by Samih Rifat [Yalnızgil] Bey who claimed that the belief in the existence of autochthon Greeks were refuted by new data from recent archaeological studies and the toponyms must no longer to be deemed as Greek ([Yalnızgil], 2010, pp. 225-228).

The Turkish History Thesis evaluated classical antiquity as partly Turkish and partly shaped by Turkish influences, strongly refuting the term the "Greek genius". The Bronze Age predecessors of classical antiquity were regarded either solely Turkish (Hittites) or influenced by and mixed with Turkish people (i.e. the Minoans and Mycenaeans). The Phrygians, Lydians, Thracians and Etruscans were also seen as Turkish, and the inception of classical Greek culture was attributed to them. The Ionians were considered a continuation of the aforementioned Anatolian cultures and the "real geniuses". Therefore, even though the Thesis does not fully accept the Greek element in classical antiquity, it also could not completely integrate it to Turkish history. Rather, the Thesis chose to emphasize the role of "Anatolian Turks" in the development of classical antiquity to prevent its full credit to Greek history. Among several oppositions, Fazıl Nazmi Bey's challenges to the Thesis are significant in understanding that the Thesis was not broadly accepted by the classics scholars of the country and that the many claims for etymological continuity were deemed weak.

4. Second Congress of Turkish History: Dealing with antiquity or classical antiquity

The Turkish Historical Society organized the Second Congress, which targeted a wider audience, on September 20-25, 1937. Possibly due to its international format, the congress was held at Dolmabahçe Palace in Istanbul. The aim of the event was mainly to receive the approval of the international scientific community for the Turkish History Thesis, which had been studied further since 1932 with several archaeological expeditions throughout the country as presented by Afet İnan as the first paper "Türk Tarih Kurumunun arkeolojik faaliyetleri [Archaeological works of the Turkish Historical Society]" (2010, pp. 8-15) of the congress [4].

4.1. Proceedings: Dealing with the Etruscans, Greeks, Romans and Byzantines

Among 93 proceedings in the congress book, 47 are by Western scholars, many of them renowned, demonstrating the accomplishment of Turkish Historical Society in engaging international researchers.

Thesis's statements mentioned above regarding Etruscans being Turks while ancient Greek, Roman, and Byzantine cultures being shaped under influence of the Turkish cultures are represented in various papers of the congress.

Saffet Engin's (1900-1987) "Eti ve Grek dini sistemlerinin mukayesesi [Comparison of Hittite and Greek religions]" compared Central Asian Turkish religious elements with those of Sumerian, Hittite, Aegean, Cretan, and Greek belief systems, asserting that Greek mythology was only a continuation of products from Turkish conceptions (2010, p. 788). Engin presented some evidence for the Central Asian origins of the Hittites; furthermore, he claimed that the Etruscans were related to the Hittites, while suggesting that the double-headed eagle symbol originated from Central Asia, adopted by the Hittites and introduced to the Romans via the Etruscans (2010, p. 791).

Wilhelm Brandenstein's (1898-1967) presentation on "Etrüsk meselesinin şimdiki durumu [Present state of the Etruscan issue]" stated that the Anatolian origins of Etruscans was an undeniable fact based on ancient sources. According to Brandenstein, some characteristics of Etruscan culture, such as metalworking (especially zoomorphological styles), social life (women's role in family structure), religion (totemism), and language (plural suffixes) could be affiliated with Central Asian origins (2010a, pp. 215-218). The author said that the Etruscans might have lived in the same region of Central Asia around the same time as Turkish societies and might have migrated

first to Asia Minor and then to Italy in 9th century BCE, influencing their conquerors, i.e. the Romans (2010a, p. 219). Another article by Brandenstein, with similar assertions, "Etrüsklerin ve Tyrrhenlerin En Eski Tarihine Ait Dil Tetkikleri" also published in German as "Sprachliches zur Urgeschichte der Etrusker und Tyrrhener" appeared in *Belleten*'s issue 3-4 in 1937 (pp. 677-713, for German, pp. 714-751).

Wilhelm Brandenstein's second paper in 1937 congress is titled "Limni'de bulunan kitabe – Etrüsklerin Anadoludan neşet ettiklerinde dair dil bakımından en ehemmiyetli delil [The inscription found at Lemnos - Most significant evidence for Anatolian origins of Etruscans]" (2010b, pp. 1044-1051). This conference provided additional proof for this affiliation by studying the Lemnos Stele, which was presented in the accompanying exhibition. Brandenstein also published a book in Leipzig in 1937, *Die Herkunft der Etrusker*, studying the roots of the Etruscans.

Waldemar Deonna's (1880-1959) lecture at the congress, "Şark ve Kadim Yunanistan: Primitivisme = iptidaicilik ve Classicisme = klasikçilik. – Bunlar arasındaki mübadele ve muarazalar [The East and Ancient Greece: Primitivism and Classicism - Exchanges and conflicts between them]" studied the cultural exchange between ancient Greece and the "civilizations in the east", concluding that Eastern influences on Greek art should be deemed limited (2010, pp. 874-887).

Martin Schede's (1883-1947) paper, "Yunan ve Roma harabelerinin nevi ve ehemmiyetleri [Variety and importance of Greek and Roman ruins]" focused on the Greek and Roman architectural remains in Anatolia. Schede began with praising the congress and the exhibition: "This congress and exhibition are the most brilliant demonstration of the richness of Asia Minor in terms of antiquity. The recent interest of Turks towards the oldest cultural periods of the land is both natural and rightful" (2010, p. 794). Schede's paper commented on architectural examples from classical antiquity and their influence outside Anatolia (2010, p. 794, 801).

Georg Rohde's (1899-1960) paper titled "Roma ve Anadolu Ana İlahesi [Rome and the Anatolian Mother Goddess]" studied the common features of goddesses Kubaba, Kybele, Magna Mater, Artemis, and Diana, referencing the influencing nature of Anatolia in terms of religious history (2010, p. 237) [5].

In a similar approach, Clemens Bosch's (1899-1955) paper, "Tarihte Anadolu [Anatolia in history]" referred to a frequently used metaphor, Anatolia being "the bridge between Asia and Europe" that witnessed different cultures, while adding "Anatolia's role throughout history was not limited to providing passage. All foreign societies, all of which we know to enter Anatolia, settled here, gradually integrating with Anatolian communities and cultures" (2010, p. 802). Bosch continued with a focus on Roman and Byzantine civilizations; according to him, the Roman and Byzantine empires did not belong to a single society, the essence of their empire could be used by different societies and Byzantium showed a significant Anatolian quality. He mentioned that "A study and investigation of Byzantine monuments on Anatolian soil reveals that they have been created by Anatolians, certainly not by inexistent foreign Byzantine conquerors", and concentrated on the Anatolian features of Roman and Byzantine cultures. Bosch [6] claimed that the Mother Goddess cult witnessed in Anatolia from an earliest period laid the foundations for the later cults of Kybele, Magna Mater, Hera, Artemis, Aphrodite, Athena, Gaia, Leto, the Muses, and even the Virgin Mary (2010, pp. 806-807).

Gyula Moravcsik's (1892-1972) lecture "Türklüğün tetkiki bakımından Bizantolojinin ehemmiyeti [Importance of Byzantinology for the study of Turkishness]" studied Byzantine written sources that contained close relations with a variety of Turkish communities such as the Huns, Avars, Seljuks, Khazars, Göktürks, Pechenegs, Oghuzs, Kumans, Bulgars, Magyars, and Ottomans. The paper also commented on the Turkish influence on the Byzantines, "Byzantium learnt many things from Turks and borrowed

many civilized elements. Especially in terms of clothing, Turks had strong influence… In Byzantine military organization, influences of the Turks, especially those of the Göktürk and Avar can be found" (2010, pp. 486-487).

An overview of aforementioned papers of the congress shows that Saffet Engin, a member of the Turkish Historical Society with a background in sociology and education, made similar claims about relationship of the Etruscans with the Austrian linguist Wilhelm Brandenstein who would later become the director of the Institute for Comparative Linguistics at the University of Graz (1941-1967). Saffet Engin differs from Brandenstein in his strong belief for the Turkish nature of Anatolia throughout history and he can be described as an eager supporter of the Thesis, which can be also seen by his *Ülkü* article "Anadolu'da En Eski Türk Medeniyeti ve Cihan Medeniyetlerine Hakimiyeti [Oldest Turkish Civilization in Anatolia and Its Dominion Over World Civilizations]" in 1934 which described the Hittites as Turkish with heavy influence on ancient Greece. Engin also authored a three-volume book between 1938-1939 titled *Kemalizm İnkılâbının Temel Prensipleri* [Basic Principles of the Kemalist Revolution], which occasionally referenced the idea that classical antiquity had Turkish roots, even putting forward that "Introducing and promoting the works of Greek literature, philosophy and arts, which are Turkish in origin…is also a matter of national honor" (p. 115).

Swiss archaeologist Waldemar Deonna, a professor in the University of Geneva and curator of the Geneva Archaeological Museum and director of the Geneva Museum of Art and History, did not refer to claims of the Thesis while explaining that he saw little Eastern influence on Greek art. Similarly, German archaeologist Martin Schede who was the director of the German Archaeological Institute in Istanbul between 1937 and 1945 limited his paper to the features and importance of Greek and Roman art developed in Anatolia. German classical philologist Georg Rohde presented a paper describing the Anatolian origins of Magna Mater. He worked as a professor at the Faculty of Language and History – Geography in Ankara between 1935 and 1949, took part in efforts in establishing the department while educating many important Turkish philologists, including renowned Azra Erhat. Rohde also published the book *Büyük Ana Magna Mater* [Great Mother Magna Mater] in 1940 with Ankara Halkevi. German ancient historian and numismatist Clemens Bosch who worked as a numismatist at Istanbul Archaeological Museums in 1935-1939 and as an ancient history professor at Istanbul University between 1940-1955, focused only on the significance of Anatolia throughout history in his paper. Hungarian philologist and Byzantinologist Gyula Moravcsik who taught Byzantinology at the University of Budapest between 1936 and 1967, famous for his edition of Constantine Porphyrogenitus' *De Administrando Imperio* with R. J. H. Jenkins (Budapest, 1949), considered the influence of the Turks on Byzantine society in his paper. Thus, Bosch, Rohde, and Moravcsik indirectly supported the Thesis, but in the case of Moravcsik, the cultures regarded Turkic origin can be safely identified as such.

In parallel to congress papers, Remzi Oğuz Arık's 1934's paper on Karalar excavations in *Türk Arkeoloji Dergisi* mentioned that the "Greek miracle" could be dismissed based on the research of early 1900s, asserting the Hellenistic Period was nurtured by Anatolian motifs, techniques, and thought (p. 162). Arık was the first archaeologist of Turkey with formal education and directed many significant excavations of the country, such as Göllüdağ, Alacahöyük, Çankırıkapı, Karaoğlan, Hacılar, Alâddin Tepesi, and Bitik. His report on Alacahöyük works in early 1937 (which were included in the 1937 exhibition) also refers to "autochthone" people of Anatolia in the Chalcolithic Age who impacted later art (1937, p. 219).

Nationwide and international echoes of the second congress should be underlined here. Daily newspapers of the era, such as *Ulus, Cumhuriyet, Kurun, Akşam, Haber, Son Posta,* and *Son Telgraf,* widely featured the news of the congress, sometimes dedicating several pages to print the Turkish texts

of papers presented. They also give information about the live radio broadcast of the congress via İstanbul Radyosu. Ülkü magazine's news section in the issue of October 1937 focused on the congress and informed the readers about the closing speeches of congress, which were delivered by the foreign delegates [Richard] Hartmann and [Oswald] Menghin on behalf of Germany, [Jan] Rypka on behalf of Czechoslovakia, [Louis] Delaporte on behalf of France, [John Linton] Myres on behalf of England [7], [Stefan] Przeworski on behalf of Poland, [Ettore?] Rossi on behalf of Italy, [Eugen?] Zichy on behalf of Hungary, [Axel Waldemar] Persson on behalf of Sweden, [Jon] Nestor on behalf of Romania, [Spyridon] Marinatos on behalf of Greece, and [Fehim] Bayraktareviç on behalf of Yugoslavia ("Haberler", p. 178 and for daily newspapers "Tarih kurultayı muvaffakiyetli mesaisini dün bitirdi", p. 7) [8]. One of the reasons behind this success was surely a rich exhibition on Turkish history accompanying the event. The following section will focus on the exhibition's organization and the contents related to Etruscan, Greek, Roman, and Byzantine cultures.

4.2. Exhibition of the second congress of Turkish History

4.2.1. Idea and organization

To accompany the congress, an exhibition on Turkish history was prepared to present material evidence for different aspects of the Turkish History Thesis, while demonstrating the fast modernization of the young republic with a central section. Hasan Cemil Çambel's letter to Mustafa Kemal Atatürk on 24 May 1937 outlines the reasons for the request of Turkish Historical Society to prepare the exhibition which can be summarized as; demonstrating the tangible evidence to the scientific papers of the congress to prove the Thesis, presenting an up-to-date exhibit of the creativity and leadership of Turkish people throughout history, demonstrating the progress of the republic with documents from related government institutions, providing a venue for education of history teachers (BCA 030-0-010-000-000-117-817-10).

The highlight of the event was the opening ceremony led by Mustafa Kemal Atatürk, the founding president of Türkiye, on September 20, 1937, at 10.00 o'clock [9]. After the opening ceremony, groups of parliament members, congress guests and school teachers were given tours of the exhibition: the Paleolithic and Neolithic periods were explained by Şevket Aziz Kansu and his assistants; Bronze Age Turkistan, Iran, Egypt, Sumer, and Anatolia were presented by Hamit Zübeyir Koşay and his assistants and/or Hans Henning von der Osten and his assistants; the Bronze Age Mycenae, Aegean, Crete, Babylonia and Iron Age were narrated by Arif Müfid Mansel and his assistant and/or Helmuth Theodor Bossert and his assistants; the Greek, Roman and Byzantine section was highlighted by Aziz Ogan and his assistants; Eurasian Turks (Huns, Magyars, Göktürks, Scythians and Avars) were described by Reşit Rahmeti Arat, László Rásonyi, M. Fuat Köprülü, M. Abdülkadir Erdoğan and Mükrimin Halil Yinanç; the Ottoman Period was detailed by Hamit Ongunsu and Tahsin Öz and his assistants; miniatures and calligraphy were recounted by Fehmi Ethem [Karatay]; the Turkish Republic was explained by İhsan Sungu; and contemporary museums and excavations were summarized by Hamit Zübeyir Koşay (*Türk Tarih Sergisi Programı*, 1937). Even though we do not have a list for the curators, we know that there was a preparation committee chaired by Aziz Ogan, the general director of the museums of Istanbul (BCA 030-0-010-000-000-117-817-10). Nonetheless, we can assume that the scholars providing tours acted as the curators for the sections they had guided. This idea is strengthened by an article from September 27, 1937's *Tan* newspaper, informing us that in fact, Tahsin Öz selected the tiles to be included in the exhibition, while Abdülkadir Erdoğan selected the mother-of-pearl decorated artifacts ("*Tarih Sergisinin İçinden Röportaj*").

What is known about the preparations includes that the layout plan of the exhibition was designed by Martin Wagner, an employee of the Istanbul Municipality during the period (Oran, 1957, p. 83). In his oral history inter-

views, architect Feridun Akozan accounted his university years at the Güzel Sanatlar Akademisi (then Academy of Fine Arts, Mimar Sinan University of Fine Arts today), mentioning that he worked as an assistant to Wagner during preparations and they had assistance from Ankara Yapı Usta Okulu lecturers along with carpenters and masters from Yıldız Akademisi (Üşenmez, 1989). According to Akozan, Atatürk had visited the hall and observed the preparations every other day (Üşenmez, 1989). The maps used in the exhibition were prepared by Emin Halid Onat and Afet İnan (İnan, 2006, p. 117).

After Atatürk's request, it was decided to have the exhibit as a permanent feature at the palace; however, after remaining open to public for over a year between September 1937 and November 1938, the exhibition was dismantled upon Atatürk's death in order to place Atatürk's catafalque inside the Ceremony Hall of Dolmabahçe Palace (İğdemir, 1973, p. 45; Üşenmez, 1989).

Although the second congress has been studied by several scholars and its exhibition was briefly mentioned, its contents were not evaluated in detail before Özkılıç 2016 (e.g. see, Bayındır-Uluskan, 2010; pp. 266-267; Özdoğan, 2006b, pp. 37-39; Pala, 2008, pp. 93-94, 97-98; Atakuman, 2008, p. 229; Tanyeri-Erdemir, 2006, p. 385). There is no published catalog of the exhibition, and the data regarding the contents have been scattered among several sources. The majority of documents consist of the images and partial lists in the archives of Turkish Historical Society, which were studied and scanned by the author of this paper. Another important source is the *La Turquie Kémaliste*'s special issue for the congress (no. 21-22) with an introductory exhibition article by İhsan Sungu and a photography album at the end of the journal (Sungu, 1937 and "L'Exposition de La Société D'Histoire Turque 1937: Annexe Photographie", pp. 58-96). There are also several correspondence documents regarding preparations housed at the Presidency of the Republic of Türkiye, Directorate of State Archives (BCA). Proceedings of the congress, published as *İkinci Türk Tarih Kongresi, Kongrenin Çalışmaları, Kongreye Sunulan Tebliğler* (first in 1943 and then in 2010) provides insight into the motives behind the inclusion of artifact groups, while daily newspapers of the era have additional images and some complementary information for the contents not known from other sources. All these data allow us to reconstruct many important points: The presentation of the objects followed a straight chronology with twelve sections, A) Paleolithic and Neolithic; B) Chalcolithic; C) Bronze Age; D) Bronze Age; E) Iron Age; F) Classical Antiquity and Byzantium; G) Turkish Eurasian cultures; H) Turkish Central Asian cultures; I) Seljuks and Turkish Principalities; J) Ottomans (golden age); K) Ottomans (decline) and L) the Turkish Republic. Following a U-shaped plan inside the Ceremony Hall of the Dolmabahçe Palace, the exhibition had the republic at the center with another U-shaped structure (Figure 1). Thus, the section of the republic was visible from nearly all compartments of the layout. There were also two rooms that remained outside the exhibition area marked by curtained passageways flanking the bust of Mustafa Kemal Atatürk made by Josef Thorak (later purchased by the Turkish Historical Society). These

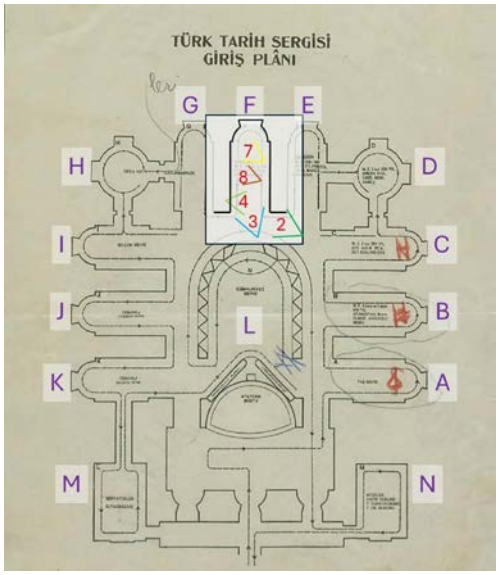

Figure 1. *Layout of the exhibition (altered from Boğaziçi University, Aziz Ogan Archive, OGNIST0101303 to include the codes of sections mentioned in the text and the numbers of the following photographs from the compartment of Etruscans, Greeks, Romans and Byzantines to show the angle they were taken from).*

two, rather remote spaces were situated towards the Ceremony Hall's entrance and housed two nonchronological exhibits: M) Turkish manuscripts and miniatures and N) Republic's history, museology, and excavation studies.

The financial support for the exhibition was essentially secured through the existence of the section on the republic since the budget of the Ministry of Culture fell short and was compensated by additional funds from ministries of justice, foreign affairs, finance, internal affairs, agriculture, health and welfare, economy, customs and monopolies, and public works (BCA 030-0-010-000-000-117-817-10). Two booklets were printed in parallel, *Türk Tarihi ve Eski Eserleri Sergisi Hazırlık Planları No. 1*, conveying the success of the governmental institutions in modernization, and *Maliye: Türk Tarih Kurumu Sergisi 1937*, explaining the principles and functioning of the Ministry of Finance.

Here, it is worth mentioning that the republic section of the exhibition leaned toward comparisons between the last 150 years of the Ottoman Empire and first 14 years of the republic as the state organizations visualized the impact of the reforms with graphs. An important kiosk of this section is titled "San'at [Art]" divided into two with "İmparatorlukta San'at [Art in the Empire]" and "Cumhuriyette San'at [Art in the Republic]", showing their different approaches to the fine arts. From the images selected for the sculpture and architecture (such as Ankara Sergi Evi, Camlı Köşk, Ulus Zafer Anıtı, etc. in comparison to Abide-i Hürriyet, Mekteb-i Tıbbıye-i Şahane, and Dolmabahçe Palace, etc.), we can deduce that the adoption and adaptation of contemporary art styles were one of the showcased values of the era.

4.2.2. Dealing with the Etruscans, Greeks, Romans and Byzantines

In the long chronology from prehistory to the Turkish Republic, the exhibition featured Etruscan, Greek, Roman, and Byzantine cultures as well. They were included as a group in a single section (one of the fourteen compartments in total), chronologically placed between the sections of the Iron Age and the

Figure 2. *Entrance to the exhibition's section on the Etruscans, Greeks, Romans and Byzantines (Turkish Historical Society Archive).*

Figure 3. *General view of the exhibition's section on the Etruscans, Greeks, Romans and Byzantines (Turkish Historical Society Archive).*

Figure 4. *Etruscan images with copies of the Nisyros grave stele and Branchid statue (Turkish Historical Society Archive).*

Figure 5. *Artifacts from Istanbul Archaeological Museums, from left to right: Bust of Alexander the Great, seated Kybele statuette and Ephebos sculpture (copy), also see Table 1 (Turkish Historical Society).*

Figure 6. *Artifacts from Istanbul Archaeological Museums, from left to right: Roman grave stele (copy), emperor Valentinianus II (copy), a magistrate statue (copy) and panel of Saint Eudokia, also see Table 1 (Turkish Historical Society).*

Figure 7. *Showcase for Greek Art, 5th-4th centuries BCE, the Hellenistic Era (Turkish Historical Society Archive).*

Central Asian Turks (Figure 1, Figure 2 and Figure 3). Since the exhibition program booklet names Aziz Ogan as the guide to guests of the congress, it can be assumed that he was the curator of this sector (*Türk Tarih Sergisi Programı*, 1937).

Exhibiting freestanding or wall-mounted sculptures, a sarcophagus, grave stelae, a column capital, and copies of a few architectural decorations and statues (Figure 4, Figure 5 and Figure 6), the compartment also housed two showcases for small finds (Figure 7 and Figure 8). The showcases were titled "Roma ve Bizans Sanatı [Roman and Byzantine Art]" and "Yunan Sanatı, 5:4 inci Asır, Helenistik Devri [Greek Art, 5th-4th centuries, Hellenistic Era]", they mostly contained terracotta, ceramics and metal vessels, figurines, and jewelry. Additionally, there were two smaller freestanding showcases, one for a rather large vessel and another for an unidentified structure model (possibly a Thracian tumulus, seen at the center of Figure 2). The display was supported by several images hung on the walls. As the showcases contained original small finds, freestanding objects were mostly gypsum copies of sculpture. This decision must have been made to decrease the problems of transport. Some copies carried on shelves on the walls must have provided more efficient use of the space as well.

The archives of the Turkish Historical Society do not have any artifacts list for this section, but their photography archive, along with images and articles appearing in the contemporary newspapers and *La Turquie Kémaliste*, enable us to identify the included artifacts. Table 1 contains a list of artifacts based on the pictures from the Turkish Historical Society Archive while Table 2 contains the list of images that can be seen supporting the display. [10]

The general outline of the section does not follow a strict chronology, the latest artifact of the section is a 12th century AD column capital, which is neighbored by a copy of an early Roman sculpture, marking the exit towards the Central Asian and Steppe Cultures section.

Most of the objects in this section seem to be loaned from Istanbul Archaeological Museums, while the Lemnos Stele that provided significant support for the Thesis must have been loaned from the National Archaeology

Museum of Athens in Greece (Figure 3, lower right).

The images supporting this section of the exhibition center around the creations of Anatolian architecture, including Pergamon's gymnasion, Temple of Demeter, Asklepion, and Red Hall Basilica, Ankara's Temple of Augustus and Byzantine Period tombs from Ürgüp. The nature of this selection seems to reflect the Thesis's emphasis on the Anatolian origins of the arts and architecture in classical and late antiquity (especially when compared to the vast variety of provenances seen in assisting images of the other sections like cultures of the Bronze and Iron ages, see Özkılıç, 2016, pp. 107-270). This idea is supported by İhsan Sungu's article on exhibition in *La Turquie Kémaliste*, which names this section as "F" and mentions that it demonstrates Anatolian influence on Greek and Etruscan cultures (1937, p. 17), indicating the selection was not strictly made by concerns of logistics.

As the congress papers refer to the Turkish History Thesis's claims about the Turkish origins of the Etruscan, Egyptian, Hittite, and Mesopotamian cultures that later shaped the Greeks, Romans and Byzantines, the exhibition also emphasizes the interactions between civilizations. The section contained a Kybele statuette, paralleling the presentations of Rohde and Bosch's centering on the mother goddess of Anatolia (Figure 5, center and Table 1). An object included to refer to linguistics; the Lemnos Stele, was one of the strongest pieces of material evidence for Etruscan and Anatolian relations. In addition to Brandenstein's paper, the stele was mentioned in *Türk Tarihinin Ana Hatları* as evidence for the said relation along with influence of Aegean languages on the Greek language (1930, p. 303, 317).

The artifacts of the showcases complimented the arguments of the Thesis as well; pottery and metal crafts of Anatolia were associated with Turkish influence. Freestanding architectural elements, a column capital, and a relief fragment also refer to a frequently mentioned Thesis claim that is a figurative aspect of Turkish artistry. Sculpture copies, figurines, and supporting images are mostly Anatolian finds, which

Figure 8. *Showcase for Roman and Byzantine Art (Turkish Historical Society Archive)*

can be deemed as a reference to original Anatolian creations in arts and architecture, also emphasized by the Thesis. The three images of Etruscan art highlight the Anatolian connection proposed by the Thesis (Figure 4 and Table 2).

Another part of the exhibition which must have had Greek, Roman, and Byzantine artifacts is the section referred as "coins minted in Anatolia since antiquity", implying a chronological arrangement. Although we know of its existence from Sungu's article (p. 19), there are no other visual or written records which could enable us to identify the artifacts displayed.

The material heritage from classical antiquity has been represented as a stage within Turkish History Thesis and its visualization, Turkish History Exhibition. Meanwhile, the intellectuals of the era were encouraged by this indirect sense of ownership and used the perceived familiarity of classical antiquity as a basis for their suggestions of integrating their written sources and languages in school curriculums [11]. From the archives of Istanbul Archeological Museums, we know that the exhibition resonated with the public since it was visited by 154,125 people between October 1937 and August 1938. Considering the population of the city at the time (741,148 people according to census in 1935, Uzman, 2020), this popularity can be attributed to the enthusiasm of the era fueled by the new

Table 1. *A list of artifacts based on the photographs from the Turkish Historical Society Archive.*

Artifact	Date	Provenance	Housing Museum	Period
Ephebos sculpture (copy)	Early Roman Period	Tralles	Istanbul Archaeological Museums, Inv. No. 1191 (T)	Roman Period
Model (tumulus cross section?)	Archaic Period (?)	_	_	Archaic Period (?)
Charioteer relief (copy)	last quarter of 6th century BCE	Kyzikos	Istanbul Archaeological Museums, Inv. No. 2813 (T)	Archaic Period
Seated branchid sculpture (copy)	mid 6th century BCE	Didyma	Istanbul Archaeological Museums, Inv. No. 1945 (T)	Archaic Period
Unidentified relief (copy)	_	_	_	_
Athlete's grave stele (copy)	480-450 BCE	Nisyros	Istanbul Archaeological Museums, Inv. No. 1142 (T)	Classical Period
Relief depicting two lions attacking a bull (copy)	8th - 9th century CE	Beyazıt	Istanbul Archaeological Museums, Inv. No. 229 (T)	Byzantine Period
Capital with Salome (copy)	12th century CE	Sebaste	Istanbul Archaeological Museums, Inv. No. 821 (T)	Byzantine Period
Fresco fragment	Byzantine Period	_	_	Byzantine Period
Relief fragment (copy)	_	_	_	_
Red-figure pottery	Classical Period	_	_	Classical Period
Magistrate sculpture (copy)	late 3rd century CE	Aphrodisias	Istanbul Archaeological Museums, Inv. No. 2266 (T)	Roman Period
Sarcophagus fragment? (copy)	Greco-Persian?	_	_	_
Lemnos Stele	late 6th century BCE	Lemnos	National Museum Archaeology of Athens, Inv. No. 13644	Archaic Period
Portrait of Alexander the Great	first half of 2nd century BCE	Pergamon	Istanbul Archaeological Museums, Inv. No. 1138 (T)	Hellenistic Period
Kybele statuette	3rd-4th century CE	Nikeia	Istanbul Archaeological Museums, Inv. No. 787 (T)	Roman Period
Red-figure pottery, Lampsakos vase and 10 more different vessels	5th to 1st centuries BCE	_	Istanbul Archaeological Museums (?)	Classical Antiquity
9 different figurines	Hellenistic/Roman periods	_	Istanbul Archaeological Museums (?)	Classical Antiquity
2 diadems	Hellenistic Period		Istanbul Archaeological Museums (?)	Hellenistic Period
Mirror	_		Istanbul Archaeological Museums (?)	Classical Antiquity
Bust shaped steelyard weight	5th century CE	Herakleia Pontike	Istanbul Archaeological Museums, Inv. No. 6166 (M)	Byzantine Period
Bust shaped steelyard weight	Early Byzantine Period	_	Istanbul Archaeological Museums (?)	Byzantine Period
Icon of Saint Eudokia	late 10th - early 11th century CE	Lips Monastery	Istanbul Archaeological Museums, Inv. No. 4309 (T)	Byzantine Period
Chalice	9th century CE	Tiran	Istanbul Archaeological Museums, Inv. No. 1532 (M)	Byzantine Period
Plate	6th century CE	Aleppo-Stuma	Istanbul Archaeological Museums, Inv. No. 3759 (M)	Byzantine Period
Paten	6th-7th century	Lampsakos	Istanbul Archaeological Museums, 78 (M)	Byzantine Period
6 vessels	Byzantine Period	_	Istanbul Archaeological Museums (?)	Byzantine Period
Lamp	Byzantine Period	_	Istanbul Archaeological Museums (?)	Byzantine Period
Wrestlers' statuette	1st century CE	Antiocheia	Istanbul Archaeological Museums, 266 (M)	Roman Period
Bowl	Roman Period	_	Istanbul Archaeological Museums, 87 (ÇÇ)	Roman Period
Grave stele (copy)	Roman Period	Soa or Kotiaeion	Istanbul Archaeological Museums, Inv. No. 5 (T)	Roman Period
Statue of Valentinian II (copy)	4th century CE	Aphrodisias	Istanbul Archaeological Museums, Inv. No. 2264 (T)	Roman/Byzantine Period

Table 2. *A list of supporting images based on the photographs from the Turkish Historical Society Archive.*

Image of	Date	Provenance	Housing Museum	Period
Fresco detail from Tomb of the Triclinium	ca. 470 BCE	Tarquinia		Etruscan
Bronze cauldron	4th century BCE	Palestrina	National Etruscan Museum of Villa Giulia	Etruscan
Disc of Magliano	5th–4th century BCE	Magliano	National Archaeological Museum of Florence	Etruscan
Tombs	Byzantine Period	Ürgüp		Byzantine
Upper terrace of the gymnasion	2nd century CE	Pergamon		Roman
Temple of Demeter	late 2nd century BCE	Pergamon		Roman
Upper terrace of the gymnasion	2nd century CE	Pergamon		Roman
Asklepion	2nd century CE	Pergamon		Roman
Temple of Augustus	25 CE	Ankara		Roman
Red Hall Basilica	early 2nd century CE	Pergamon		Roman

global trends about national identities. Prepared in a very limited time frame (only four months from its inception on May 24, 1937, to its opening on September 20, 1937) with a very wide scope (from prehistory to 1937), the exhibition's success attests to the devotion of the state and scholars to the subject.

5. Conclusion

Following the fall of the Ottoman Empire, nation states sought new national identities and ideals, severing their ties with the empire. Among the most significant aspects of these efforts were policies on education and culture, with each nation emphasizing

their own national stance. Thus, the Republic of Türkiye, the sole Turkish state established after the Ottoman Empire, concentrated on the idea of Turkishness. The new idea did not limit itself to the Turkish states in Anatolia and Thrace and sought an uninterrupted chronological line between prehistory and contemporary history as it was emphasized by the *Türk Tarihinin Ana Hatları* and the contents of the two congresses mentioned above.

The congresses on Turkish history organized by the state reflect the efforts of the republic for the dissemination of these new ideals. In this context, the second congress held in 1937, gains more significance since it also had an exhibition emphasizing Anatolian civilizations accompanying an international symposium (a much smaller one would be organized in the Third Congress of Turkish History in Ankara in 1943, but lacked any reference to the claims of the Thesis).

The exhibition of 1937, laid out in a U-shaped plan inside the Ceremony Hall of Dolmabahçe Palace dedicated its center to the republic. Thus, the Turkish identity of the state was emphasized, while communicating the message that the young republic is the new patron and protector of the civilizations of the land. Moreover, the papers of the congresses showed acceptance toward Türkiye's patronage.

Despite their limited presence in the exhibition, the inclusion of Greek, Roman and Byzantine artifacts in the Turkish History Exhibition can be interpreted as a significant step towards the young Turkish Republic's acceptance of all architectural and archaeological remains of Anatolian cultures as its own, in spite of the tumultuous political environment of the early 20th century.

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Endnotes

[1] Both versions of the book contained the statements that "the aim of this work is to remind the dignified past of the great Turkish nation based on historical facts since their contribution and efforts to the earliest civilizations has been ignored and they have been made to suffer baseless accusations for centuries" (1930, p. 68 and 1931, p. 73).

[2] The quotes from the book have been translated to English by the author, while square brackets in quotations mark additions by the author as well.

[3] Anthropologic concerns of the period in determining differences between human races is an important component of Turkish History Thesis, which emphasized that Turkish people were regarded brachycephalic; this discussion on anthropologic classifications of human races was a very popular subject during the period and for its significance (see Toprak, 2012; Toprak, 2021).

[4] İnan gave the preliminary results of the excavations and surveys at following sites; Ahlatlıbel (1933), Karalar (1933), Göllüdağ (1934), Alacahöyük (1935-1937), Thracian mounds/tumuli (1936-1937), Ankara Castle (1937), Çankırıkapı (1937), Etiyokuşu (1937), Pazarlı (1937), Kuştepe (surveyed in 1937?), Izmir Namazgah (not dated) and Istanbul Sarayburnu (1937). It should be noted here that İnan, one of *Türk Tarihinin Ana Hatları*'s authors, is closely related to the development of Thesis as she reports that in 1928, upon seeing Turkish people being classified as "secondary" human beings in a history book in French, she informed Atatürk who delegated the task of researching the matter to her (İnan, 1939, p. 244). She continued her studies with

a doctoral dissertation prepared under supervision of Eugène Pittard in University of Geneva on anthropological nature of Turkish people. Pittard is an important figure seen as the creator of theoretical basis for the anthropological claims of the Thesis (Toprak, 2012, pp. 200-204).

[5] Rohde had to leave Germany and emigrated to Turkey in 1935 since he faced discrimination due to being married to a Jewish woman.

[6] Similar to Rohde, Bosch left Germany and emigrated to Turkey in 1935 since he faced discrimination due to being married to a Jewish woman.

[7] Myres also wrote a small piece praising the archaeological site studies, organization of the congress, and the exhibition (Myres, 1937).

[8] Both *Ülkü* and *Akşam* only wrote the last names, thus first names have been added inside square brackets by the author.

[9] On the same day, Atatürk also inaugurated the Museum of Painting and Sculpture at the Chambers of the Crown Prince of Dolmabahçe Palace. This opening might be the reason for the exclusion of contemporary Turkish arts in the exhibition on Turkish history.

[10] In the aforementioned letter from Çambel to Atatürk, Çambel refers to exhibition contents in addition to original artifacts, such as maps for each chronological section, high-quality photographs of sites and monuments, and models and copies from museums for the artifacts that could not be transported (BCA 030-0-010-000-000-117-817-10). All of these plans, including printing an exhibition issue of *La Turquie kémaliste* seem to have been actualized.

[11] The Republic's patronage of cultural heritage of the land continued after 1937 and notions of classical antiquity were adopted in line with the ideals of the republic from literature to architecture. A more in-depth analysis on the subject is being studied by the author in a PhD dissertation titled "Perception and Heritage Value of Classical Antiquity in Art and Architecture of Early Turkish Republic" at the History of Architecture program of İTÜ under the supervision of Prof. Dr. Turgut Saner.

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Reflective planning towards conservation and future of Sille

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Abstract
This study addresses the renewal of the Conservation Development Plan and Urban Design Guidelines for the rural settlement of Sille. Employing a reflective planning approach, it integrates mixed methodologies, including archival research, oral histories, and both analog and digital measurements. The research critiques conventional, top-down planning practices, proposing instead a dynamic, cyclical process informed by pilot projects and stakeholder participation. Key findings highlight the inadequacies of rigid planning methods in conserving rural heritage and underscore the need for multi-scalar, participatory strategies tailored to local contexts. This paper demonstrates how reflective integration of lessons from implementation phases can reshape planning decisions, contributing to sustainable, adaptive conservation frameworks. The insights from this study provide a replicable model for achieving holistic and resilient rural conservation.

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Keywords
Cyclical planning approach, Participatory conservation, Reflective planning, Rural heritage conservation, Sustainable rural development.

1. Introduction

Rural areas worldwide face significant transformations, driven by factors such as population decline, urban sprawl, loss of biodiversity, and shifts in agricultural practices (Scazzosi, 2018; Ruben & Pender, 2004). These changes, coupled with the growing urban population projected to double by 2050 (United Nations Habitat, 2022), place increasing pressure on rural settlements to adapt to new socio-economic and ecological realities. Yet, conventional planning approaches often fail to address the unique challenges of rural areas, leading to homogenization and the erosion of local identity (García-Esparza, 2015). Addressing these issues requires innovative methodologies that integrate heritage conservation with sustainable development.

Understanding and conserving rural heritage and local architecture has long been the subject of research and policy (Rapoport, 1969; Oliver, 2006; International Council on Monuments and Sites (ICOMOS), 1999). Traditional buildings in rural areas and their associated cultural practices and social rituals (Rapoport, 1969; Maudlin 2010), as well as vernacular architecture, which refers to traditional, anonymous, indigenous or regionally specific architectural forms (Oliver, 2006), are widely recognized.

In this study, rural conservation refers to the safeguarding and revitalization of the cultural, architectural, ecological, and social assets of rural settlements in a manner that respects their traditional forms while allowing for sustainable development. Drawing on the ICOMOS "Principles for Rural Landscapes" (2017), rural conservation is approached as a multi-dimensional practice encompassing tangible elements, such as vernacular architecture, topography, and agricultural infrastructure, and intangible aspects including community practices, local knowledge systems, and cultural identities (Elagöz & Baturayoğlu Yöney, 2020). It addresses not only the protection of individual structures, but also the preservation of the settlement's spatial organization, environmental context, and socio-economic resilience.

1.1. Rural heritage planning and legal framework in Türkiye

Rural heritage in Türkiye is under increasing threat due to population decline, displacement, and rapid urbanization. These pressures have led to the erosion of traditional values and weakened local economies, particularly in rural areas that lack institutional support (Akgün et al., 2014; Gülümser et al., 2011). In this context, conventional, building-centered conservation approaches are proving inadequate for addressing the complex challenges facing rural settlements.

Recent studies have proposed more holistic frameworks that go beyond the physical preservation of buildings. Güler and Kâhya (2019) introduce a five-stage model that emphasizes community participation, adaptive reuse, and ecological sensitivity. Their approach integrates local values and encourages heritage-informed planning. Similarly, Bilgin Altınöz (2023) stresses the layered nature of rural heritage and calls for management strategies that respect cultural identity, historical continuity, and governance dynamics. The reflective planning approach developed in the Sille case builds on these perspectives by promoting adaptability, feedback mechanisms, and iterative decision-making. It treats rural heritage not as a static artifact but as a living system shaped by cultural practices and ecological relationships.

Despite these evolving frameworks, implementation in Türkiye remains constrained by legal and institutional limitations. Law No. 2863 on the Conservation of Cultural and Natural Assets (Law on the Conservation of Cultural and Natural Property, 1983, Art. 3) defines four main site types: archaeological, historical, urban, and mixed (complex) conservation areas. Although urban conservation areas may include landscape or ecological features, many rural settlements, such as Sille and Cumalıkızık, are still categorized under urban designations, despite their strong environmental and topographical characteristics (Bursa Metropolitan Municipality, 2021).

This creates overlapping classifications and fragmented responsibilities. The separation between cultural and natural heritage governance, admin-

istered through distinct mechanisms, poses a major barrier to integrated planning (Elagöz & Baturayoğlu Yöney, 2020). Although the law allows for interpretive flexibility, its vague terminology can limit site-specific strategies grounded in landscape-based heritage understandings.

This study does not aim to provide a comprehensive legal review. Rather, it acknowledges that many rural areas with ecological and cultural significance are still managed through legal tools designed for urban or monumental contexts. The Sille case illustrates how rigid classifications and divided jurisdictions hinder adaptive planning. In response, the proposed model suggests a reflective and cyclical process that links planning with implementation through stakeholder engagement, pilot projects, and flexible tools, without requiring immediate legal reform.

The lack of rural-specific planning theories and forward-looking frameworks further complicates conservation efforts. Although rural sites often include architectural, ecological, and archaeological values, these are rarely managed through integrated strategies. For example, interim conservation guidelines issued by local committees are meant to guide interventions until full conservation plans are adopted. However, such instruments are usually generic and temporary, leaving heritage areas vulnerable during long delays in formal planning.

To address these gaps, flexible and locally grounded planning tools are needed. Village design guides are one such tool, as seen in cases like Balıkesir (Çorapçıoğlu et al., 2010) and Küre-Ersizdere (Öğdül & Olgun, 2015). These guides integrate local knowledge, ecological context, and community input. Yet scholars argue that a one-size-fits-all approach is not viable; each guide must be tailored to the specific character of the settlement (Boyacıoğlu et al., 2015). Ongoing participation and iterative revisions are essential to ensure their relevance and effectiveness over time (Öğdül et al., 2018).

1.2. Precedents in reflective rural planning

Reflective practice, as employed in this study, is grounded in the theory of reflection-in-action (Schön, 1984) and is further developed through its application in participatory and adaptive planning contexts (Willson, 2020). This approach prioritizes experiential learning through the iterative testing, evaluation, and modification of planning decisions based on site-specific feedback. Reflective planning treats conservation not as a linear, static process, but as a cyclical one, where pilot implementations generate new insights, shaping future design and regulatory strategies (Friedmann, 1987; Janssen et al., 2017).

To better contextualize the Sille case, several international and national rural planning models provide useful precedents. The European Union's Liaison Entre Actions de Développement de l'Économie Rurale (LEADER) Programme illustrates community-led rural development via Local Action Groups that promote site-specific strategies blending conservation, economic diversification, and adaptive governance (Dax & Oedl-Wieser, 2016). In Scotland, rural frameworks support skills transfer, adaptive reuse of heritage assets, and phased project implementation shaped by stakeholder input and evolving needs (Shucksmith, 2010). England and Ireland treat rural areas as core to national identity. Ireland's Village Design Statements, which gained traction in the 1990s, emerged from valuing local distinctiveness and community-scale planning (The Heritage Council, 2012). These are supported by a hierarchy of tools; Local Plan, Village Development Framework, Village Design Framework, and Village Action Plan, that structure planning comprehensively (Çevik & Eminağaoğlu, 2007).

Since the 2000s, guides have emphasized community involvement, reflecting shared values and local character. Ireland, in particular, centers "place," "character," and "community" in its design approach (The Heritage Council, 2012), often integrating participatory principles and sensitivity to local identity. The Village Design Framework and Village Action Plan are developed collaboratively with residents. The Landscape Character Assessment method, first created by the British Countryside Agency for village

guides, identifies distinct landscape features (Öğdül et al., 2018). In Türkiye, the Küre-Ersizdere Village Design Guide demonstrates how local engagement and tailored design regulations can preserve rural identity through a participatory, site-sensitive process (Öğdül and Olgun, 2015). The management framework of Cumalıkızık (Bursa Metropolitan Municipality, 2021), a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site in Bursa, reflects a reflective trajectory wherein the original conservation approach has been periodically revised in response to monitoring outcomes, evolving tourism dynamics, and resident participation.These practices exemplify how village design tools integrate with broader planning strategies and underscore the importance of participation and local specificity.

Across these examples, several parameters emerge as critical for reflective and sustainable rural conservation: (i) participatory engagement with local communities; (ii) integration of traditional knowledge and ecological data; (iii) iterative design and policy revision based on real-world outcomes; (iv) interdisciplinary collaboration among planners, ecologists, historians, and residents; and (v) the linking of conservation strategies to long-term socio-economic viability.

The Sille case both adopts and adapts these parameters. It aligns through its participatory design process, documentation of local construction knowledge, and implementation of pilot projects. Uniquely, it institutionalizes reflection as a central tool for planning revision, making the planning instruments themselves—Urban Design Guidelines and Conservation Development Plan—open-ended, adaptive, and grounded in implementation feedback. This approach positions Sille as a model for cyclical and participatory rural conservation planning.

This study discusses the potential of reflective, participatory, site-specific, and site-relevant planning approaches in contemporary conservation literature through the revision of Sille's existing conservation plan by asking the following questions: What tools and methods can support planners' reflective practice in rural conservation planning? How can reflective planning contribute to sustainable and resilient rural development? What are the obstacles and limits to the practical implementation of reflective planning approaches?

Sille is a rural settlement in north-western Konya, a major city in Central Anatolia in Türkiye (Figure 1). The proposed Conservation Development Plan (CDP) for Sille was designed with a multi-disciplinary, multi-layered and multi-scale approach in contrast to the two-dimensional and top-down approach of the existing plan. The CDP aims to create a holistic approach to conservation by incorporating landscape, natural areas, infrastructure, street use, lighting and urban identity as key components of the plan and considering local dynamics. In addition, Urban Design Guidelines (UDG) were prepared and integrated into the CDP to provide guidance to property owners, authorities and designers. In parallel, several pilot projects were conducted in the region to test the planning process. The design and implementation of the pilot projects considered the unique characteristics of the region, and local construction techniques were documented and applied in collaboration with local artisans. The participatory approach of the pilot projects provided new insights and experiences that helped to revise the CDP and UDG decisions. Unlike general approaches that focus only on protecting monuments and individual buildings, the new CDP proposal is designed to be flexible and adaptable to different circumstances. By establishing a circular relationship between planning and design guideline decisions and implementation experiences, this study sets an example of a reflective planning process that can be replicated in similar contexts to achieve comprehensive and sustainable rural conservation plans.

2. Mixed methodological approach

The built environment of Sille has suffered a significant loss due to past migrations. In heritage areas like Sille, which are severely damaged,

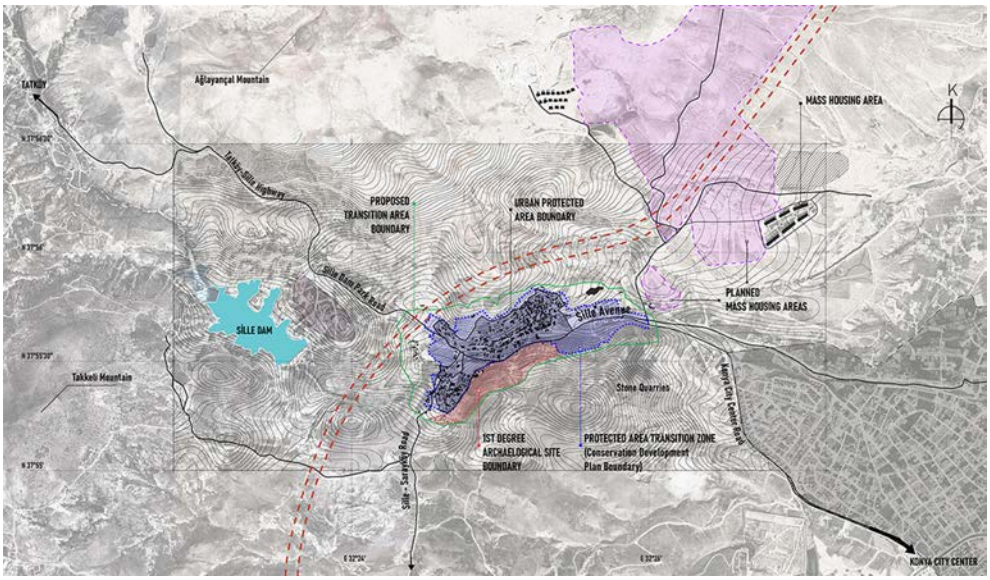

Figure 1. *Sille settlement and its surroundings.*

characterized primarily by vernacular architecture and unique geographical conditions, conventional planning methods and modern technologies alone are insufficient. To provide a comprehensive understanding of the built environment, manual methods, such as archival reseco arch, field analysis, oral history, and on-site inspections, must be employed in conjunction with contemporary digital tools. To this end, the study uses a mixed methodology that combines three-dimensional (3D) mapping, comparison of archival and current data, field research, and in-depth interview techniques. The study was carried out by a large project team composed of experts from different disciplines working simultaneously at different scales (Figure 2). The project team consisted of architects, heritage consultants, planning consultants, landscape consultants, lighting consultants, visual identity and orientation consultants, infrastructure consultants and fire safety consultants. During the process, the project team collaborated with various experts from the local municipality.

We started the process with a comprehensive documentation to analyze the region and the settlement. This was done in three steps. First, we recorded, compared and confirmed all relevant written sources and recent measurements of the area. Then, we created a 3D model base layer that accurately depicted the entire topography by integrating orthographic drone imagery. Finally, we supplemented the drone imagery in areas not captured, including regions under edges, corners and trees, with analogue measurements.

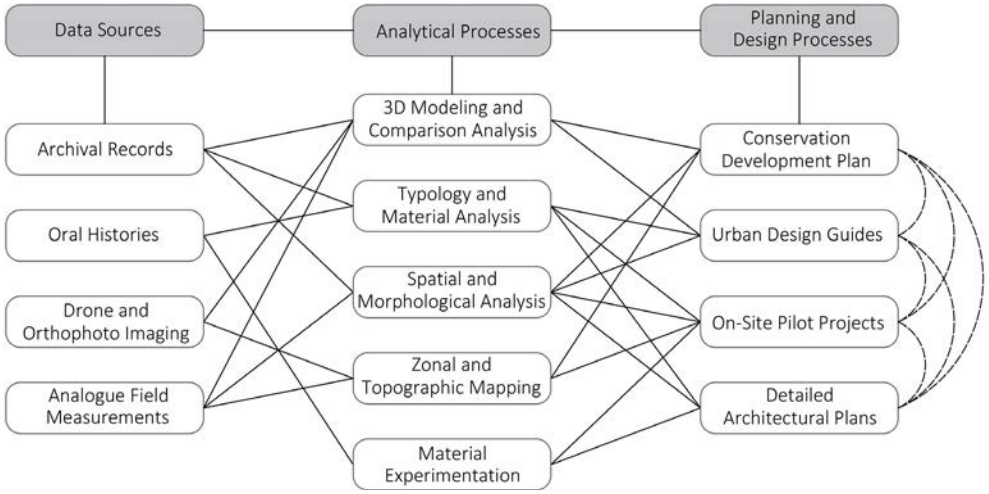

Figure 2. *Methodologic network diagram.*

The result of this work was a detailed record of the existing situation of the study area in 2022, depicting the settlement and its natural valley with minimum deviation. Following this study, we carried out a thorough analysis of the terrain, using data from sources that can be grouped into four categories; (i) dissertations, books and research on Sille, (ii) interviews with local government employees who used to work in the village, the local authority (village headman) and village inhabitants, as well as the results of surveys conducted by the local government, (iii) maps, old land use plans and aerial photographs used by local and central authorities (data on population, topography, cultural values, vegetation, climate, development/decay of the village over the years, permits issued, number of shops opened, etc., (iv) findings from observations made during visits to the village and workshops conducted in the village office.

In order to identify the lost building fabric, we adopted a multifaceted approach, based on the analysis of various historical sources and field studies. In the first phase, photo albums of the municipality and aerial photographs from the General Directorate of Mapping, dating from 1951 to 1998 were scrutinized to identify changes in the building fabric and to provide an approximation of the appearance of the village in the early 20th century. In addition, we compared 3D drone scans and recent photographs taken from similar perspectives with historic photographs to identify the deterioration of buildings. To fill in missing information, we conducted a comprehensive field study that lasted 18 months. In the process, two researchers meticulously examined each building, extracted information from old cadastral plans and conducted interviews with the village headman and building owners. The data obtained from these various sources was then combined to create a comprehensive and detailed 3D model of the settlement, including the relationships between buildings, blocks and the surrounding topography, allowing for a more complete understanding of the lost building fabric.

The existing conservation development plan of Sille was found to be inadequate for a number of reasons. It failed to address the traditional design criteria of the old town, such as the steep terrain, asymmetrical topography and historic building techniques. To address these deficiencies, we first studied the revised development plan in three dimensions and then transformed into two dimensions by considering the massing relationships between the buildings located on the plots. Then we combined the island-based designs incorporating the data obtained from the three-dimensional study to complete the overall planning layout.

In the planning process, we first divided the entire study area into sub-areas. Each sub-area was then assessed based on its individual requirements and potential, considering conservation principles and user needs. In the planning process, the conservation zoning plan, the urban design guide and the implementation of the pilot projects, were carried out simultaneously, rather than in a conventional, hierarchical and linear process. Throughout the decision-making and design process, we reflected upon cyclically the findings and experiences from these simultaneous studies, and revised the planning and design principles when required. This approach enabled the revised development plan to overcome the limitations of the previous plan and provide a more comprehensive and inclusive framework that respects the unique characteristics of the settlement.

3. Findings and analysis

The findings presented in this section build upon a reflective planning framework that integrates historical, spatial, and socio-cultural analyses with iterative feedback from site-specific implementations. Rather than proposing a prescriptive or fixed solution, the approach emphasizes cyclical learning, allowing planning strategies to evolve in response to contextual dynamics, an idea rooted in Schön's theory of reflection-in-action and further developed in adaptive planning discourse (Schön, 1984; Willson, 2020). By dividing the

settlement into sub-areas based on topography, typologies, and land use patterns, the planning process sought to align conservation principles with user needs while remaining open to revision. This method aimed not to replace previous planning efforts but to address their limitations, particularly the rigidity of hierarchical processes, by embedding participatory mechanisms and spatial diagnostics into a more responsive and localized conservation strategy. The following subsections discuss the analytical foundations of this approach and the resulting planning and design interventions.

3.1. Sille as a shrinking historical settlement

Sille, located in a valley approximately 8 km west of Konya in Central Anatolia, traces its origins to the Phrygian civilization in the 8th–7th centuries B.C., as evidenced by archaeological discoveries at the Sizma Tumulus (Belke & Restle, 1984). Known as Sylata or Sylla in antiquity, the settlement was a key stop along the King's Road from Ephesus to the east during the Roman era (Dawkins, 1916). During the Byzantine period, its position on the pilgrimage route to Jerusalem enhanced its religious significance, exemplified by the construction of Aya Eleni Church in 327 A.D., the largest church in Sille (Sarıköse, 2008).

Sille's prominence grew during the Seljuk and Ottoman periods. Under Sultan Alaeddin Keykubad (1220–1237), a structured settlement policy facilitated its expansion (Konyalı, 1964, while the Ottoman era transformed Sille into a vibrant, diverse community along the Silk and Spice Routes (Özönder 1998). Historical records from the 19th century document its population as a blend of Turkish and Greek residents, both Muslim and Christian, reflecting its inclusive social fabric (Aklanoğlu, 2009). The Lausanne Peace Treaty of 1923 marked a turning point, as the compulsory population exchange led to a social and cultural collapse. The departure of Sille's Greek population and the arrival of new settlers with limited resources disrupted community cohesion and accelerated the decline of its historic environment.

Losses in population were followed by losses in the physical environment. Insufficient resources and the lack of a sense of belonging among the new settlers from surrounding villages gradually damaged Sille, but the structures that have survived to the present day still provide an environment worth protecting. During the last two decades, some of the monumental buildings were restored and the population was encouraged to engage in trading activities. Although these measures have made Sille an alternative destination for day tourists, the settlement has not progressed beyond the status of a weekend destination, centered on a main street where commercial activities are concentrated, and has not been able to realize the potential of its history and topography.

Sille has become a popular tourist destination since it was declared a protected area in 2001 due to its proximity to Konya city center and its cultural values. The number of commercial enterprises for day and short-term tourists has increased day by day, and efforts have been made to integrate Sille into the popular tourist routes in Central Anatolia along with Cappadocia and Konya. Some restoration and renovation work carried out for this purpose have caused irreversible damage to the building fabric. Especially in the last 10 years, many buildings that form the historical fabric of Sille have disappeared or been rebuilt using new construction techniques, although it was possible to preserve them through partial reconstructions and appropriate restorations. These lost buildings have left a large gap in the urban fabric and interrupted the historical continuity of the built environment. Some of the lost buildings have been replaced by reconstructions that are incompatible with the original in terms of materials, construction techniques, dimensions and measurements. This has led to a deterioration of the historic building fabric that is difficult to restore. In addition to the destruction of the historic fabric, the lack of basic social facilities for the needs of the inhabitants has gradually increased, so that Sille has become a settlement that is inadequate for the people living here and only serves tourist visitors.

Based on aerial photographs showing the historical change of the built environment and data from official sources (General Directorate of Mapping, 2020), we found that the physical boundaries of the settlement gradually shrunk, the population decreased [1], the economic and social development weakened in the past periods and this change was reflected in the physical space. The 1925 photograph (Figure 3) shows that Sille was a densely populated settlement. Comparison of aerial photographs from 1951, 1975 and 2022 shows the fragmentation and vacancy of the settlement (Figure 4). The lost building fabric in the Karataş area, the southern section of Hacıali Ağa Street and the archaeological site are clearly visible. These changes reflect the broader socio-economic decline of the settlement. Residential areas remain compact and close-knit in the northern and eastern parts of Sille, while commercial activities are concentrated along the flat areas near the Sille stream.

3.2. Analyses of the built environment

Sille's physical environment, shaped by its valley location and surrounding mountains, including Takkeli, Ardış, and Gevenli, has profoundly influenced its built form and spatial organization. The Sille stream, fed by snow and rainwater, historically structured the settlement's layout. The tuff rock formations and microclimatic conditions allowed for the use of local materials and distinctive construction techniques. Due to the terrain structure, there are mainly sloping areas and the settlement structure is proximal and compact (Figure 5). The flat areas are located on both sides of the Sille Creek and are mainly the sections where commercial uses are found. The residential areas are located close to each other in the northern and eastern parts of the settlement [2].

The first conservation development plan for Sille was prepared in 1999 and this plan was renewed in 2016.

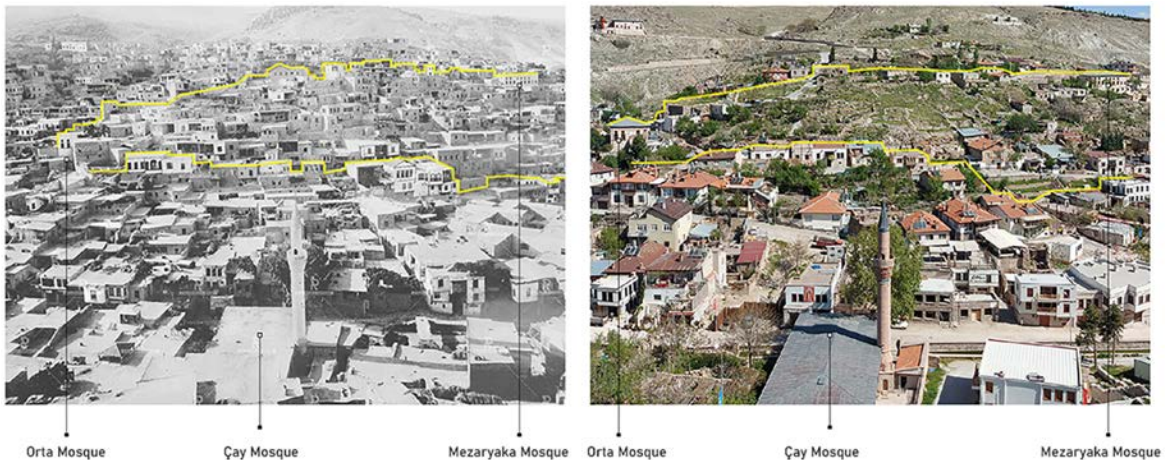

Figure 3. *Sille settlement in the early 20th century (left) and in 2022 (right).*

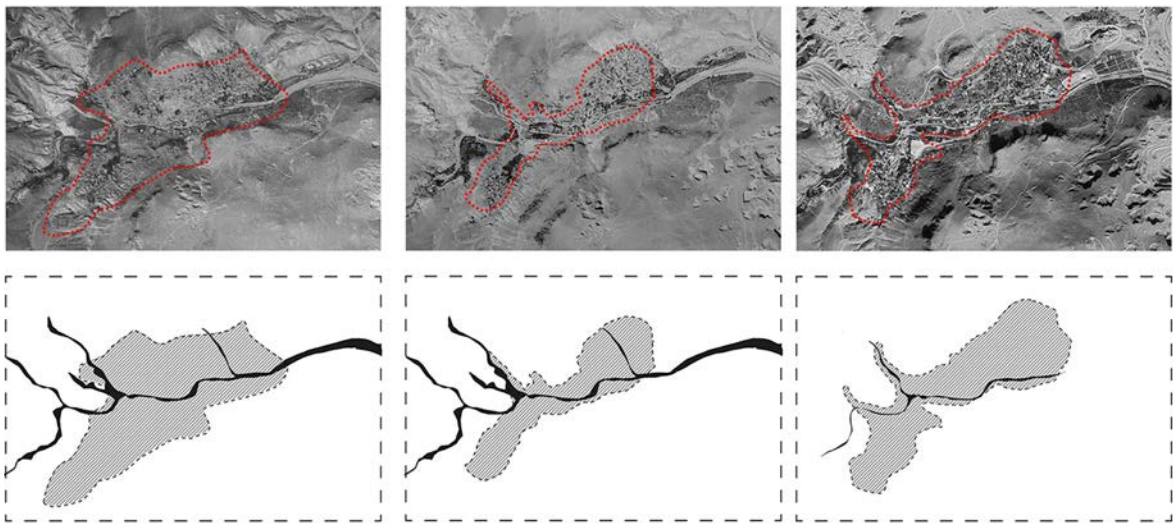

Figure 4. *Sille settlement trace in 1951, 1975 and 2022.*

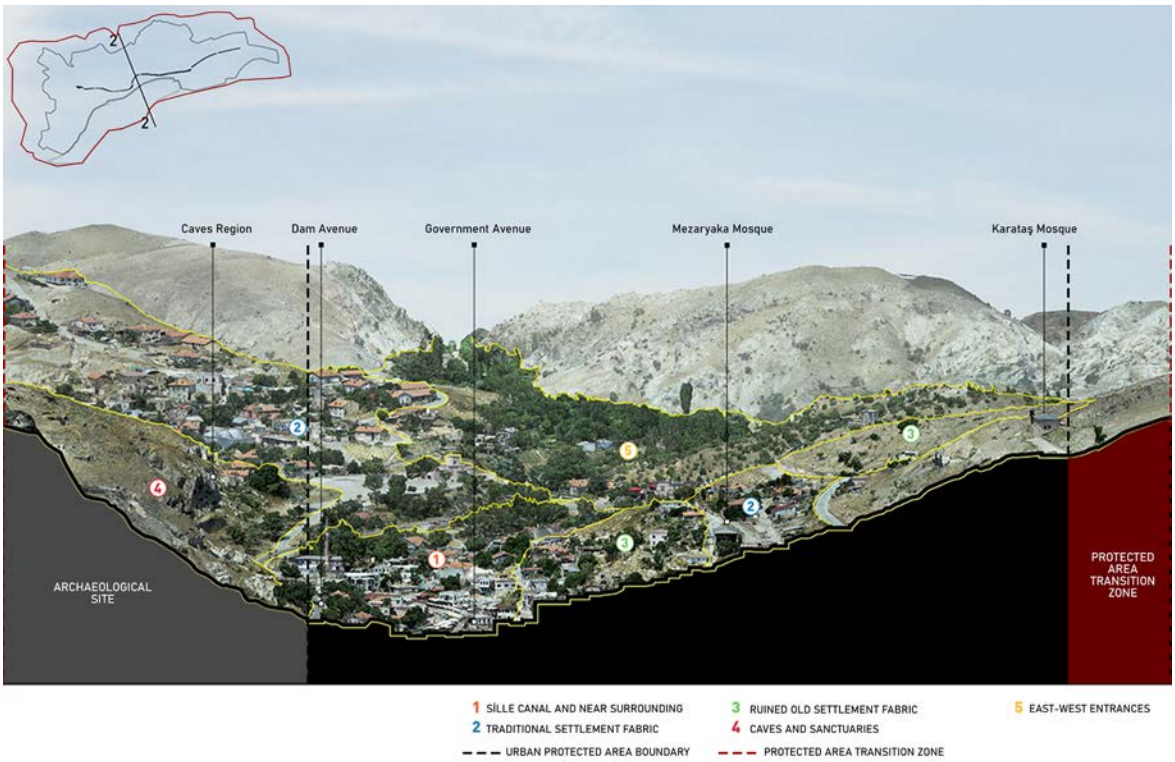

Figure 5. *North-south section of the settlement.*

The 2016 updated plan is still in force today. As its content and components (zoning plans and urban design guide) were not able to solve the problems that arose during the validity of the plan, the need for its renewal became apparent. The study was developed based on this need. One of the objectives of the proposed plan is to ensure the preservation and renovation of buildings on the one hand, and to make changes to provide the missing facilities and commercial diversity on the other. Based on this objective, we have adopted a holistic planning approach, encompassing not only the preservation of the historic buildings, but also all levels of the physical environment of the settlement, from waste collection and storage to the communication network. Another approach of the revised plan, based on the idea that the built environment forms a unity with its cultural and natural surroundings, is to protect Sille's historic values and natural resources by keeping them alive. To this end, we have given priority to the protection and preservation of values such as gastronomic culture, carpet production with root dye raw materials and the unique landscape. In line with these objectives, the revision of the planning aimed at preserving the historic fabric, repairing the worn parts and connecting them with the landscape, meeting the different user needs, and increasing the quality of the built environment and the open spaces.

The revised CDP addresses these issues by subdividing the settlement into characteristic zones based on topography, land use, and current conditions. This zonal strategy enables targeted, context-sensitive interventions. The plan emphasizes reconnecting fragmented urban spaces, preserving historic values, and integrating Sille's cultural and natural resources. Urban design guidelines complement the plan by providing detailed recommendations for restoration, landscaping, and wayfinding, ensuring consistency in conservation practices. Through these measures, the plan seeks to establish a sustainable framework for preserving Sille's unique identity while meeting contemporary needs.

Within the Sille Historic Site Area, there are a total of 60 registered cultural properties [3] (Figure 6 and 7). Substandard residential buildings without traditional architectural features are located in the existing Historic Site Area (Figure 8). The lack of conservation targets on the building pattern of

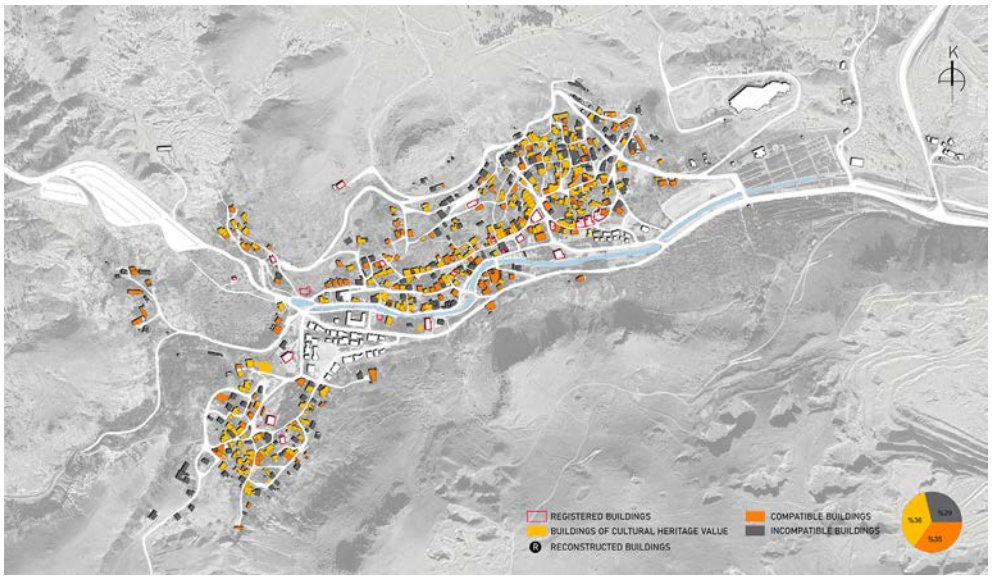

Figure 6. *Cultural value analysis of the buildings.*

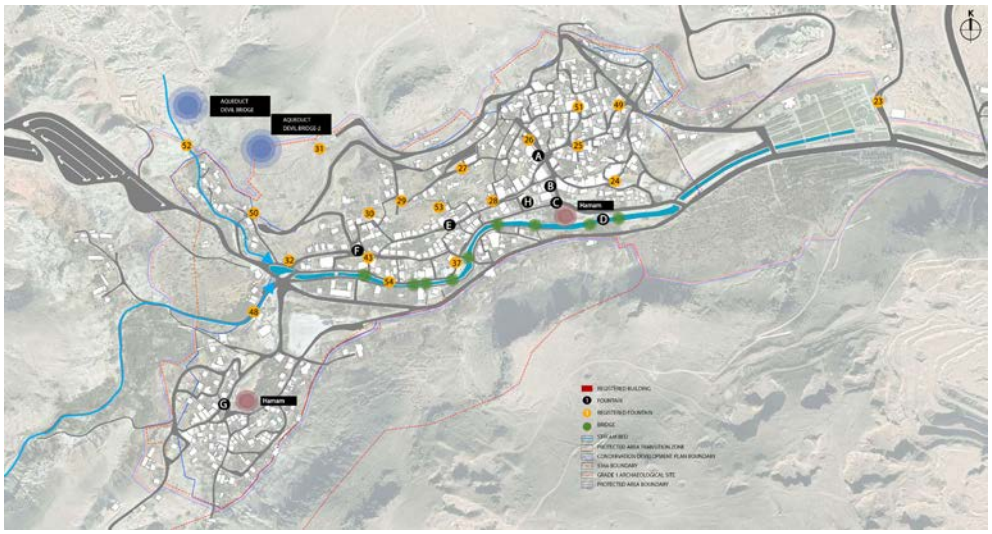

Figure 7. *Water resources of the settlement.*

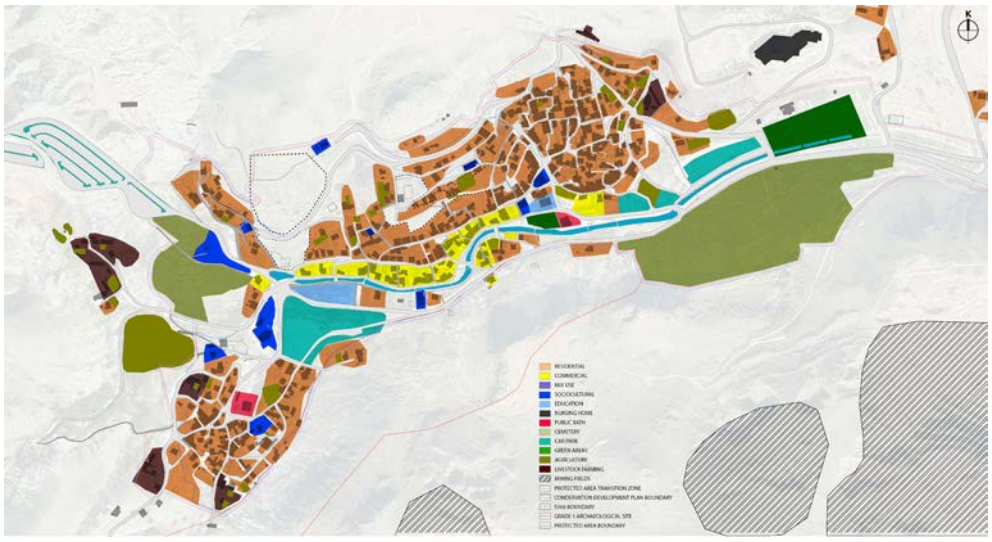

Figure 8. *Land use analysis of the settlement.*

non-traditional structures results in a decline in the quality of historic building fabric and street texture in the area. The streets in the Historic Site Area are quite narrow and reflect the traditional street pattern. There are no designated parking areas in the area. There is a Grade 1 Archaeological Site located on the southern boundary of the Sille Historic Site Area.

The analysis of the urban block patterns in Sille, based on their architectural configurations, reveals three main typologies: (i) high-density blocks characterized by attached row houses, (ii) low-density blocks where gardened dwellings are positioned centrally within the parcel, and (iii) courtyard-type blocks in which structures open directly onto the Street (Table 1). In addition to building typology, the street cross-sections also play a decisive role in shaping settlement patterns. The characteristic streets of Sille, defined by their topographical alignment, spatial orientation with respect to slope, relationship with the built fabric, and patterns of development across opposing façades, are illustrated through schematic sections in Figure 9. The analysis of the legal status revealed that land in Sille is owned by private individuals, municipalities, state treasuries and foundations. The current ownership status with a majority of individual parcels was taken into account in the preparation of building proposals in the CDP.

3.3. Planning and design studies

We divided the planning and design studies for Sille into four main categories: CDP, UDG, Projects, and Pilot Studies on-site. We first approached these studies within a scale hierarchy and based on the extensive analyses conducted in the study area. Macro-level plans were developed through ongoing field surveys, and information gathered was continuously integrated into the creation of UDGs. Throughout this process, new findings and knowledge from the implementation of projects and pilot studies in the region were used to revise macro-level planning decisions. The planning and design decisions made under these four categories are briefly outlined in the following subsections, followed by the examples of cyclical transitivity between categories.

Table 1. *Building block typologies.*

TYPE	TOP VIEW	AXONOMETRIC VIEW
TYPE 1 *High density attached row houses* *(Plot no: 29507)*		
TYPE 2 *Low density gardened houses* *(Plot no: 29452-53)*		
TYPE 3 *Attached houses with courtyards* *(Plot no: 29472)*		

3.3.1. Conservation development plan (CDP) renewal

The scope of the CDP includes both the existing urban conservation area, which is 32.8 hectares, and the transition area proposed for protection, resulting in a total planning area of approximately 107.2 hectares. The CDP aims to identify and protect the values that make up the urban fabric. These include registered cultural monuments, traditional buildings of historical significance, monumental trees, fountains, bridges and the unique characteristics of the settlement, such as the design of buildings, number of storeys, construction methods, relationships between buildings and parcels, and relationships between neighbors.

However, preserving the heritage of listed buildings in Sille has become a challenge due to various factors such as additions to the structures, interventions with inappropriate materials and techniques, porches, garages, changes in the proportions and materials of the cornices, alterations to the roofs and the forced incorporation of commercial functions into traditional buildings. As a result, the CDP aims to identify the values that give heritage significance to buildings that have been altered over time and have lost their original character, and the measures needed to revitalize them. Thus, the conservation approach adopted in the revision study is based on the findings of research in lost traditional building fabric.

The CDP study aims to identify methods for enhancing the visibility of the existing heritage through the selection of an appropriate function, followed by interventions utilizing suitable materials and techniques that improve the quality of life in the prevalent building fabric. In addition, a transportation analysis was conducted to understand the traditional street network of Sille. This involved comparing historic aerial photographs with old cadastral data to plan for pedestrian and vehicular access. The CDP focuses on preserving the environment and listed buildings as a whole, as opposed to protecting each building individually. The data collected on site was re-evaluated to create urban design guidelines. Furthermore, to understand the original construction techniques and materials of the listed buildings; original wall weaving techniques, stone-wood construction, Sille-specific joining techniques and materials were investigated through interviews with local experts and field research.

To ensure the CDP reflected spatial specificity and implementable strategies, the entire settlement was subdivided into eleven character areas based on landform, building typology, and existing conditions (Figure 10). For each area, design and conservation decisions were developed with tailored proposals and phased projections. For example, in the Karataş Valley Area, due to steep slopes and its position as a natural basin, the plan avoided intensifying development pressure and instead proposed the reactivation of traditional viticultural practices. Drawing from historical land use records, the area was designated for urban agriculture, incorporating vineyard terraces constructed using locally sourced stone. Where public land allowed, development rights were relocated to more suitable parcels through a land-swap strategy. This approach preserved the valley's landscape identity while offering ecological and economic regeneration opportunities.

The Ruins Area, located on a ridge between two residential clusters, was addressed as a strategic site for combined archaeological research and infill development. Historic photographs and site surveys confirmed the presence of a lost civic structure, and the masterplan designated a sub-zone for controlled excavation. Based on findings, the plan projected a mixed-use redevelopment scenario, combining cultural, residential, and green space programs. This area-based intervention illustrates the alignment between archival research, spatial analysis, and adaptive reuse strategies.

The basic approach of the plan and the project proposals focuses on the concepts of continuity, diversity and conservation. We emphasized the creation of green spaces, vehicular and pedestrian access, diversification of commercial activities, renovation of buildings and construction techniques, and preservation

of monuments, urban architecture and archaeological values. In line with these objectives, we divided the proposed plan into different layers to show the future development of the settlement. These layers include plans for land use, transport, tourism, landscape, lighting, way finding and infrastructure.

3.3.2. Urban design guidelines (UDG)

The Sille UDGs have been prepared and integrated into the Sille CDP to provide guidance to property owners, authorities and designers. The aim of the guidelines is to preserve the heritage of the settlement while meeting current and future needs with sustainable approaches. We consider the guidelines as reflective and evolving documents that can be adapted to new uses, changing needs and user feedback. Through the implementation of pilot projects, the guidelines will be further developed based on lessons learned. In conjunction with the CDP, we have developed four guidelines; on Building, Landscape and Amenities, Lighting, Visual Identity and Orientation.

The development of the UDG was strongly influenced by the differentiated needs and spatial conditions across the character areas. In Ak Neighborhood, one of the densest districts, the design guidelines were directly shaped by field surveys and resident feedback. Here, four

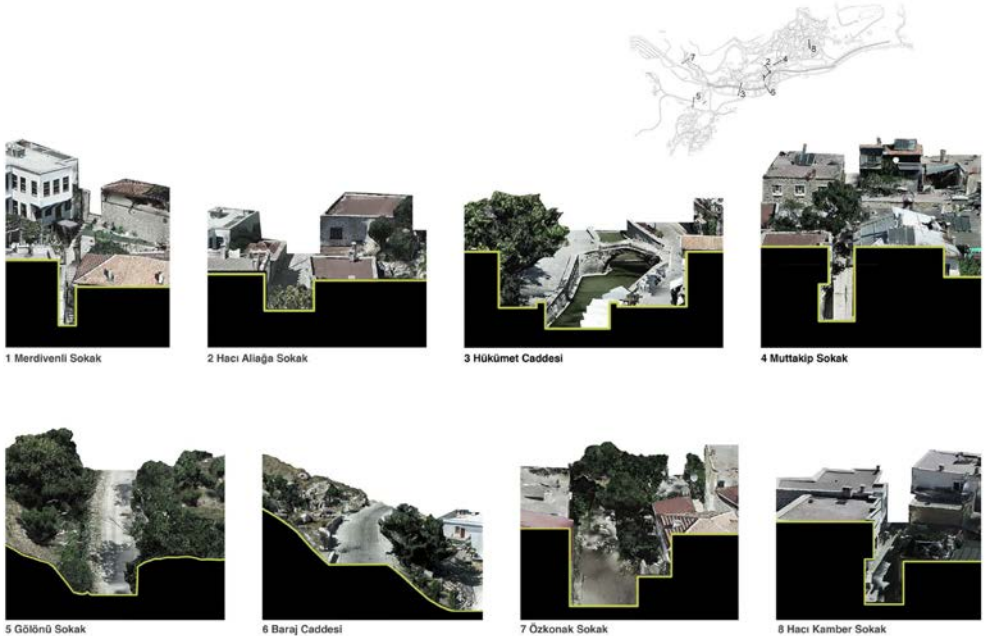

Figure 9. *Characteristic street sections.*

Figure 10. *11-character areas in the CDP proposal.*

civic squares (M1–M4) were defined at strategic street intersections. Each was programmed with specific uses, ranging from public seating and fountains to commercial kiosks, and material and signage typologies were adjusted accordingly. Plot-level design rules were derived from 3D massing studies, considering light penetration, visibility, and historic alignment with adjacent garden walls.

Likewise, the stone masonry standards and joinery details tested in stepped street rehabilitation in the Government Avenue Region were translated into material-specific clauses in the UDG. The participatory implementation process led to revisions in façade treatments, parapet heights, and allowable deviations for window openings, all of which were documented through comparative plan notes. The guidelines thus moved beyond descriptive instruction to become performance-tested regulatory tools, responsive to real-time field conditions.

In conjunction with the studies aimed at comprehending the settlement on macro scale and resolving its issues, we conducted investigations on micro scale to comprehend the structural solutions and details. Along with the compiled stone knitting catalog, we examined wooden and iron fabrications of complementary nature Interior elements such as wooden doors, windows, mirrors and cabinets in Sille houses were recorded and exemplified. We scrutinized the materials and characteristics utilized in flooring and roofing, as well as the fabrication techniques. In addition, some windows and doors made in Sille in various forms and styles were measured in detail and used as complementary system details. These measurements formed a model for the production of joinery with original shapes and details as specified in the UDG. We used all these specifications, which are relevant for the construction of new buildings or for renovations, to establish conservation principles.

3.3.3. Projects

In accordance with the CDP and UDG, we designed several pilot projects at different scales. These projects include the conversion of an old inn into a school, a 15-unit housing project built on the stone foundations of an old neighbourhood, and an urban design project for a main pedestrian axis along the Sille stream (Figure 6 11) that forms the backbone of the settlement. Through these projects, legally binding macro-level decisions were subjected to implementation, to test their relevance. In addition, various architectural firms were commissioned to restore four municipality-owned houses in order to test the overall studies from a perspective other than planning. These architectural restoration projects will

Figure 11. *Government Avenue Region project proposal.*

be prepared as a whole, from concept to tender documents. This method contributes to our understanding of the effectiveness of planning studies and design guidelines in practice and informs future planning and design initiatives.

In the Government Avenue Region, which serves as the main pedestrian and commercial axis, the CDP strategies were operationalized through an urban design and infrastructure project spanning nearly 3 kilometers. The initiative included the rehabilitation of stone-paved streets, creation of pocket parks, integration of public seating, and façade restoration guidelines. Projects such as the adaptive reuse of a historical inn into an educational facility, and the development of a multi-use square near Ak Hamam, tested the feasibility of both regulatory and design frameworks. This spatial testing helped refine the macro-level plan in terms of accessibility, material durability, and spatial continuity.

3.3.4. On-site pilot studies

Four stepped streets were reconstructed, and best practices for stone and paving identified during the construction process were standardized and incorporated into the UDG (Figure 12). Inappropriate practices were also documented as negative examples. A team of local stonemasons was trained in updated techniques through site visits and experimentation.

These interventions did not merely aim at physical improvement but functioned as live laboratories for testing the applicability of planning guidelines. Their implementation prompted real-time revisions in regulatory documents such as the UDG and CDP. In this sense, the stepped street restorations exemplify how pilot projects serve as reflective mechanisms within a cyclical planning system, enabling continuous feedback between design, application, and policy refinement.

In the Karataş Housing Zone, an infill residential cluster was designed based on the historic layout. Before construction, volumetric studies were conducted to harmonize with the topography and existing urban silhouette. Window sizes, cornice lines, and roof pitches were fine-tuned during the application phase, and the feedback informed updates in both UDG and CDP documents. Similarly, in the Subaşı (Kârhane) District, square designs and street furniture details were prototyped and revised in response to usage patterns and material availability.

Overall, the stepped street implementations provided tangible spatial improvements and brought immediate benefits to residents. They also reinforced community trust in the planning process and highlighted how iterative applications can strengthen planning tools through direct experience.

The reflective planning approach shed light on the interplay between four different categories as described in the subheadings, during the simultaneous planning and design work for Sille. The following examples illustrate this interaction.

We conducted UDG studies, often considered independent of the planning, in parallel with the planning process from the beginning. This involved digitally reconstructing the settlement in 3D and making decisions about massing. As part of UDG, we made decisions

Figure 12. *Stepped streets, on site studies.*

about the surface, color, stone texture, wood color, height of garden walls, and relationships between houses and garden walls in conjunction with the CDP. The layout and footprint of each lot was determined individually based on the topography, village silhouette and relationships between garden views and light penetration into neighboring plots.

During the implementation of the streets with staircases, we found that the houses opening to and accessed from these streets do not comply with any of the UDG and CDP regulations and are exceptions. We have included additional plan notes to the UDG and CDP to address the exceptions. Collaboration with local experts led to the exploration of various stone types from different quarries, masonry techniques, and paving options for the stepped streets. UDG choices were informed by these investigations.

While working on the urban design project for Government Avenue, an axis about 3 kilometers long, we developed solutions for any exceptional cases that might occur in other parts of the village. UDG was shaped by the outcomes of this experience.

In parallel with the CDP, another group of architects worked on two small houses in the settlement. They used the draft version of CDP and UDG and noted their comments and reviews with the planning team. This feedback led to flexible adjustments in window sizes, parapets, capstones, and garage door dimensions. Similarly, while conceptualizing a project for 15 parcels in the Karataş area, we adjusted bay window specifications, that gave designers more flexibility in choosing window sizes, balcony dimensions, and wall heights around the lots.

The cultural heritage of Sille is a complex mixture of various historical, natural, topographical, cultural and endemic features. Developing a conservation plan for the area is crucial to its future, and as such, requires great care to ensure that the settlement's structure does not become rigid. To this end, we conducted a series of projects and pilot applications in parallel with the CDP, utilizing different techniques, scales, and programs to adequately define the limits of flexibility. These processes took place over a period of more than 1.5 years, and while the above examples illustrate some of the interactions within the process, the contributions of the reflexive planning approach are too multi-layered to list individually.

3.4. Reflections on research questions

Reflective tools and methods used in the Sille case were characterized by their iterative, site-responsive nature. The combination of archival documentation, comparative aerial photograph analysis (1925–2022), 3D digital modelling, and typological assessments of urban and building fabric created a comprehensive base for understanding past and present conditions. These tools were not used in isolation, but embedded in a cyclical workflow, linking analysis, planning, and implementation. The multi-scalar mapping techniques and character area zoning enabled planners to test assumptions, revise priorities, and adapt conservation strategies. Moreover, pilot studies and material-specific experiments (e.g., stonework trials) functioned as real-world laboratories for verifying planning hypotheses. Thus, reflective practice was supported not just by representational tools, but by a hybrid methodology that embraced feedback loops between planning instruments and built interventions.

Reflective planning in Sille enabled a shift from rigid preservation to a more adaptive and sustainability-oriented framework. By embedding trial-and-error processes into the plan, particularly through pilot projects and onsite implementations, the approach fostered locally grounded solutions rather than prescriptive, one-size-fits-all policies. This method supported social resilience by actively involving local craftspeople, adapting design guidelines based on real-time feedback, and prioritizing public use areas, such as stepped streets and pedestrian corridors, which immediately improved accessibility and community engagement. The integration of environmental assets (e.g., natural water flows, endemic vegetation) into the planning layers further enhanced long-

term ecological viability. Ultimately, sustainability was not treated as an abstract goal but as a practical outcome of repeated reflection, calibration, and dialogue with the physical and cultural context of the settlement.

While the Sille case demonstrates the promise of reflective planning, it also reveals structural limitations that constrain its broader applicability. One significant obstacle was the challenge of monitoring implementation in a topographically complex and spatially fragmented environment. Although the planning team introduced detailed material guidelines and typological classifications, the absence of clear and enforceable supervision mechanisms led to inconsistencies on site, particularly during periods of political transition when regulatory oversight weakened. Moreover, reflective planning requires institutional continuity and learning capacity, which are often disrupted in local governance contexts lacking long-term administrative support. Another limitation lies in the difficulty of translating iterative, small-scale insights into formalized policies that operate across scales. In the absence of integrated governance and cross-sectoral coordination, the reflective approach risks remaining localized and vulnerable to reversal. These constraints underline the need to embed reflexivity not only in planning tools, but also within the operational structures of governance.

4. Conclusion

This study explored how reflective planning methodologies can be applied to rural heritage conservation, using the case of Sille as a comprehensive field of experimentation. It began with three interrelated research questions: (i) What tools and methods support reflective practice in rural conservation planning? (ii) How can reflective planning contribute to sustainable and resilient rural development? (iii) What are the obstacles and limitations to the implementation of such approaches?

The findings demonstrated that combining analog and digital documentation methods, typological analysis, and multi-scalar zoning can serve as a robust methodological base for reflection-in-action. These tools were not only analytical, but instrumental in iteratively shaping both the Conservation Development Plan (CDP) and Urban Design Guidelines (UDG). Their effectiveness was tested and validated through material experiments and built pilot projects. This integration of theory and practice underscored how reflective planning facilitates sustainability, not as an abstract goal, but through measurable improvements in spatial quality, community engagement, and ecological responsiveness. The outcomes also align with Schön's (1984) conception of reflection-in-action, in which practitioners iteratively redefine problems and test ideas through real-time engagement with the built environment. In the Sille case, this occurred through feedback-informed revisions of the CDP and UDG, grounded in lessons from site-specific pilot applications.

At the same time, the Sille case revealed key implementation challenges. These include the difficulty of monitoring in a complex terrain, inconsistent enforcement of design guidelines, and the fragility of institutional memory under shifting political conditions. Perhaps most critically, the findings point to a gap between the adaptability embedded in planning tools and the rigidity of bureaucratic and legal structures that often prevent responsive action. Bridging this gap requires not only technical revisions to planning tools, but also institutional learning structures capable of translating localized experimentation into regulatory transformation. Without formal mechanisms for integrating implementation feedback, the adaptive potential of reflective planning risks remaining isolated or episodic.

Despite these challenges, the case confirms that reflective planning can produce adaptive, grounded, and replicable models of rural conservation, when operationalized through site-based testing, iterative adjustments, and stakeholder dialogue. It calls for institutional frameworks that treat plans not as static instruments but as evolving tools responsive to feedback and change. Future studies could further investigate mechanisms for scaling up

reflective planning insights, exploring how such models can be formally embedded within national heritage policies or adapted to other rural contexts with layered cultural landscapes. Ultimately, this study suggests that conservation planning in rural heritage contexts should be conceived not as a conclusive act but as an evolving dialogue between space, society, and governance. The reflective planning approach tested in Sille offers a replicable model for designing open-ended, site-responsive, and participatory conservation frameworks in similar geographies.

Endnotes

[1] It is estimated that Sille had a population of 18,000 people with about 3600 households around 1900 (Tapur, 2009). Today, Sille has 1291 people living in 358 households, where the traces of the dense settlement structure of the past have been lost.

[2] According to the land use analysis within the planning area, 24.62% of the land is allocated for residential use, 30.19% for roads, 5% for commercial use, 0.97% for mosques, churches and bath houses, 0.46% for schools, 1.62% for social amenities, museums and community services, 18.93% for parks, 14.68% for cemeteries and 3.53% for the area surrounding the creek and fountains.

[3] Including 18 dwellings, 11 religious' buildings (4 churches and 7 mosques), 27 water structures (2 bathhouses, 1 laundry, 1 cistern, 3 bridges and 20 wells), 3 cemeteries and 1 military structure (barracks).

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Intervention to the building – Exploring the interrelations by systematic literature review

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Abstract
Various factors contribute to the obsolescence of a building or its part(s), and these are addressed through interventions resulting in physical alterations. In other words, intervention is a complex process involving the following components: building or its part(s), factors, obsolescence, and intervention approach (i.e. intervention type and criteria). Additionally, there are numerous intervention types, such as adaptation, conservation, maintenance, remodelling, renewal, replacement, restoration, strengthening, etc., whose contexts may sometimes partially overlap. Therefore, this study aimed to gain insight into the boundaries, interrelations, and differences within the scope of the intervention process through a systematic literature review of 170 articles. Firstly, the components of the intervention were examined and classified from key references. Subsequently, 170 articles to be analysed were determined through a literature scan. While reviewing these articles, the preliminary classification was refined, and the articles were systematically categorized accordingly. Finally, analyses were performed on the categorized data to understand the scope and focal points of each intervention component, the relationship between them, and the physical output of the intervention, namely the planned/executed application. In conclusion, it is observed through this review that parts of the envelope, which constitute the boundary between the external and internal environment, are generally the primary targets of intervention to remove the marks of physical and environmental obsolescence. Retrofit is the most common intervention type, typically applied to fulfil sustainability criteria, regardless of heritage value. Additionally, rehabilitation and restoration are frequently applied in heritage buildings, while refurbishment and renovation are more prevalent in non-heritage ones.

Keywords
Building envelope, Degradation, Retrofit, Refurbishment, Renovation.

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1. Introduction

The building life cycle, which is related to the assessment of the environmental performance of buildings, comprises a series of interconnected stages: product, construction, use, and end-of-life (British Standards Institution [BSI], 2011a, 2021). The use stage encompasses maintenance, repair, replacement, and refurbishment with the objective of extending the useful life of the building and preventing it from becoming partially/fully obsolete (BSI, 2011a; Douglas, 2006). In other words, interventions on different scales are applied to the building for this purpose, resulting in physical changes (BSI, 2013, 2017a, 2019; International Council on Monuments and Sites [ICOMOS] International Committee on Twentieth Century Heritage, 2017). These changes in buildings were classified by Markus et al. (1972) as: improvision – easily reversible and low-cost small physical changes, change – not easily reversible adaptation of the building system, and extension – addition of spaces. Similarly, Broadbent (1980) defined four categories as changes in furniture, fittings/finishes, services, and structure. Brand (1994) further developed this classification by considering the change period and changing layers and classified them from the most permanent to the most temporary as changes in site, structure, skin, services, space plan, and stuff. Within these classifications, interventions that cause changes appear in diverse dimensions.

The intervention process can be explained by examining its components, which can be identified through the questions "WHEREAT", "WHY", and "HOW". The response to the "WHEREAT?" question describes the subject of the process, that is, the building or its parts(s). Factors and obsolescence that address the "WHY?" question serve as the rationale for intervention. The response to the "HOW?" question represents the intervention approach, which defines the selected intervention type, and the associated criteria. In summary, these answers constitute the components of the intervention process as presented in Figure 1, which was developed by the authors as a conceptual framework based on the synthesis of the reviewed literature.

Regarding intervention types as one of these components, various classifications were usually done considering their main objective and the magnitude of physical changes that they cause. For example, Douglas (2006) listed them as preservation, conservation, refurbishment, rehabilitation, renovation, remodelling, restoration, and demolition. Similarly, Vos and Storgaard (2018) proposed a hierarchical classification ranging from the least to the most extensive as preservation, conservation, restoration, refurbishment, rehabilitation, renovation, conversion, and retrofit. Pereira Roders (2007), considered deprivation and demolition as initial and ultimate levels respectively, and listed among them preservation, conservation, restoration, rehabilitation, and reconstruction. Regarding conservation, Zhang and Dong (2021) defined intervention levels from low to high as maintenance, repair, renewal, reuse, and new design. Furthermore, interventions were classified according to their application time during the building life cycle such as in the report of the International Council for Research and Innovation in Building and Construction [CIB] Working Commission W60 (1982) where restoration was considered to be a more complex intervention following maintenance. Likewise, priority was another perspective in the classification as in BS ISO 15686-7:2017 (2017b) where interventions applied during the use phase of building life cycle were outlined to be maintenance, refurbishment and repair, replacement, and renewal respectively.

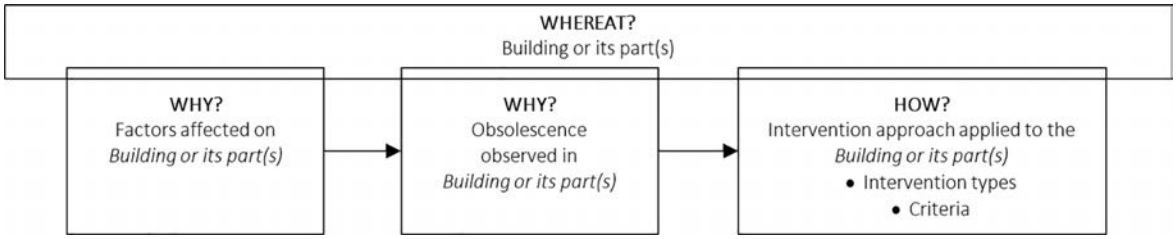

Figure 1. *Intervention process and its components.*

Most of these intervention types were explored usually individually in various literature review papers, delving into their implementation scales, factors considered, and obsolescences causing them to consider a particular focus. Sustainable development was a common focus in this respect, where, for instance, life cycle assessment of building refurbishment (Vilches et al., 2017), retrofit interventions to reduce energy consumption (Sarihi et al., 2021), correlation between energy consumption and maintenance strategies (Alghanmi et al., 2022), and thermal renovations on opaque façade consisting auto-responsive technologies (Andrade Santos et al., 2020) were studied. Sustainability of residential buildings was a common consideration too, where residential building renovations in temperate climates (Abdul Hamid et al., 2018), low-energy retrofit interventions (Hurst & O'Donovan, 2019), deep energy retrofit interventions (Ibañez Iralde et al., 2021), passive thermal retrofit interventions (Carratt et al., 2020), data-centric retrofit actions (Simpson et al., 2020), etc. were explored. Sustainability and energy efficiency of heritage buildings gained importance as well, where for instance, the embodied energies of demolishing and rebuilding and of adaptive reuse were comparatively reviewed to support deciding between those (Guidetti & Ferrara, 2023), the criteria used for sustainable conservation (Gonçalves et al., 2022), zero-emission refurbishment applications (Loli & Bertolin, 2018), or the sustainability of historic buildings' envelopes (Posani et al., 2021) were investigated. Regarding buildings with heritage value, in addition to the review studies, studies on interventions for employing non-destructive monitoring methods to identify defects and to determine preservation methods (Zendri et al., 2017), use of as-built parametric models to support refurbishment and conservation interventions (S. Bruno et al., 2018), and multi-criteria decision-making methods for intervention approaches (Nadkarni & Puthuvayi, 2020) were of particular significance.

Apart from the aforementioned literature review papers, there are papers that present methodological approaches to intervention types and their components. One current issue is the assessment of building conditions, which was considered a key step in planning rehabilitation and maintenance activities (Ferraz et al., 2016). The type and severity of the defects were used to determine the extent of upgrading works (Brandt & Rasmussen, 2002), and the repairs, which also influence the rental prices (Pedro et al., 2008). There are also papers focusing on the degradation of the specific part of the building and the relation of the degradation level to the repair, such as the building envelope (Ferreira, Silva, et al., 2021b) and roof (Gocer, 2024). Some other papers discuss existing preservation approaches, such as the vernacular preservation of the post-industrial landscape (Arnold & Lafreniere, 2017) and modern architecture (Prudon, 2017). As in the literature review studies, sustainability is of great importance in terms of retrofitting (Filippi, 2015) and green maintenance (Forster et al., 2011) of historic buildings, as well as cost-effective energy efficiency and carbon emission optimization (Almeida & Ferreira, 2018) and bottom-up energy efficiency in the residential sector (McKenna et al., 2013).

On the other hand, papers present literature review and methodological approach generally address on specific intervention types rather than multiple types. Notably, there were no studies in which all intervention types were considered together, where their boundaries, interrelations and differences were discussed. To address this gap, the present study aimed to conduct a systematic literature review on all intervention types with the objective of examining their relations, distinctions and hierarchy. To this end, the intervention process was examined in a broader term to understand the relations between the components given in Figure 1. Following in-depth examinations, the scope of each intervention type within the context of the intervention process was delineated.

In this context, the methodology employed in the literature review was first explained, and the findings of analyses were then presented. Subsequently, important points regarding each type of intervention were summarized and discussed. Finally, the relation between intervention types was attempted to be explained in consideration of the components of the intervention process.

2. Method

The study was comprised of four stages: (i) formulation of the intervention process and its components from key references, (ii) determination of the analysis dataset, i.e. research studies through a systematic database search, screening and elimination, (iii) systematic categorization of the data in these studies, and (iv) analysis of the articles through categorized data considering all the intervention components up to the planned/executed applications to understand the scope of each main intervention type (Figure 2).

2.1. Formulation of the intervention process and its components

Initially, the definitions of different intervention types were gathered from key references (i.e. standards, regulations, and main references) to be a base for the analyses (Table 1). Different classifications and definitions were then searched for the remaining components of the intervention process using similar references, i.e. for factors, obsolescences, and criteria. Consequently, a preliminary classification of intervention components

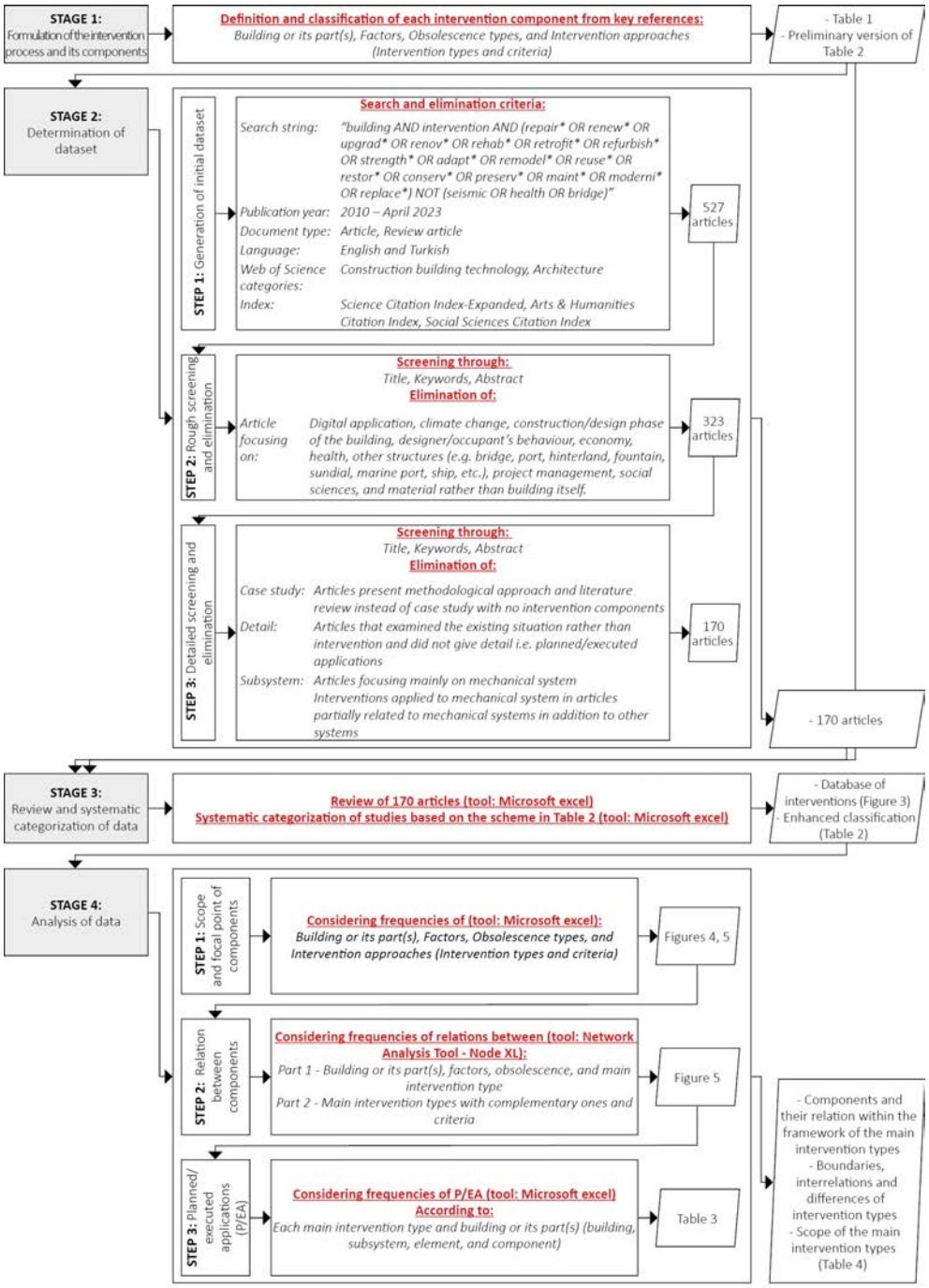

Figure 2. *The literature review method.*

was formed and later enhanced during the third stage, which was also utilized for the systematic categorization of the articles.

Hierarchically, a man-made system is composed of subsystems, elements, components, general products, and materials (CIB Working Commission W60, 1982; Rush, 1986). A hierarchical building classification was observed to be necessary since interventions are not only applied to the whole building but its parts. In this regard, Broadbent (1980) divided the building system into two parts: internal ambience, and building technology which included structural, space separating, services system, and fitting system. Rush (1986) examined building under four subsystems: structure, envelope, mechanical, and interior. CIB Working Commission W60 (1982) and International Standard of Organization [ISO] 19208:2016 (2016) evaluated building under five subsystems: structure, external envelope, spatial dividers outside the envelope, spatial dividers within the envelope, and services. Following the classifications in (CIB Working Commission W60, 1982; ISO, 2016; Rush, 1986) and the subgroups within, the subsystems of the building and their elements are specified for the study as (i) structural system – load-bearing structural wall, skeletal structural members, foundation/floor; (ii) envelope – non-structural external wall, wall opening, roof; (iii) spatial dividers – non-structural internal wall, circulation element; and (iv) services – water supply and disposal, heating and ventilation, gas/electricity supply, etc. This classification was then enhanced through the literature review and presented in Table 2 under the heading "Scale".

Regarding factors, as a component of intervention, the service life of a building or its parts is influenced by three major groups of factors: inherent quality characteristics, environment, and operation conditions (BSI, 2008, 2017b). Inherent quality characteristics encompass the inherent performance level – its features when it is first sup-

Table 1. *Intervention types and their brief definitions.*

Intervention Types	Definition
Adaptation	Interventions leading to change in the use, size, or performance of a building or its part(s) (Australia IC 2006).
Conservation	Interventions aiming to preserve a culturally significant building or its part(s) (Australia ICOMOS, 201
Maintenance	Periodic conservation/protective care actions to sustain the required performance level of a building ICOMOS, 2013; BSI, 2011b, 2013, 2019; ICOMOS International Committee on Twentieth Centu distinction was expressed for repair by Australia ICOMOS (2013).
Modernization	Improving a building or its part(s) to bring it to an acceptable standard (BSI, 2020; Douglas, 2006).
Preservation	Maintenance/repair of building or its part(s) to prevent demolition/decay in its existing form (Austral 2013, 2020; Douglas, 2006).
Refurbishment	Large-scale interventions to sustain current function and to improve the building or its part(s)s par such as technical modernization, change of plan or function, etc. (BSI, 2017a, 2020). It was limi interventions by Douglas (2006). In BS EN 15643:2021 (2021), it was taken similarly with deep renova
Rehabilitation	Interventions aiming to meet existing/new function's requirements (BSI, 2020; Douglas, 2006; Eur Standardization [CEN], 2020). In BS EN 15898:2019 (2019), the possibility of containing conservation a although not considered as a conservation activity.
Remodelling	Making new or restoring a building or its part(s) to the former situation. Its similarities to the adapta by Douglas (2006).
Renewal	Increasing the performance of a building or its part(s) by demolishing or rebuilding it at a level equal t to that of during its initial construction (BSI, 2017b; Douglas, 2006).
Renovation	Upgrading/repairing/changing/renewing an old building or its part(s) to the current expectations (BSI, Respecting the original material or significance is not a must, and therefore, it was not considered as a in BS EN 15898:2019 (2019).
Repair	Restoration/reconstruction/renewal/replacement of damaged or degraded part(s) of building or its state (BSI, 2020; ICOMOS International Committee on Twentieth Century Heritage, 2017). In BS EN was counted as a conservation action if heritage significance was taken into consideration.
Replacement	Changing parts to meet functional requirements (BSI, 2017b).
Restoration	Returning a building or its part(s) to a known previous state by removing/reassembling (Australia ICO CEN, 2020; ICOMOS International Committee on Twentieth Century Heritage, 2017).
Retrofit	Increasing the performance of a subsystem considering the current requirements by replacing the e ones that were not originally present (Douglas, 2006).
Reuse	Using a building or its part(s) with a function different from its original (Australia ICOMOS, 2013).
Strengthening	Restoring deteriorated structural system or its part(s) to its original situation or improvement of me 2019; ISO, 2013).

plied, decided design level – features determined at the design stage, and work execution level – skill and control at the construction site (BSI, 2008). The environment includes indoor and outdoor environmental agents that affect the building or its parts (BSI, 2008). The operation conditions are mainly related to the building use phase i.e. usage and maintenance conditions (BSI, 2008). This classification was further enhanced again in the third stage, as provided in Table 2, under the heading "Factors".

Obsolescence is the "loss of ability of an item to perform satisfactorily due to changes in performance requirements (BSI, 2011b), and as a component, it is the reason for the intervention. BS ISO 15686-1:2011 (2011b) examined obsolescence under three categories: functional where the initial function is no longer required; technological where better/modern alternatives exist or usage way changes; and economic where efficient/cheaper alternatives exist. Replacement due to changing fashion or style, as a common issue, was evaluated under economic obsolescence (BSI, 2011b). In BS 7913:2013 (2013), although obsolescence was not specifically mentioned, similar parameters were addressed for the conservation process as "drivers for change", which were economic (i.e. economic regeneration, change of use), social (i.e. changes of owner/tenant, planning policy, legislations) and environmental changes, and building's vulnerability (i.e. condition, external pressure). Pourebrahimi et al. (2020) offered a classification for obsolescence that covers and elaborates on the aforementioned ones, which were aesthetic, economic, environmental, functional, legal, locational, physical, social, technological, and tenure. Since this classification encompasses others, it was used as exactly in Table 2 for "Obsolescence" classes.

The intervention approach to be applied to a particular building was developed within a broader context which may include different intervention types as mentioned by ICOMOS Türkiye (2013), which were shaped with various criteria to judge or decide something. The intervention types given in Table 1 were used in Table 2 with an additional categorization of main and complementary.

In a building, the criteria both for design and intervention approach are parallel to the user's requirements. Broadbent (1980) defined internal ambiance as physical conditions for performance of activities in terms of structural mass – visible surfaces and enclosed space, and sensory environment – lighting, sound control, and heating/ventilation. Markus et. al. (1972) named the criteria as the boundaries of physical performance, which were cost, durability, fire, flexibility, maintenance, optical, sound, strength, thermal conductance, etc. ISO 19208:2016 (2016) associated objectives directly with user requirements/social expectations and listed them as accessibility, acoustical, air purity, contributions to sustainable development, durability, dynamic, economic, fire safety, hygiene, hygrothermal, safety in use, stability, suitability of spaces for specific uses, tactile, tightness, and visual. Similarly, BS EN 16883:2017 (2017a) specified targets for improving the energy efficiency of heritage buildings as technical compatibility with the existing systems, heritage significance of the building and its settings, economic viability, energy performance-sustainability, indoor environmental quality, impact on the outdoor environment, and aspects of use. Considering the criteria in (BSI, 2017a; ISO, 2016; Markus et al., 1972), an intervention criteria list presented in Table 2 under the heading of "Criteria" was formed and further developed in the third stage.

2.2. Determination of dataset

The systematic literature review comprised of three steps: (i) determination of the initial dataset, (ii) rough screening and elimination, and (iii) detailed screening and elimination (Stage 2 in Figure 2).

In the first step, a search was performed on "Web of Science" database until April 2023 using the search terms "building", "intervention" and intervention types outlined in Table 1. The formulated search string and further limitations retrieved 527 articles. In the second step, a rough screening was conducted on the article title, keywords, and abstract, and 204 articles were eliminated as their focus did not align

with the research objectives. During the third step, the remaining 323 articles underwent screening and elimination process through full-text reading. The elimination criteria in this step were mainly concerning the method of work, the details given about the intervention and the presence of mechanical systems from the building subsystems. Finally, 170 articles were selected for systematic categorization and analysis.

2.3. Review and systematic categorization of data

While reviewing selected articles, the classifications developed in Stage 1 (see Section 2.1) were enhanced simultaneously, and using the enhanced version, the articles were categorized in a database (Figure 3). The major revisions made in this respect in Table 2 were as follows;

- Regarding building or its part(s), the examined building's function, construction period, and heritage value were decided to be noted as identity information. To specify the function, the OmniClass classification of "Construction Entities by Function" (Construction Specifications Institute [CSI], 2013) was used. Additionally, concerning the intervention scale, elements can be a part of more than one subsystem (e.g. loadbearing masonry external wall is part of both structural system and envelope), and sometimes, more than one element/subsystem was presented together in the articles (e.g. external wall, window, and roof mean envelope above ground). Therefore, the classification of subsystems and elements was enhanced by including the combination of them. Likewise, some of the articles presented the intervention process considering all elements, or an addition to the building was subjected. To cover such instances, the intervention scale "Building" was included. Moreover, elements were further divided into their components to use in the detailed investigation. In the case that the article presents a detailed intervention type description, the related components were also noted, otherwise it was noted as general.
- Regarding the intervention approach, it was seen that ascertaining a clear distinction between intervention approach and type was not possible. For example, retrofit can either be an approach encompassing conservation, preservation, and renovation as intervention types or be a type under renovation approach. Consequently, instead of naming them as intervention approach and type, they were called as the main and complementary intervention types (M-, C-). The intervention type mentioned in the article title or keywords was considered as the main intervention type while the others were complementary. Furthermore, a list of planned/executed applications containing six types was generated while reviewing the full texts to note the physical output of the decision process. This list was included in Table 2.

2.4. Analysis of data

The analysis of the articles consisted of three steps; analysis of (i) the scope and focal points of each intervention component, (ii) the relation between the components, and (iii) the physical output of the intervention process i.e. planned/executed application. In the analysis, the categorized data shown

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1		BUILDING OR ITS PART(S)				FACTOR (F)	OBSOLESCENCE (O)	INTERVENTION APPROACH						
2											PLANNED/EXECUTED APPLICATIONS (PEA)			
3	ARTICLE CODE	FUNCTION	CONS. PERIOD	HERITAGE VALUE	SCALE (S)			MAIN INTERVENTION TYPE	COMPLEMENTARY INTERVENTION TYPE	CRITERIA	DETAIL	PEA CODE	ELEMENT	COMPONENT
4	10	Housing facility	19	1	(S4) - Structural system and Envelope* (without roof)	F8 - Degradation type/level	O3 - Environmental	M-Renovation	C-Preservation	C5 - Durability	Application of internal thermal insulation and vapor barrier	PEA1	S10	c
5							O4 - Functional			C7 - Economic	Usage of insulated lining with plaster on the window	PEA1	S15	c
6						F10 - Intervention character/level	O5 - Legal			C17 - Heritage value		PEA1	S15	d
7							O7 - Physical			C10 - Hygrothermal	Replacing existing glazing with double or triple glazing	PEA2	S15	e
8	14	Production facility	19	1	(S1) - Building	F8 - Degradation type/level	O4 - Functional	M-Reuse	C-Restoration	C5 - Durability	Addition of new reinforced concrete strip foundation inside the	PEA5	S12	b
9							O5 - Legal		C-Conservation	C17 - Heritage value	Strengthening the load bearing wall with steel mesh polymer	PEA5	S10	b
10							O7 - Physical		C-Adaptation	C12 - Stability	Strengthening the timber truss and string beam with steel plates	PEA5	S14	b
11										C13 - Suitability of spaces	Some bricks of the façade were replaced with the new ones, and	PEA2	S10	b
12											Doors and windows were repaired and replaced	PEA2	S15	a
13											Doors and windows were repaired and replaced	PEA4	S15	a
14											Addition of insulation and waterproofing	PEA1	S10	c
15											Interior staircase was reconstructed and steel staircase was added	PEA1	S17	a
16											Addition of internal walls to create new alyout	PEA1	S16	e

Figure 3. *A screenshot of the database for systematic categorization.*

Table 2. *Components of intervention process and their codes.*

Building or its part(s)		
Examined building's		
Function is adapted from (CSI, 2013) (assembly, cultural, educational, health care, housing, lodging, office, production, and public service, retail, storage, and transportation facilities, other, no information), Construction period, Heritage value		
Scale (S) (Adapted from (CIB Working Commission W60, 1982; ISO, 2016; Rush, 1986)		
Building	**(S1)** Building	
Subsystems (Combination of Subsystems/ Elements)	***(S2)*** *Structural system and Envelope**	***(S7)*** *Envelope (without wall opening)*
	(S3) *Structural system and Envelope* (without window/door)*	***(S8)*** *Envelope (without roof)*
	(S4) *Structural system and Envelope* (without roof)*	***(S9)*** *Spatial dividers***
	(S5) *Structural system*	***(S10)*** *Other*
	(S6) *Envelope*	
Elements	**(S11)** Masonry structural wall, **(S12)** Skeletal structural members, **(S13)** Foundation/Floor, **(S14)** External wall (non-structural), **(S15)** Roof, **(S16)** Window/door, **(S17)** Internal wall (non-structural), **(S18)** Circulation element**	
Components	**(a)** General, **(b)** Core/structural component, **(c)** Protective layer, **(d)** Finishing layer, **(e)** Complementary component	
Factors (F) (Classification is adapted from (BSI, 2008, 2017b), and examples are collected from articles)		
(F1) Inherent performance level	Envelope performance, thermo-physical characteristics, performance level	
(F2) Design level	Selected materials, façade characteristics, presence of window, structural system	
(F3) Work execution level	Vulnerable original structure, material incompatibilities	
(F4) Outdoor environment	Climate condition, earthquake, closeness to the sea, location, vegetation, humidity	
(F5) Indoor environment	Internal condition, relative humidity, solar and internal gains, heat capacity	
(F6) Usage condition	Vandalism, building uses, addition of high live loads	
(F7) Maintenance condition	Preservation status, maintenance plan, maintenance/preservation condition	
(F8) *Degradation type/level*	Damage/degradation/deterioration pattern/level, risk condition, severity	
(F9) *Descriptive properties*	Construction period, typology, heritage value, geometry, building type/size	
(F10) *Intervention character/level*	Location/thickness of the material, intervention level/scenario/time/frequency	
(F11) *Other*	Occupancy, stakeholder, users	
Obsolescence (O) (Classification and definitions are adapted from (BSI, 2011b, 2013; Pourebrahimi et al., 2020)		
(O1) Aesthetic	Fashion or architectural style may be changed.	
(O2) Economic	Higher operation and maintenance cost than a new building/part of it	
(O3) Environmental	Building is not enough to fulfil or detrimental concerning environmental expectations	
(O4) Functional	Building is not enough to fulfil functional requirements or function is not required	
(O5) Legal	Building is no longer in compliance with the regulations	
(O6) Locational**	Function of area changes or its value decreases	
(O7) Physical	Deterioration occurs due to environmental, design or construction-related factors	
(O8) Social **	Society's request or expectations changes over time	
(O9) Technological	Building technology/service is no longer enough due to the existence of better alternatives	
(O10) Tenure **	Existing situation may be changed/enhanced parallel to occupants and host relation	
Intervention Approach		
Main (M-) and Complementary (C-) Intervention Types		
Adaptation, Conservation, Maintenance, Modernization, Preservation, Refurbishment, Rehabilitation, Remodelling, Renewal, Renovation, Repair, Replacement, Restoration, Retrofit, Reuse, Strengthening, Upgrading		
Criteria (C) (Classification is adapted from (BSI, 2017a; ISO, 2016; Markus et al., 1972), and examples are collected from articles)		
(C1) Accessibility	Accessibility	
(C2) Acoustical	Acoustic comfort/performance/condition/properties	
(C3) Air purity	Indoor air quality, air change rate, ventilation	
(C4) Sustainability	Energy efficiency/consumption, reducing environmental impact, net-zero energy	
(C5) Durability	Severity of the anomaly, ensuring durability, deformation, service life	
(C6) Dynamic **		
(C7) Economic	Cost, feasibility, minimum economic impact, operation/maintenance cost	
(C8) Fire safety	Fire resistance/protection, fireproofing	
(C9) Hygiene	Hygric properties	
(C10) Hygrothermal	Thermal transmittance/comfort/behaviour/conductivity, heat loss/gain, water vapor	
(C11) Safety in use	Security, habitability, comfort	
(C12) Stability	Mechanical properties, load capacity, structural stability/safety, compressive strength	
(C13) Suitability for specific uses	New functions requirement, dimensional standard, spatial layout	
(C14) Tactile	Physical properties, shape and texture, aesthetic aspect, density	
(C15) Tightness	Airflow, water permeability, airtightness, hydraulic resistance	
(C16) Visual	Visual comfort, aesthetic appearance, glare, light and shadow	
(C17) Heritage value	Minimum intervention, preserving authenticity, integrity, compatibility, reversibility	
(C18) *Constructability*	Time, easy installation, ease of use, feasibility, workability on-site, affordability	
(C19) *Other*	Social context/benefit, socio-economic	
Planned/Executed Applications (P/EA) (Definitions are developed through articles are given)		
(P/EA1) *Addition/removal*	The addition of a new or removal of an old element/component, and even the building.	
(P/EA2) *Changing*	Replacement of deteriorated or insufficient element/component totally/partially.	
(P/EA3) *Cleaning*	Effacement of deteriorated parts on surface, generally.	
(P/EA4) *Mending*	Repairing the deteriorated element/component to turn it into original/better condition.	
(P/EA5) *Structural reinforcement*	Applications on structural parts to retrieve or improve original performance.	
(P/EA6) *Other*	Any application whose details were not given.	

*: Floors and foundations are not included in this grouping, since in some of the articles they had been studied as a part of the structural system, while omitted in some others. **: Not detected in the investigated articles.
Factors and Criteria written in italic are added to the classifications through the systematic literature review.

in Figure 3 was used, based on the frequencies of components discussed in the articles. In the first step, each component was examined, separately. In some articles, several buildings with different construction years or functions may be presented, or several types of intervention components may be considered. As a result, the total number of construction periods, functions, factors, obsolescence types, complementary intervention types, and criteria exceeds the number of reviewed articles (i.e. 170). In the second step, the frequency of the connections between the components was examined rather than the relations of most common components. Finally, planned/executed applications to the element/component under the main intervention type were discussed. Among components, heritage value was regarded as a distinctive and significant characteristic of a building and therefore, examinations were conducted considering it. The scope of these analyses, the tools used in them and the figures/tables that were the output of each were detailed in Figure 2.

3. Results

Analysis results of 170 articles done to understand the scope and focal points of each intervention component, the relations between them, and planned/executed applications for intervention types were given in the following subsections. The heritage value was highlighted with colours (i.e., blue and red) in the figures or symbols (i.e., + and -) in the tables, and the number of instances was presented in parenthesis as total, with and without heritage value, respectively.

3.1. The scope and focal points of each intervention component

The scope and focal points of each component were evaluated separately. The frequencies of the functions and construction years are shown in Figure 4 and observations on them were given below.

- Regarding the functions, the housing, education, and cultural facility buildings were the most incident (37%, 12%, and 10%, respectively). It should be noted that all cultural facilities possess heritage value. Consequently, office facilities assume greater importance in buildings without heritage value.
- 20th and 19th century buildings were the most frequently discussed ones (38% and 14%, respectively), when those with insufficient information were excluded. In association with their heritage value, all buildings were constructed in the 19th century and before, and one-third of the 20th-century buildings had heritage value.

The frequencies of the other components (i.e., intervention scales, factors, obsolescences, main/complementary intervention types and criteria) were shown in Figure 5, which also shows the relationship between the components and will be discussed in the next section.

- 9% of the articles discussed interventions throughout the entirety of the building (i.e. S1), especially in the case of heritage buildings. Of the subsystems, "structural system and envelope (S2)", "envelope (S6)", and "structural system and envelope – without window/roof

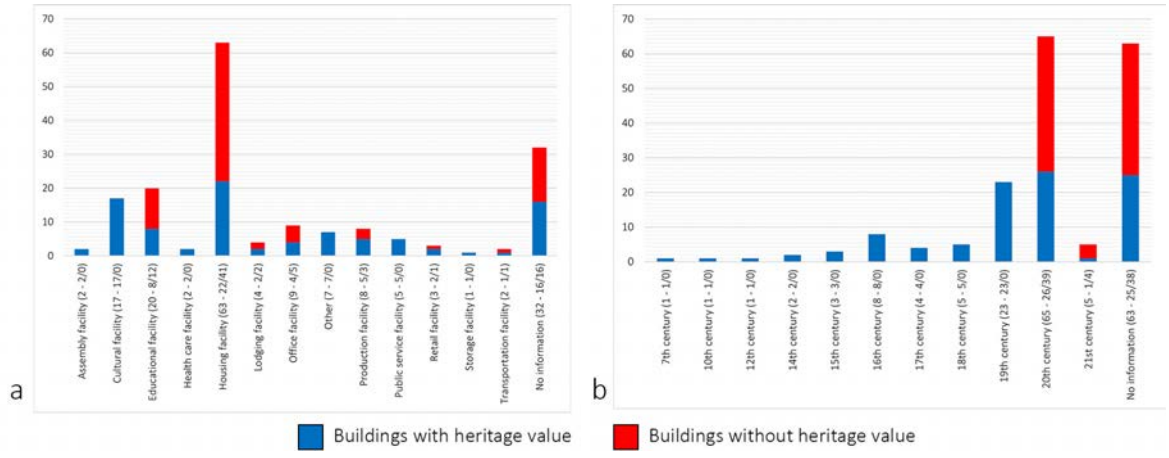

Figure 4. *Frequency of a) Construction years, b) Function.*

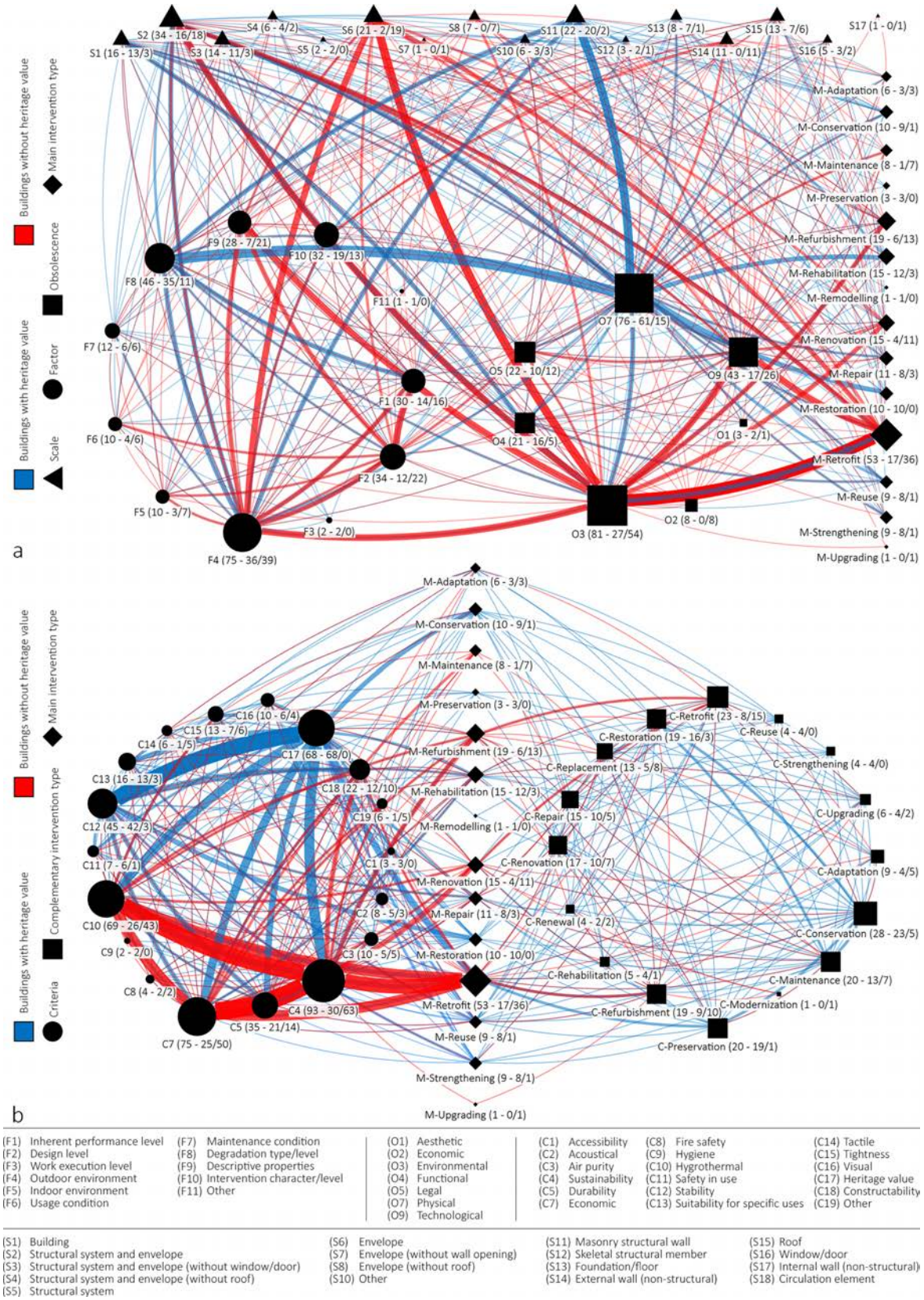

Figure 5. *Relations among a) Building or its part(s), factors, obsolescence, and main intervention types, b) Criteria and main/complementary intervention types (Note: The width/opacity of the lines, and the size of the symbols represent frequency.).*

(S3)" were the three most frequently intervened parts (19%, 12%, and 8%, respectively). In the case of elements, "masonry structural wall (S11)", "roof (S15)", and "external wall (S14)" were the three mostly intervened elements (13%, 8%, and 6%, respectively). The envelope-related subsystems/elements were the most frequently intervened parts, regardless of heritage value, while subsystems/elements including load-bearing parts were mostly associated with heritage buildings (i.e. S3 and S11). The reason for this could be attributed to technological advancements in the structural system, i.e. the increased use of skeletal structural system and non-structural external wall instead of a masonry structural wall.

- Analysis of the factors showed that "outdoor environment (F4)", "degradation type/level (F8)", and "design level (F2)" were the three most effective ones (44%, 27%, and 20%, respectively). The high incidence of F4, regardless of heritage value, could be attributed to its relation to the envelope. It is notable that F2 was predominantly associated with buildings without heritage value, while F8, observed in heritage buildings due to their relatively long-life span. Long-life span, where a detailed analysis on the severity levels of these degradations could be a future research focus.
- The most frequently observed obsolescence types were "environmental (O3)", "physical (O7)", and "technological (O9)" (48%, 45%, and 25%, respectively). The results were similar in buildings with/without heritage value, although in a different order. In the heritage buildings, O7 emerged as a significant consideration among the three, while O3 assumed greater significance for the others. This may be attributed to the long service life of heritage buildings where the damage that occurs during this period may cause sustainability to become less prominent.
- Analyses concerning the intervention approach presented that the most prevalent main intervention type was M-Retrofit (31%), followed, with a considerable decrease, by M-Refurbishment (11%), and M-Rehabilitation and M-Renovation both with the same frequency (9%). Among them, M-Rehabilitation was generally preferred for those with heritage value alongside M-Restoration and M-Conservation. On the other hand, M-Retrofit was mostly applied to other buildings.
- Concerning the complementary intervention types, C-Conservation was the most prevalent (16%), followed by C-Retrofit (14%), and then C-Maintenance and C-Preservation with the same incidences (12%). In heritage buildings, the significance of C-Restoration increased, while C-Refurbishment and C-Replacement came into prominence in the other buildings.
- It was observed that "sustainability (C4)", "economic (C7)", and "hygrothermal (C10)" were three of the most used criteria (55%, 44%, and 41%). High incidence of the C4 was expected since energy-related issues are a global concern. Likewise, as each intervention project has a certain budget, C7 was another crucial criterion, and C10 pertains to the thermal and water resistance performance of mostly the envelope. Among them, "heritage value (C17)" emerged as the most important in heritage buildings, as would be expected, while C7 related to other buildings.

3.2. Relation between the components

The relations observed between the intervention components were illustrated in Figure 5 in two parts to facilitate comprehension, where the link is the main intervention type.

Regarding buildings with heritage value (90/170), in the relation between intervention scales and influencing factors, the "masonry structural wall (S11)", as the most intervened element, and its relations with the factors of "degradation type/level (F8)", "outdoor environment (F4)", and "intervention character/level (F10)" came front. The reason for this situation may be that

F4 causes degradation (i.e. F8) on S11, and F10 becomes important in deciding how to overcome the degradation. The intense connection of "structural system and envelope (S2)", as the most intervened subsystem, with F4 might be due to the same reason. Concerning the interconnections of the factors, in addition to the relation between "inherent performance level (F1)" and "design level (F2)", those between F4, F8, and F10 came to the fore. Regarding the obsolescence types observed on building parts, "physical (O7)" obsolescence on S11 was the most common. Looking at the causes (i.e. the factors) F4 and F8 stand out. Although not as strong as previous, there were considerable relationships between "environmental (O3)" obsolescence and S2, "functional (O4)" obsolescence and "building (S1), and O7 and "structural system and envelope – without window/door (S3)" as well. As expected, O4 was related to the whole building, while the others were related to its envelope, mostly. Concerning the interrelations within obsolescence types, O7 was frequently accompanied by "technological (O9)" obsolescence, while it had less strong associations with O3, O4, and "legal (O5)" obsolescences. Looking at the main intervention types applied at different scales, the relationships between M-Reuse and S1, M-Retrofit and S2, and M-Rehabilitation and S11 appeared dominant. Given that, loss of function (O4) was observed to be the main reason for M-Reuse, and thus it was mainly related to the building. In M-Retrofit, interventions on the envelope to meet environmental expectations were one of the main concerns, and although less dominant, it was also applied to remove traces of degradation (i.e. O3, and O7, respectively). On the other hand, M-Rehabilitation was mainly related to the removal of degradation (i.e. O7), rather than the fulfilment of environmental expectations. The two main intervention types aforementioned (i.e. M-Retrofit and M-Rehabilitation) came forward also, when examining their relationships with the complementary interventions, and criteria. In the case of M-Retrofit, C-Refurbishment and C-Preservation were used as complementary with the criteria of "sustainability (C4)" and "heritage value (C17)" mainly. On the other hand, M-Rehabilitation was used accompanied by C-Conservation and C-Maintenance with the criteria of "stability (C12)" and C17. These results support the findings on the relation of these two main intervention types with obsolescence types. Besides, the relationship between M-Restoration and C-Conservation, and M-Repair and C-Conservation also attracted attention. In both cases, C12 and C17 were the criteria mainly used.

Concerning buildings without heritage value (80/170), in the relation between the intervention scale and factors, the connection between "envelope (S6)" and "outdoor environment (F4)" was notable. Although less dominant, "inherent performance level (F1)" and "design level (F2)" were also affected on S6. Similarly, F4 was affected on "structural system and envelope (S2)" as well. Therefore, it can be said that the outdoor environment is an important factor for the parts of the building envelope, as in the case of heritage buildings. F1 and F2 were of great importance for the multilayer walls, in contrast to masonry walls, which were mostly seen in heritage buildings, with simpler details and one/fewer layers. Regarding the relations between factors, these three factors (i.e. F1, F2, and F4) were observed to have strong interconnection too, and also related to "descriptive properties (F9)". Considering the obsolescence types and intervention scales, "environmental (O3)" obsolescence was detected on S2 and S6. Although less prominent, "envelope – without roof (S8)" was also under the effect of the same type of obsolescence. Additionally, interventions on S6 were also related to "technological (O9)" obsolescence. The reasons for O3 on parts of the envelope were being exposed to outdoor environment and being behind the current technology in terms of construction year and typology (i.e. factors of F4 and F9, respectively), as also observed in heritage buildings. Looking at the interconnections between obsolescence, that of "legal (O5)" obsolescence with O3 and O9 also stands out. This inference confirms that environmental and techno-

logical development is reflected in regulations. Analysis of the relationships between the intervention scale and the main intervention types showed that M-Retrofit was associated with S2, S6 and S8. Similarly, there was a notable association between M-Renovation and S6. Therefore, it can be said that the focus of the interventions on buildings without heritage value was mainly the envelope. Looking at the obsolescence that led to intervention, the main reason for the M-Retrofit was O3, and O9 with a considerable frequency decrease. O3 was also effective for the M-Renovation and M-Refurbishment. The aforementioned three main intervention types came into prominence too, regarding their relation to the complementary intervention types and criteria. C-Retrofit was used as a complementary intervention type in the M-Renovation and M-Refurbishment, while C-Refurbishment and C-Renovation were accompanying M-Retrofit. "Sustainability (C4)", "economic (C7)", and "hygrothermal (C10)" criteria were dominant for all of them, and their interconnections appeared to be quite strong. As a result, all three types of main interventions were applied to fulfil environmental expectations.

3.3. Planned/executed applications for main intervention types

The relations between each planned/executed application (P/EA) and the main intervention types were given in Table 3, through the intervened parts of the building. The observations for each of them were mentioned in the following.

- Addition/removal (P/EA1) was the most preferred application (71%) seen in more than half of the buildings with heritage value and in almost all the others. It was applied from the scale of the "building (S1)" to the elements (S11, S12, S13, S14, S15, S16, S17, S18). Among them, the addition of a protective layer (thermal insulation in most cases) to the roof (S15c, 52%), external wall (S14c, 45%), masonry structural wall (S11c, 28%), and foundation/floor (S13c, 27%), and addition of sun shading/shutter to the window/door (S16e, 20%) were the most prevalent. It was involved in almost all the main intervention types, except M-Strengthening, and most preferred within the scope of the M-Refurbishment (100%), M-Retrofit (91%), M-Reuse (89%), M-Renovation (87%), M-Adaptation (83%), M-Rehabilitation (73%), and M-Preservation (67%). Although the preference rate for P/EA1 in M-Remodelling and M-Upgrading was 100%, it was not accounted for since these main interventions were only considered in one article.
- Changing (P/EA2) was the second most common intervention (55%), particularly in more than half of the buildings without heritage value and almost half of the heritage buildings. It was applied to almost all elements, except the internal wall and not used in the building scale (S11, S12, S13, S14, S15, S16, S18). Among them, changing a component of window/door i.e. glazing (S16e, 55%), whole window/door (S16a, 22%), and frame (S16b, 113%) to improve thermal performance were by far the most preferred. Although with a lower incidence, changing either the whole or finishing layer of the external wall both to ensure performance or eliminate deterioration (S14d, 6%, S14a, 5%), and changing the deteriorated parts of the masonry structural wall and roof (S11b, S15b, 5% for both) were also detected. It was involved in almost all main intervention types, except M-Remodelling and M-Upgrading, and mostly preferred as part of M-Maintenance (75%), M-Refurbishment (68%), M-Preservation (67%), M-Repair (64%), and M-Conservation (%60).
- Cleaning (P/EA3) was one of the least preferred interventions, regardless of the heritage value of the building (9%). It was applied to the core of the masonry structural wall in most cases (S11b, 33%), followed by the whole/core of other elements such as skeletal structural member, foundation/floor, external wall, and roof (S12, S13, S14, S15). It constituted the largest proportion for M-Maintenance (75%) and M-Preservation (67%).

Table 3. *Incidence of P/EA according to main intervention type and intervention scale.*

Addition/Removal (P/EA1)	Changing (P/EA2)	Cleaning (P/EA3)	Mending (P/EA4)	Structural Reinforcement (P/EA5)	Other (P/EA6)
M-Adaptation (T^1: 6-3/3) (Buxadé, 2014; Domínguez-Amarillo et al., 2019; Marinic, 2016; Philokyprou, 2014; S. Porritt et al., 2011; Tian & de Wilde, 2011)					
S1; S11c, d; S12a; S14c; S15c, d; S16a, e; S17a, d; S18a	S16a, e			S13b	
T^3: 83% (5-2/3)	50% (3-2/1)	-	-	17% (1-1/0)	-
M-Conservation (T^1: 10-9/1) (Arrieta et al., 2018; Conde et al., 2014; Efthymiopoulos et al., 2021; García-Esparza, 2011; Iyer-Raniga & Wong, 2012; Marcus et al., 2019; Muñoz-González et al., 2016; Musso & Franco, 2015; Pankhurst & Harris, 2013; Salman et al., 2018)					
S11c; S13c; S14c; S15c; S16e	S12b; 15a; S16a, e	S11b	S11b; 12b; S14c; S16a	S11b; S13b; S15b	S17a
T^3: 50% (5-4/1)	60% (6-6/0)	10% (1-1/0)	50% (5-4/1)	40% (4-4/0)	10% (1-1/0)
M-Maintenance (T^1: 8-1/7) (Dias et al., 2022; Ferreira, Dias, et al., 2021; Ferreira, Silva, et al., 2021; Flores-Colen & de Brito, 2010; Morgado et al., 2017; Pallis et al., 2019, 2021; Perez-Monserrat et al., 2018)					
S13c; S14c; S15c; 16e	S14a, d; S16a, e	S11b; 14a, d; S15a	S14d		S14a, d; S15a
T^3: 25% (2-0/2)	75% (6-0/6)	75% (6-1/5)	13% (1-0/1)	-	63% (5-0/5)
M-Preservation (T^1: 3-3/0) (Guizzardi et al., 2015; Kou et al., 2020; Resende et al., 2022)					
S11c, d	S11d; S14a	S11a, b; S12b	S11a	S12b; S13b	
T^3: 67% (2-2/0)	67% (2-2/0)	67% (2-2/0)	34% (1-1/0)	34% (1-1/0)	-
M-Refurbishment (T^1: 19-6/13) (Ascione et al., 2017; Badea & George-Vlad, 2015; Barbosa et al., 2020; Bellia et al., 2018; Berto et al., 2018; Bruno et al., 2021; Carpino et al., 2018, 2020; D'Agostino et al., 2022; De Fino et al., 2017; Dukanovic et al., 2016; Gaspar & Santos, 2015; Hawkins & Mumovic, 2017b, 2017a; Milone et al., 2015; Pierangioli et al., 2017; Pomponi et al., 2015; Rodrigues et al., 2018; Watson, 2022)					
S1; S11c, d; S13c; S14a, c; S15a, c, e; S16a, e; S17a; S18a	S13d; S14a, d; S15c, e; S16a, b, e		S16a		
T^3: 100% (19-6/13)	68% (13-5/8)	-	5% (1-1/0)	-	-
M-Rehabilitation (T^1: 15-12/3) (Alexakis et al., 2018; Boffill et al., 2020; Brás & Gomes, 2015; Cunha et al., 2015; De Berardinis et al., 2014; Garavaglia et al., 2018; Ignjatovic et al., 2016; Lstiburek, 2018; Moropoulou et al., 2021; Prieto et al., 2022; Ruiz et al., 2023; Serrrano-Lanzarote et al., 2020; Stastny et al., 2021; Stellacci et al., 2018; Vilhena et al., 2017)					
S11c, d; S11e; S13c; S14c, d; S15c	S13b; S15a; S16b, e	S11b	S11b; S13b	S11b, d; S13b; S15b	S15a
T^3: 73% (11-8/3)	33% (5-4/1)	7% (1-1/0)	13% (2-2/0)	40% (6-6/0)	7% (1-1/0)
M-Remodelling (T^1: 1-1/0) (Ultav & Savasir, 2012)					
S17a; S18a					
T^3: 100% (1-1/0)	-	-	-	-	-
M-Renovation (T^1: 15-4/11) (Borras et al., 2022; Kroftová & Zigler, 2023; Maria Calama-Gonzalez et al., 2022; Martinez-Millana & Alcaraz, 2020; Österbring et al., 2019; Palma et al., 2022; Patiño-Cambeiro et al., 2019; Salvalai et al., 2017; Semprini et al., 2016; Serrano-Jimenez et al., 2017; Serrano-Jiménez et al., 2018; Serrano-Lanzarote et al., 2016; Tovarovic et al., 2017; Unuk et al., 2021; van der Bent et al., 2021)					
S1; S11c; S13c; S14a, c; S15a, c; S16a, c, d, e; S18a, e	S13d; S14a, d; S16a, b, e		S16a, b	S13b	
T^3: 87% (13-2/11)	73% (11-2/9)	-	13% (2-1/1)	7% (1-1/0)	-
M-Repair (T^1: 11-8/3) (Alba-Rodriguez et al., 2022; Corradi et al., 2018; Fodde & Cooke, 2013; Illampas et al., 2017; Kloiber et al., 2023; Marin-Garcia et al., 2023; Ray, 2014; Sahin Güçhan & Kuleli, 2018; Salmeron et al., 2022; Theodossopoulos, 2016; Wittocx et al., 2022)					
S11c; S13c, d; S15b, c, e; S16a, e	S11b; S13b; S15a; S16b, e; S18a	S11b, d; S13b	S11b; S13b; S15b	S11b	
T^3: 36% (4-3/1)	64% (7-5/2)	27% (3-2/1)	64% (7-5/2)	27% (3-3/0)	-
M-Restoration (T^1: 10-10/0) (Bertolini-Cestari et al., 2019; Brandonisio et al., 2013; Candelas-Gutiérrez & Borrallo-Jimenez, 2020; Coronelli et al., 2015; Galli & Conserva, 2016; Gunaydin et al., 2023; Shimoda et al., 2022; Soler-Estrela & Soler-Verdú, 2016; Valença et al., 2015; Vissilia & Villi, 2010)					
S13a, c; S18a	S11b, d; S13b; S15a, d; S16a	S13a	S11a, b; S12b; S13b; S15a, b, d; S16a	S11b; S13a, b; S15a, b	S1; S15a
T^3: 18% (2-2/0)	36% (4-4/0)	9% (1-1/0)	45% (5-5/0)	64% (7-7/0)	18% (2-2/0)
M-Retrofit (T^1: 53-17/36) (Aghamolaei & Ghaani, 2020; Alonso et al., 2021; Alves et al., 2018; Asadi et al., 2012; Asdrubali et al., 2019, 2021; Aste et al., 2012, 2016; Barbaresi et al., 2017; Belpoliti & Bizzarri, 2015; Coady & Duquette, 2021; Cornaro et al., 2016; D'Agostino et al., 2023; Dall'O' et al., 2012; Dall'O et al., 2020; Daniotti et al., 2022; de Santoli et al., 2014; Di Giuseppe et al., 2017; Duran & Lomas, 2021; Eliopoulou & Mantziou, 2017; Famuyibo et al., 2013; Fantucci & Serra, 2019; Fenoglio et al., 2018; Ferrarini et al., 2016; Galbiati et al., 2021; Ginks & Painter, 2017; Hacene & Sari, 2020; Hall et al., 2013; Hamilton et al., 2014; Heo et al., 2012; Juliá et al., 2024; Litti et al., 2018; Macchi & Macchi, 2015; Martín-Garín et al., 2021; Menconi & Grohmann, 2014; Montoliu-Hernández & Rodríguez-Alvarez, 2017; Ohene et al., 2022; O'Riain & Harrison, 2016; Parker et al., 2019; Pellegrino et al., 2016; S. M. Porritt et al., 2012; Ruggeri et al., 2020; Stazi et al., 2014, 2015; Suárez & Fernández-Agüera, 2015; Sugár et al., 2020; Tagliabue et al., 2018; Taylor et al., 2010; Timur et al., 2022; Tokede et al., 2018; Varriale, 2016; Verbist et al., 2018; Zhou et al., 2017)					
S1; S11c, d, e; S13c; S14a, c, d; S15a, c, d; S16a, e; S17a	S14d; S15d; S16a, b, e		S11b; S14a; S15a; S16a, b, e	S11b; S13b; S15b	
T^3: 91% (48-13/35)	66% (35-8/27)	-	19% (10-4/6)	4% (2-2/0)	-
M-Reuse (T^1: 9-8/1) (Cascone & Sciuto, 2018; Elvarsson et al., 2021; Ferriss, 2021; Iglesias & Bernardo, 2022; Marzouk et al., 2020; Pieczka & Wowrzeczka, 2021; Ramos et al., 2016; Wilczek, 2021; Xiong et al., 2023)					
S1; S11c; S13a, c; S14c; S15a, c; S16a; S17a; S18a	S11b; S16a, b, e		S12b; S16a	S11b; S13b; S15b	S1
T^3: 89% (8-7/1)	33% (3-3/0)	-	22% (2-2/0)	44% (4-4/0)	22% (2-1/1)
M-Strengthening (T^1: 9-8/1) (Cassese et al., 2021; Cescatti et al., 2018; Corredor et al., 2016; Hamdy et al., 2018; Liberotti et al., 2022; Lignola & Manfredi, 2011; Sandoval et al., 2021; Shrestha et al., 2020; Valluzzi et al., 2014)					
	S11b	S11a; S12a; S13a	S11b; S13b; S15d; S18e	S11b; S12b; S13b; S15b	
T^3: -	11% (1-1/0)	11% (1-1/0)	33% (3-3/0)	89% (8-7/1)	-
M-Upgrading (T^1: 1-0/1) (Pomponi & D'Amico, 2017)					
S14a; S16a					
T^3: %100 (1-0/1)	-	-	-	-	-
Total (T: 170-90/80)					
S1 (7); S11c, d, e (34, 6, 2)	S11b, d (5, 2); S12b (2)	S11a, b, d (2, 5, 1)	S11a, b (2, 11); S12b (3)	S11b, d (25, 1)	S1 (2)
S12a (1); S13a, c, d (2, 32, 1)	S13b, d (4, 2)	S12a, b (1, 1)	S13a, b (1, 6)	S12b (2)	S14a, d (3, 1)
S14a, c, d (4, 54, 2)	S14a, d (5, 6)	S13a, b (2, 1)	S14a, c, d (1, 1, 1)	S13a, b (1, 21)	S15a (3)
S15a, b, c, e (8, 1, 62, 3, 2)	S15a, b, c, d, e (5, 1, 1, 4, 1)	S14a, d (3, 2)	S15a, b, d (3, 4, 2)	S15a, b (1, 11)	S17a (1)
S16a, c, d, e (9, 1, 1, 24)	S16a, b, e (21, 12, 52)	S15a (1)	S16a, b, e (11, 2, 2)		
S17a, d (12, 1); S18a, e (8, 1)	S18a (2)		S18e (1)		
T^2: 71% (120-49/71)	55% (94-40/54)	9% (15-9/6)	23% (39-28/11)	22% (38-37/1)	6% (10-4/6)

Codes of the intervention scale are given in Table 2. Total number of articles (T). Total number of articles per; each main intervention type (T^1), each planned/executed application (T^2), each main intervention type and planned/executed application (T^3).

- Mending (P/EA4) was the third most frequently discussed intervention, particularly in heritage buildings. It was applied to almost all elements, except internal walls (23%), to repair the deteriorated parts. Most instances involved the core of the masonry structural wall (S11b, 48%), and the structural components of the foundation/floor (S13b, 26%) and roof (S14b, 17%), respectively. It was applied under almost all main intervention types, except M-Adaptation, M-Remodelling, and M-Upgrading. Yet, it was preferred only in the M-Retrofit in the first order (64%). In addition, it had also an important role in the scope of the M-Conservation (50%) and M-Restoration (45%).
- Structural reinforcement (P/EA5) had almost the same incidence as mending (22%) and was particularly preferred for the heritage buildings. It was applied to the structural elements (i.e. masonry structural wall, skeletal structural member, foundation/floor) and roof to retain or improve their structural capacity. Among them, those applied to the core of the masonry structural wall (S11b, 66%), foundation/floor (S13b, 55%), and roof (S15b, 29%) were of particular significance. It was the most significant aspect of the M-Strengthening (89%) and M-Restoration (64%), whereas it was not included in M-Maintenance, M-Refurbishment, M-Remodelling, and M-Upgrading.
- Others (P/EA6) encompassed major/minor/light/cyclic intervention, and it was the least preferred intervention, regardless of heritage value (6%). It was frequently preferred only for M-Maintenance (63%).

4. Summary and discussion

The main intervention types and their first three relations with other components which stood out in the analyses were summarized in Table 4. In the table, intervention components that were only discussed in one or no article were not mentioned, and marked with an asterisk (*), since it was not possible to provide accurate inference. Additionally, Modernization, Renewal, and Replacement were not included in the table as a main intervention type, since they were used as complementary intervention, rather than main. Aspects of each main intervention type that differed from the general (i.e. those seen in all the buildings with and without heritage value) were summarized and discussed as follows, regarding the definitions given in Table 1 and existing literature review studies.

- In the articles focusing on M-Adaptation, the "outdoor environment (F4)" and "addition/removal (P/EA1)" appear to be a significant factor and intervention type regardless of heritage value. Therefore, its main objective can be defined as the adaptation to the changing outdoor environment, which in turn the adaptation of the performance level. This inference is partially aligned with the definition provided in Table 1 by considering only the performance.
- M-Conservation was primarily discussed for heritage buildings. On the contrary to the general, "changing (P/EA2)" of deteriorated parts presented greater significance. This inference potentially reflects the objective of preserving the original as mentioned in Table 1, by opposing the addition of a new or removal of an original part.
- M-Maintenance was mainly related to buildings without heritage value. Among the planned/executed applications observed, "changing (P/EA2)", "cleaning (P/EA3)", and "others (P/EA6)" were far more frequent than "addition/removal (P/EA1). The absence of the "mending (P/EA4)" proves its difference from M-Repair, and the existences of the "physical (O7)" obsolescence and "economic (C7)" criterion reflects the objective of maintaining the required performance level as mentioned in Table 1.
- M-Preservation was preferred mainly for buildings with heritage value. The existence of C-Restoration as a complementary intervention type and "heritage value (C17)" as a criterion support the definition given in Table 1.
- M-Refurbishment was observed regardless of heritage value, although it was more dominant in buildings

Table 4. *The scope of the main intervention types.*

	Factors (F)	Obsolescence (O)	Intervention Scale (S)	Criteria (C)	Planned/Executed Application (P/EA)
M-Adaptation (6-3/3) without specific complementary intervention type in the buildings with/without heritage value					
(+)	F4 (2)	*	*	C12 (2)	P/EA1 (2); P/EA2 (2)
(-)	F4 (2)	*	*	C4 (2); C10 (2)	P/EA1 (3)
M-Conservation (10-9/1) with C-Renovation (3); C-Repair (3); C-Restoration (3); and C-Maintenance (2) in the buildings with heritage value					
(+)	F8 (7); F1 (3); F4 (3); F2 (2)	O7 (6); O3 (4); O5 (2); O9 (2)	S2 (2)	C17 (9); C4 (4); C5(3); C12 (3); C13 (3)	P/EA2 (6); P/EA1 (4); P/EA4 (4); P/EA5 (4)
M-Maintenance (8-1/7) with C-Repair (2); and C-Replacement (2) in the buildings without heritage value					
(-)	F8 (5); F2 (4); F4 (4); F9 (4); F1 (3); F7 (3)	O7 (5); O2 (3); O3 (3)	S2 (2)	C7 (6); C4 (3); C5 (3)	P/EA2 (6); P/EA3 (5); P/EA6 (5); P/EA1 (2)
M-Preservation (3-3/0) with C-Restoration (2) in the buildings with heritage value					
(+)	F4 (2)	O7 (3); O9 (2)	S11 (2)	C10 (2); C15 (2); C17 (2)	P/EA1 (2); P/EA2 (2); P/EA3 (2)
M-Refurbishment (19-6/13) with C-Retrofit (2) in the buildings with heritage value; with C-Retrofit (5); C-Maintenance (3); C-Renovation (2); C-Repair (2); and C-Replacement (2) in the others					
(+)	F1 (2); F4 (2); F9 (2)	O3 (5); O7 (2)	S2 (3)	C4 (5); C17 (4); C7 (3); C10 (3)	P/EA1 (6); P/EA2 (5)
(-)	F4 (7); F1 (4); F2 (4); F6 (3)	O3(10); O5 (3); O7 (2); O9 (2)	S6 (4); S2 (2); S15 (2)	C4 (11); C7 (7); C10 (7); C3 (2)	P/EA1 (13); P/EA2 (8)
M-Rehabilitation (15-12/3) with C-Conservation (4); C-Maintenance (4); C-Restoration (3); and C-Preservation (2) in the buildings with heritage value; without specific complementary intervention type in the others					
(+)	F4 (7); F8 (5); F2 (2)	O7 (10); O9 (4); O3 (3); O5 (3)	S11 (5); S3(3)	C17 (8); C12 (7); C7 (5)	P/EA1 (8); P/EA5 (6); P/EA2 (4)
(-)	*	O3 (3)	S14 (2)	C4 (3); C10(3); C5 (2)	P/EA1 (3)
M-Renovation (15-4/11) with C-Preservation (2) in the buildings with heritage value; with C-Retrofit (7); C-Adaptation (2); C-Conservation (2); and C-Refurbishment (2) in the others					
(+)	F10 (2)	O3 (3); O4 (2)	*	C17 (3); C4 (2); C5 (2)	P/EA1 (2); P/EA2 (2)
(-)	F4 (6); F9 (5); F2 (2)	O3 (9); O9 (7); O5 (3)	S6 (5); S2 (3)	C4 (11); C7 (8); C10 (8); C19 (3)	P/EA1 (11); P/EA2 (9)
M-Repair (11-8/3) with C-Conservation (4); C-Preservation (3); C-Renovation (2); and C-Restoration (2) in the buildings with heritage value; with C-Replacement (2) in the others					
(+)	F4 (3); F8 (3); F10 (2)	O7 (7); O9 (2)	S11 (2)	C12 (6); C17 (6); C7 (3); C5 (2)	P/EA2 (5); P/EA4 (5); P/EA1 (3); P/EA5 (3); P/EA3 (2)
(-)	F8 (2)	O7 (3)	*	C4 (2); C5 (2); C7 (2)	P/EA2 (2); P/EA4 (2)
M-Restoration (10-10/0) with C-Conservation (4); C-Repair (3); and C-Strengthening (2) in the buildings with heritage value					
(+)	F8 (8); F1 (3); F4 (3); F6 (3); F2 (2); F3 (2)	O7 (10)	S3 (3); S15 (3)	C12 (9); C17 (8); C5 (2); C7 (2); C10 (2)	P/EA5 (7); P/EA4 (5); P/EA2 (4)
M-Retrofit (53-17/36) with C-Refurbishment (6); C-Preservation (5); C-Conservation (3); and C-Renovation (3) in the buildings with heritage value; with C-Refurbishment (5); C-Renovation (4); C-Conservation (3); and C-Maintenance (3) in the others					
(+)	F4 (11); F10 (7); F9 (3)	O3 (10); O7 (8); O9 (3)	S2 (6); S11 (4); S6 (2); S16 (2)	C17 (13); C4 (12); C10 (9)	P/EA1 (13); P/EA2 (8); P/EA4 (4); P/EA5 (2)
(-)	F4 (17); F9 (10); F10 (7)	O3 (27); O9 (13); O2 (4); O5 (4)	S2 (10); S6 (9); S8 (5)	C4 (30); C7 (24); C10 (21)	P/EA1 (35); P/EA2 (27); P/EA4 (6)
M-Reuse (9-8/1) with C-Adaptation (2); C-Conservation (2); C-Maintenance (2); C-Preservation (2); C-Restoration (2); and C-Retrofit (2) in the buildings with heritage value					
(+)	F10 (3); F8 (2)	O4 (8); O7 (5); O5 (2)	S1 (6)	C17 (8); C13 (6); C16 (4)	P/EA1 (7); P/EA5 (4); P/EA2 (3)
M-Strengthening (9-8/1) with C-Restoration (3); and C-Conservation (2) in the buildings with heritage value					
(+)	F8 (4); F10 (3)	O7 (7)	S11 (4); S13 (2)	C12 (8); C17 (5); C18 (4)	P/EA5 (7); P/EA4 (3)

+: Buildings with heritage value; -: Buildings without heritage value (also related line is coloured with grey).
*: Intervention components that are discussed in one or no article. Codes are given in Table 2.

without heritage value. As mentioned in Section 3, it was one of the intervention types focusing on sustainability. It included "addition/removal (P/EA1)" and "changing (P/EA2)", but not "structural intervention (P/EA5)" in line with the explanations in Table 1. In a literature review discussing zero-emission refurbishment for heritage buildings, the intervention levels were classified as low (preservation and conservation), middle (refurbishment and rehabilitation), and high (renovation and restoration), and conservation, preservation, and restoration were the most preferred ones (Loli & Bertolin, 2018). When these levels were counted as complementary intervention types as used in this study, their findings were different, since retrofit was found here as a prominent complementary intervention for heritage buildings. A possible reason was the occurrence of the word "preserv*" in the search string, and in turns, all the reviewed articles related to preservation.

- M-Rehabilitation was applied mainly to heritage buildings, while less to others. It was related to "physical (O7)" obsolescence, and in relation

to that, "structural reinforcement (P/EA5)" was generally planned/executed, as described similarly in Table 1. However, the description highlighting that it is not a conservation activity is not in line with the findings considering that there were many articles focusing on heritage building.

- M-Renovation was mainly seen in buildings without heritage value to fulfil environmental expectations (i.e. O3), and applied less in the others. "Technological (O9)" obsolescence was also significant, which might reflect fulfilling current expectations as defined in Table 1. The small number of heritage buildings with this intervention type was also parallel to the definition. In a study on the renovation of multifamily buildings, energy efficiency measures were the most frequent compared to economic, environmental, user-related, and other measures and generally improvements of the wall/façade, roof/attic, and windows interventions were preferred (Abdul Hamid et al., 2018). Parallel to that, sustainability criterion (i.e. C4) was found here more important than others and "addition/removal (P/EA1)" of protective layer came to the fore.
- M-Repair was generally applied to buildings with heritage value rather than others. "Stability (C12)" criterion and "mending (P/EA4)" application appeared important as much as "heritage value (C17)" and "addition/removal (P/EA1)". In other words, concerning stability, the objective was related only to degraded parts similar to those defined in Table 1. The frequency of the heritage buildings, the heritage value criterion, and the presence of the complementary intervention types such as conservation, preservation, and restoration were in line with the definition, also.
- M-Restoration was totally concerned with heritage buildings. As in the case of M-Repair, "stability (C12)" had an importance, and even surpassed that of "heritage value (C17)". Besides, "structural reinforcement (P/EA5)" was preferred most for doing it, followed by "mending (P/EA4)". Therefore, it can be said that M-Restoration commonly includes structural interventions among others with the objective of returning it to its original condition, in line with the definition in Table 1.
- M-Retrofit was the most preferred intervention, regardless of heritage value with the objective of sustainability (i.e. in relation to "environmental (O3)" obsolescence and "contribution to sustainable development (C4)" criterion), which is consistent with the definition in Table 1. In parallel, in a bibliometric literature review on retrofit of dwelling across Northwestern Europe, energy efficiency was expressed as the leading trend in this field (Simpson et al., 2020). In another study on energy retrofitting of the residential buildings (Ibañez Iralde et al., 2021), the most preferred intervention category was identified as the passive strategy obtained by façade/roof/floor insulation and green/ventilated façade/roof, window/glass replacement, and providing airtightness and waterproofing, etc. Among these, façade insulation, window/glass replacement, and roof insulation were three of the most selected interventions in the current analysis. Similarly, another study evaluating passive thermal retrofit strategies expressed that wall insulation, glazing improvement, and roof insulation were three of the most preferred ones (Carratt et al., 2020), which are parallel to the "addition/removal (P/EA1)" and "changing (P/EA2)".
- M-Reuse was preferred mainly in heritage buildings, particularly in instances where alterations were made to accommodate a change in function, i.e. "functional (O4)" obsolescence. On the contrary of the other main intervention types, the criterion of "suitability of spaces for specific uses (C13)" attracted attention, which was an expected result of function change in parallel to the definition in Table 1.
- M-Strengthening, which was generally preferred for heritage buildings, is like M-Restoration considering

prominent type of obsolescence, criteria, and planned/executed applications. But, in specifically, it is related to restoration of degraded parts of structural system, as indicated in Table 1. Apart from these, the criterion "constructability (C18)" appeared to be important.

5. Conclusion

The study aimed to examine the intervention types starting from a broader framework of the intervention process to its components. The components of the intervention process (i.e. building or its part(s), factors, obsolescence types, and intervention approaches covering intervention types and criteria) were identified and classified in this respect. Throughout this classification, a systematic review of 170 articles was conducted to understand the frequencies and relation of the intervention components, and the scope of the intervention types (i.e. planned/executed applications). Key conclusions drawn from this review are briefly as follows;

- The elements and subsystems constituting the envelope are directly influenced by the outdoor environment and therefore have the greatest degree of intervention. Influenced parts of the envelope are changed according to the structural system of the building. In this case, it is notable that the construction year and technology of that period are important indicators. As a result of the long-life span, physical obsolescence is typically observed in heritage buildings, whereas environmental obsolescence becomes more prevalent in the others.
- The most prevalent intervention type is retrofit, aimed at addressing environmental obsolescence, regardless of heritage value. In this process, sustainability criterion is prioritized in buildings without heritage value, while in heritage buildings, preservation of heritage value supersedes sustainability concerns.

Concerning the intervention types the generalized remarks are as follows;

- Adaptation and reuse resemble each other since they are used to meet changing circumstances (i.e. performance and function).
- Conservation and preservation are predominantly associated with heritage buildings, with the objective of maintaining their cultural significance and preventing the formation of degradation. It can be argued that maintenance can be considered as a version of the aforementioned approaches applied to buildings without heritage value.
- Rehabilitation, repair and strengthening are preferred for the heritage buildings to remove the degradation, whereas the last one relates to structural reinforcement, specifically. In other words, these interventions represent a more comprehensive version of the conservation, preservation, and maintenance, which aim beyond keeping the parts in its existing situation.
- Restoration can be conceptualized as a comprehensive version of the aforementioned interventions related to heritage value, to turn the building into a specific period.
- Refurbishment, renovation, and retrofit are predominantly associated with the envelope and are intended to ensure sustainability. Although they are typically applied to buildings without heritage value, retrofit is also discussed for those with heritage value as well.

Consequently, the findings and information obtained in this review are largely aligned with those in the main references and existing literature reviews. Besides, as a further contribution to the associated field, the intervention process was elucidated in detail to ascertain the extent of each intervention type, and minor inferences were drawn to understand their boundaries and interrelations, and the differences between them. It is important to highlight that the frequencies presented in this study are derived from a systematic literature review, which includes simulations and experiments in addition to actual applications and therefore, may not directly reflect the real-world prevalence of interventions.

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A study on increasing practical earthquake evacuation knowledge and awareness through serious games

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Abstract
Earthquake evacuation process as a behavioral component of disaster resilience is one of the issues addressed by risk reduction strategies at spatial and urban scales. A well-planned, self-organized evacuation that considers human behavior pattern can reduce the loss of life. In this context, it is possible to establish a civilian-supported evacuation scenario with the behavioral change to be gained at the community scale during and after the earthquake. Geologically, Türkiye is a vulnerable country in terms of earthquakes, and there is a lack of comprehensive earthquake evacuation drills and training in both digital and traditional contexts. Therefore, Türkiye needs to focus on immersive, integrated efforts to increase the knowledge and experience of evacuees during earthquake evacuation. After integrating the necessities identified in the Turkish context and the affordance and potentials of serious games in evacuation, we propose a serious game called EVAC. This proposed model involves a component that enables (1) an increase in the level of knowledge and learning of the evacuation scenario on an individual and collective scale and (2) helps anticipate unforeseen problems, needs, and requirements that may arise during and after the earthquake by enabling the transition to a safe area in case of panic. This model has another potential (3) by integrating indoor and outdoor evacuation, this model can manage the evacuation time of the evacuees from the building, the roles they will gain when they arrive at the emergency assembly area, and the ability to provide civil organization in the area with cooperation.

Keywords
Disaster risk reduction, Earthquake evacuation, Evacuation knowledge, Serious game.

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1. Introduction

In the history of humanity, unpredictable natural disasters have caused significant loss of life. Within the scope of disaster risk reduction strategies, there is a preparation phase related to human behavior both on a structural scale and at the time of emergency. To build a disaster-resilient society, drills, training, and agent-based simulations are applied to improve the evacuation process and to complete the process on time and safely. Simulations are mainly used to measure the operability of exit points and evacuation time in buildings (Daude et al. 2019), while agent-based simulations are combined with various computational tools, such as cellular automata and social force models to describe the human behavior pattern during evacuation (Bernardini et al., 2016; Chapuis et al., 2022; D'Orazio et al., 2014; Iskandar et al., 2021; Serok & Blumenfeld-Lieberthal, 2015; Siyam et al., 2019; Sun et al., 2021; Tsai et al., 2011; Zhong et al., 2023). It would be easier to interpret human behavior during panic when human behavior in real earthquake videos and simulations is considered together. While all these studies are carried out to identify and predict human behavior during evacuation, the aim is to improve the process.

Şahin et al., (2019) demonstrate that improving human behavior through drills and training is possible. However, traditional disaster training, short videos, and earthquake booklets may not be sufficient for a successful evacuation since it will be difficult for individuals to remember and apply the theoretical knowledge, they have acquired about the process due to increasing panic and fear in an emergency. Since the regular experience of the acquired theoretical knowledge will reinforce the previous knowledge, gamification of the process in various scenarios with earthquake simulation that provides sensory and cognitive fidelity parameters in a virtual reality environment will possibly increase the success achieved in the evacuation process. Establishing a well-planned, self-organized, civilian-supported evacuation scenario with the behavioral change to be gained at the community scale during and after the earthquake is conceivable.

Türkiye is situated in a region where a major earthquake fault is named the North Anatolian Fault and has historically been the site of many strong earthquakes (Erdik, 2013). In the face of the expected Great Marmara earthquake and other possible earthquakes, the country needs social awareness and structural resilience. Improving evacuation practices during and after earthquakes and increasing awareness can prevent collective panic and secondary disasters. Therefore, society needs to gain behavioral resistance and receive disaster training in a repeatable way through direct experience. Under these needs, the study proposes a serious game model produced in a fully immersive environment to make the evacuees feel the shocking effect of the earthquake moment in a sensory, cognitive, and narrative way. This training game aims to enable evacuees to use their decision mechanisms effectively in an increasingly panicky environment and to complete the process on time and safely with the increased earthquake knowledge of the evacuees in a mass evacuation. Another objective of this study is to strengthen the civilian organizations, support the division of labor among the evacuees, and create collaborative support with officials after the earthquake.

Within the scope of this study, conceptual and theoretical backgrounds, literature review, and evacuation game examples are discussed in the second section. The method of this study is discussed in the third section, which includes context analysis, literature review, and integration of current serious game design methodologies. In the fourth section, the contextual background of Türkiye concerning disaster training. The game proposal in the fifth chapter includes the game design process as a model proposal and the roles and requirements for the game creation process. The last part, the conclusion, covers the study's contribution to the field, its limitations, and potential for future studies.

2. Earthquake evacuation knowledge and awareness through serious games

Researchers have produced agent-based models for planning and improving the evacuation process and the emergency evacuation route of buildings within the scope of evacuation models. In addition to agent-based models, some studies include models integrated with geographic information systems at the urban scale (Daude et al. 2019) or oppositely, some researchers use cellular automata and social force model to understand human behavior patterns in a micro-scale (Bernardini et al., 2016; Choi & Do, 2019; Quagliarini et al., 2014; Sun et al., 2021; Zhong et al., 2023). Since the evacuation process is complex and multidimensional, improving the behavior of evacuees is essential for the correct functioning of the process. Training and drills to improve human behavior during and after earthquakes are insufficient in directing the experience (Feng et al., 2022; Gwynne et al., 2020; Mitsuhara et al., 2023; Haghani, 2020; Rahouti et al., 2017). Within this perspective, it is crucial to feed by the learning-by-doing approach to improve the behavior of evacuees and thus ensure safe evacuation, which was focused on. This section will examine the conceptual and theoretical background and discuss game examples that aim to raise awareness of the earthquake evacuation process through serious games.

2.1. Conceptual and theoretical background

Natural hazards such as earthquakes, floods, or hurricanes are unavoidable phenomena; however, their transformation into disasters largely depends on the vulnerability and preparedness of societies. While hazards cannot be entirely prevented, they can often be predicted, and it is possible to build societal and structural resilience to reduce their devastating impacts. According to the United Nations General Assembly (2016), vulnerability is defined as "*The conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards*" (p. 24). Hyogo Action Framework Plan (2005-2015) draws attention to the vulnerable aspects of individuals who are victims of poverty and injustice caused by income inequality and disadvantaged groups, defines their risks to reduce disaster losses, and argues that vulnerable societies become vulnerable to disasters. Within this perspective, disaster risk management cycles have been universally accepted to prevent this inequality and the devastating effects of disasters. The disaster management cycle has two main parameters, risk management (pre-disaster) and crisis management (post-disaster); while risk management includes preparation and risk and damage reduction strategies, crisis management includes response, recovery, and reconstruction strategies (Kadıoğlu, 2022). *Risk reduction* strategies consist of two categories: structural and non-structural. Structural measures can be summarized as infrastructure, transportation, resettlement, and physical structure reinforcements, while non-structural measures can be summarized as calculation of vulnerability level, risk assessment, identification of hazards, financing preparations, supervision, education, awareness raising, and community participation (United Nations Office for Disaster Risk Reduction, 2005).

Earthquakes are the most frequent disasters and the ones that cause the most loss of life. Similarly, to provide structural and non-structural resilience for earthquake risk management strategies. The evacuation process is a critical component of preparedness and risk reduction strategies. Evacuation plans and drills may not be sufficient in the crisis, and unforeseen problems may arise (Daude et al., 2019). In contrast, a well-planned and self-organized evacuation can reduce casualties (Yao & Zhang, 2021). Therefore, to reduce casualties from earthquakes and damages from secondary disasters, it is critical to anticipate the behavioral responses of evacuees and the structural strength of the buildings, ensure that the emergency exit plan is functioning correctly, and create timely and safe evacuation plans.

Information on the well-known evacuation practice is often delivered through traditional training approaches such as courses, seminars, videos, posters, or drills. Every building has an emergency exit plan, rules, maps, signages, and actions prominently displayed on the walls. There are also traditional drill practices periodically, especially in schools. For training methods, there are new technological proposals for education and gamification of the evacuation process; these games are aimed at experiencing disasters rather than watching videos for children.

Those traditional methods, drills, and warnings are responsible for the earthquake moment, and they should be considered as preparedness strategies for the community. Researchers also need to analyze and evaluate evacuation process and propose well-planned and safe evacuation routes. There are some techniques to evaluate the evacuation process, a standard method is the analysis of *videos* that record the moment of the earthquake, researchers can analyze people one by one and examine the behavior of evacuation in interior and exterior environments. The other method is creating *simulations* as agent-based models in a virtual world that use people as agents and examine the behavioral patterns of emergency evacuation. While the technology developed, earthquake evacuation processes are also modeled on the virtual world, researchers can create simulations by replicating real earthquake moments on building models.

2.2. Literature review

The literature review on the evacuation process is considered in two different frameworks as: (1) the studies to plan and improve the evacuation process of researchers and the emergency evacuation route of buildings (Bernardini et al., 2016; Chapuis et al., 2022; D'Orazio et al., 2014; Daude, et al., 2019; Iskandar et al., 2021; No et al., 2020; Serok & Blumenfeld-Lieberthal, 2015; Siyam et al., 2019; Sun et al., 2021; Tsai et al., 2011; Tsurushima, 2020; Yamamoto & Li, 2017; Zhong et al., 2023) and (2) the activities addressed within the scope of evacuation training to improve the behavior of evacuees during the evacuation process (Feng et al., 2018; Filomena et al., 2023; Gwynne et al., 2020; Kolen et al., 2011a ; Suwanmolee, 2018). The first framework consists of micro and macro scale simulations, simulations tested by real-time evacuation videos, and simulations considering human behavior patterns. The second framework includes traditional drill approaches and gamification of the evacuation process.

Within the framework of emergency evacuation plans and behavior models, studies in the literature that aim to produce safe evacuation plans and improve the current situation with evacuation simulations on an urban scale. While integrating geographical and social data with a high level of detail, it is possible to simulate a community's evacuation scenario, and the simulations produced are suitable tools for studying how the overall dynamics of an evacuation can be affected by environmental factors (Daude et al., 2019). One of the most widely used models in earthquake evacuation simulations is Agent-Based Model (ABM), pedestrians are represented as agents that can perceive and interact with their environment and other agents (Bernardini et al., 2016; Chapuis et al., 2022; D'Orazio et al., 2014; Iskandar et al., 2021; Serok & Blumenfeld-Lieberthal, 2015; Siyam et al., 2019; Sun et al., 2021; Tsai et al., 2011; Zhong et al., 2023). Researchers use agent-based models by integrating other computational models according to the research area. Some of the researchers use Geographic Information System (GIS) for macro scale evacuation simulations to generate the shortest evacuation distance and evacuation route blockages based on the probability of collapse of buildings and use it to establish the safest evacuation route recommendation (No et al., 2020; Sun et al., 2021; Yamamoto & Li, 2017). However, most agent-based models have focused only on modeling the physical interactions between agents, representing cognitive knowledge, and complex and heterogeneous behavior modeling is a more complex process. Evacuation simulations do not adequately address human behavior at

the individual, group, or interpersonal level.

While these simulations calculate evacuation routes, some researchers add computational approaches to assume human behavior patterns and create self-organized evacuation processes. Sun et al. use the Cellular Automata (CA) model to create a crowd reaction rule equation in emergency situations, and they demonstrate that as much as evacuees are familiar with the exit, it increases evacuation efficiency (2021). Zhong et al. also focused on the non-structural components of the evacuation process by modeling the interaction between pedestrians with a Cellular Automata approach (2023). The Social Force (SF) model is also used in some studies to calculate the attractive and repulsive forces a pedestrian feels toward various aspects of the evacuee's environment and to predict the evacuation process (Bernardini et al., 2016; Choi & Do, 2019; Quagliarini et al., 2014). Some of the researchers use simulations and real earthquake moment video analysis together to create correlations between real and virtual evacuations and they try to examine evacuees' behavioral patterns during and immediately after earthquake (Bernardini et al., 2016; Lambie et al., 2016; Quagliarini et al., 2021; Tsai et al., 2011; Tsurushima, 2020; Zhong et al., 2023).

Agent-based simulations can guide decision makers on managerial issues such as emergency exits, evacuation routes, and shelter determination at the macro scale, and information on human and environment, human and human interactions can be obtained in models where simulations and computational models are integrated to include human behavior patterns at the micro-scale. However, it is also necessary to focus on the studies addressed within the scope of evacuation training to improve the behavior of evacuees during evacuation. Hence, simulations and video analysis within the earthquake risk reduction studies' scope need to be more comprehensive to prepare for the evacuation process.

Research on expected human behavior during earthquakes is based on simulations or post-event interviews and surveys, which have limitations such as the participant's willingness and memory to recall the event and the perceived reality of the simulation (Lambie et al., 2016). Evacuation simulations create a virtual environment and virtual behavior for evacuees, people move as ideal agents without thinking about social background, which may affect the decision-making process in case of emergency in these simulations. Creating an effective and well-planned evacuation process could be possible for a single family on a micro scale. However, for public evacuation there are social, demographical, physical, and psychological factors for each agent and their response to earthquakes will be different from each other, as well as interactions between evacuees that can negatively affect the mass evacuation. Evacuees need to experience the process in the best way and prevent instinctive behaviors. According to Şahin et al. (2019), individuals tend to follow their instincts in the decision-making process at the macro level. Instincts are the fastest way to react to an event and do not require consciousness, in the decision-making process, individuals mostly stick to their past experiences and apply learned behavior; experienced individuals act more rationally instead of following their instincts, while inexperienced ones cause more panic and chaos in the crowd (Şahin et al, 2019).

Effective evacuation of individuals is one of the most critical objectives in an emergency such as an earthquake. However, due to the complex nature of dense urban areas, and the substantial lack of public awareness of emergency evacuation, and also unnecessary confusion, injuries, and fatalities have frequently occurred (Sun et al., 2021). Therefore, correct, and effective earthquake evacuation responses of individuals can significantly reduce unnecessary casualties.

For evacuation procedures, every building has the rules, maps, signages, and actions prominently displayed on the walls, but people may not be aware of these procedures, and they may not experience them because they tend to follow previously used and well-known routes that determined by the

environmental setting itself (Filomena et al., 2023). Therefore, it is necessary to implement the exercise periodically. Information on the well-known evacuation practice is often delivered through traditional training approaches such as courses, seminars, videos, posters, or drills. However, more than these methods are needed for acquiring and retaining knowledge (Feng et al., 2018). One of the shortcomings of the traditional method is need for more feedback from individuals after the earthquake drill, which evaluates their behavior regarding evacuation processes (Gwynne et al., 2020). Also, these methods could be more impressive and have more sensory capabilities to refer to the earthquake scenarios to educate participants (Feng et al., 2022). As disaster risk reduction method, technology could be the medium; technological tools could have the ability to educate people via improved evacuation behaviors and decision-making mechanisms.

According to Suwanmolee (2018) through gameplay, knowledge of disaster risk reduction increases, and it becomes easier for participants to assess the situation, as well as an attitude of cooperation when communicating and negotiating for resources and behaviors of mutual assistance and sharing under limited resources. Increasing the chances of survival of earthquake victims after the shock of a chaotic situation such as an earthquake can be possible by improving the behavioral responses of building occupants to earthquakes and their evacuation skills, but traditional evacuation training approaches are insufficient to simulate earthquake scenarios (Feng et al., 2022). Filomena et al., (2023), who conducted a board game project designed by psychologists and geologists in contrast to traditional disaster education with passive participation within the scope of the seismic risk perception, stated that the game increased learning motivation as a result of this project with the young age group and emphasized that the game has the potential to develop risk response skills for their own safety and other members of the society beyond the acquisition of an excellent seismic risk perception by young people. The ability to experience the evacuation process through games in the real environment with virtual interfaces makes it possible to improve the immersive evacuation experience by repeating it, providing a "learning by doing" approach. In literature, evacuation games use different game approaches like game-based learning, gamification, and serious games, and there are different tools to create game environments for users named augmented reality, virtual reality, mixed reality.

Serious games have specific objectives and propose to transfer and abstract knowledge, train new skills, and change behaviors by creating awareness for the chosen scope. Concerning the evacuation and gamification process Feng et al., (2018) demonstrate that serious games can be adaptable for emergency education and evacuation and those games propose to educate participants by transmitting the knowledge of the game components even they can offer the possibility of behavioral analysis in case of emergency by monitoring and recording the decision process and behavior patterns during the experience. In short, introducing a new educational approach to earthquake evacuation training through serious gaming in a virtual reality environment participants' perceptions of the realism of a simulation may alter their behavior and thus provide limited insight into their actions, sequence of actions, and the influence of contextual variables (non-time dependent) that prompt them to respond to earthquake shaking (Kolen et al., 2011a).

2.3. Serious games for earthquake evacuation

A serious game is a game designed primarily for purposes other than entertainment, such as education, training, or behavior change (Damaševičius et al., 2023). In the context of disaster preparedness, they have been increasingly recognized as effective tools to support evacuation training, as they allow individuals to experience decision-making, cooperation, and spatial orientation in simulated yet safe scenarios (Feng et al., 2018; Ribeiro et al., 2012; Yang et

al., 2021). Traditional methods such as evacuation drills, written instructions, or seminars remain widely used; however, their effectiveness is often limited by three main factors: lack of realism and engagement, restricted adaptability, and insufficient educational efficiency (Gwynne et al., 2020; Mitsuhara et al., 2023; Haghani, 2020; Rahouti et al., 2017). These limitations can hinder the preparedness of individuals for real emergencies and highlight the need for more dynamic and interactive approaches.

In this regard, serious games present several advantages for evacuation education: (1) increased engagement and learning, (2) enhanced knowledge retention, (3) development of practical skills through scenario-based simulations, (4) inclusivity and accessibility (e.g., integrating the needs of disadvantaged groups), (5) adaptability and cost efficiency, and (6) cognitive and behavioral benefits that improve self-efficacy and performance during emergencies (Feng et al., 2018; Chittaro, 2023; Carvalho et al., 2022; Capuano et al., 2015). Recent studies further demonstrate that serious games, especially when supported by immersive technologies such as virtual reality (VR), provide participants with realistic and repeatable training experiences that outperform traditional methods in terms of learning outcomes, preparedness, and self-confidence (Mitsuhara et al., 2019; Feng et al., 2020; Rajabi et al., 2022; Ahmadi et al., 2024).

With the serious game proposal called SPOEL, which emphasizes the importance of both simulated and actual testing of mass evacuation planning by the government and the public and aims to prevent problems arising from the lack of real evacuation experience, Kolen et al. (2011) aimed to close the experience gap in emergency planning. SPOEL is a computer game focused on flood evacuation and is known as one of the first digital game examples. Another macro scale game example is an Augmented Reality-based game that focuses on the mass evacuation of a university building (Figure 1). In the study, which emphasizes that community members should be trained with the latest equipment and technology within the scope of experiencing procedures and rules within the scope of evacuation training, which has a vital role in emergencies, *game-based learning* systems, and AR technology were used, various animations were used in training aimed to provide access to the shortest and safest evacuation, and the mobile application tested in the university environment enabled the participants to be trained in a real environment, and positive responses were received from the people who received the training (Catal et al., 2020).

Figure 1. *Evacuation game various scenes (Catal et al., 2020).*

In another study that uses Virtual Reality (VR) technology and proposes the use of innovative digital technologies in the face of traditional drills and training that are insufficient to simulate a life-threatening earthquake scenario, a *serious game* training system was proposed to improve behavioral responses to earthquake and post-earthquake evacuation preparedness involving both employees and patients (Figure 2). an increase in self-efficacy and knowledge was observed after the game and the training was found valuable and instructive by the participants (Feng et al., 2020). The same researchers of this study propose another game after a few years that combines with Immersive Virtual Reality (IVR). In addition to the previous study, in the study aiming to analyze common earthquake behaviors, behavioral sequence analysis (BSA), which is used to understand and model individual behaviors during an earthquake, was adapted to the earthquake drill in a virtual environment, verbal protocol analysis to determine the behavioral sequence of the participants, video analysis obtained from the images of the behaviors exhibited in the IVR environment, and a picture of emergency human behaviors was revealed; it was possible to develop behavior-oriented strategies for earthquake emergencies (Feng et al., 2022).

As an example of a gamification study focusing on the optimization of the plan schemes of buildings and emergency exit routes for indoor evacuation, which is handled within the scope of mass evacuation, the issue addressed in the virtual reality-based game focusing on the evacuation of a hotel building is the analysis of undesirable route selection strategies and the tendency to retreat during evacuation, according to the findings of the researchers, the tendency to retreat is related to spatial configurations and the flatness, visibility, and width of the evacuation corridor led to a decrease in the tendency to retreat (Snopková et al., 2022). Studies focusing on earthquake scenarios at the micro-scale often aim to train evacuees or mitigate damage through spatial adjustments and improvements to avoid secondary disasters and accidents during and immediately after an earthquake. Within

Figure 2. *The storyline of the IVR SG training systems (Feng et al., 2022).*

the scope of indoor evacuation, a virtual reality-based serious game is proposal addressing earthquake scenarios in office environments. Four different methods were applied, and participants were tested: virtual reality-based serious game, video game, manual training, or no training method, compared to conventional exercises, participants were able to avoid physical damage and identify potentially dangerous objects (Li et al., 2017). In Indonesia, traditional evacuation drills with self-rescue practice are used in schools and offices, but Wibisono (2019) proposed a new tool for situations such as lack of seriousness, earthquake shaking sensation, and lack of full involvement of participants in the evacuation. They proposed a virtual reality technology-based model that is experienced individually and creates the feeling of shaking. The experimental group was selected from students who play games for 2-3 hours a day, and most of the students found the designed model more effective than static drills or animations and videos because of the direct interaction with virtual objects and the reality of the earthquake feeling (Wibisono, 2019).

When the studies in the literature on earthquake evacuation through serious play, which is one of the immersive education methods that surpass traditional drills in order to reduce the damage that will occur during and after the earthquake, were examined, most of the existing studies have focused on virtual reality (VR)–based serious games that provide *individual* evacuation experiences within indoor spaces or specific public buildings (e.g., Mitsuhara et al., 2019; Feng et al., 2020; Rajabi et al., 2022; Zhang et al., 2023). In these works, the main emphasis has been on knowledge gain, self-efficacy, and evacuation performance at the individual level, while the role of social influence and multi-user interaction has largely been overlooked. As a matter of fact, when it comes to mass evacuation, there is still no collective game design that enables immersive *multi-user* experiences in public spaces where evacuees move simultaneously and influence each other's decisions (Baraldo & Di Franco, 2024; Liu & Liu, 2025).

When the games and simulations are analyzed, no model has been proposed that provides structured feedback on the adequacy and accessibility of emergency gathering areas, the time required to reach them, or the identification of spatial needs and deficiencies at the final stage of evacuation. Among the studies, there is also a lack of inclusive approaches that incorporate task distribution and division of labor in collective evacuation management, as well as the involvement of vulnerable groups such as the elderly, children, or disabled individuals (Quagliarini et al., 2020; Zhu & Li, 2021). This study, which proposes a new game approach based on the gaps in the literature and existing game proposals, aims to identify and fill the existing gaps.

3. Methodology

This chapter outlines the research methodology adopted in this study, which integrates content analysis, a comprehensive literature review, and the examination of serious game methodologies. While content analysis contains worldwide evacuation practices, earthquake training given within the scope of disaster relief by the Disaster and Emergency Management Presidency (AFAD) in Türkiye, and earthquake evacuation training included in the school curriculum determined by the Ministry of National Education (MEB), the scope and implementation details of which are elaborated in Chapter 4. Within the scope of content analysis, practices regarding evacuation drills, evacuation training, and earthquake training were investigated both around the world and in Türkiye. Widespread and effective methods of public participation have been identified around the world, especially in Japan, Chile, America, and India. This phase, it is examined applications, evacuation and earthquake information booklets, and traning methods worldwide that focus on disaster evacuation education in a collective and participatory way.

A wide scope literature review was conducted on the given keywords between March 2023 and December 2023 by scanning existing literature databases (Web of Science, Scopus, Google

Scholar). The literature review briefly started by examining evacuation models on macro scale and micro scale evacuation simulations, including human behavior. The keywords commonly used at this literature review phase are as follows "Agent-based Models, Mass Evacuation, Behavioral Models, Post-earthquake Evacuation, Pedestrians Behavior Modelling". In the second phase of the literature review, earthquake education methods and the current situation on gamification within the scope of earthquake drills and training were reviewed. The keywords commonly used in the second phase of the literature review are as follows "Earthquake Evacuation Drills, Community-based Drills, Panic Effect, Serious Games, Education for Disaster Prevention".

To trace topic dynamics, we queried Web of Science for five review-structuring keywords—agent-based model, behaviour model, earthquake drill, mass evacuation, and serious game—and exported yearly publication counts for 2010–2023 (Figure 3). For cross-term comparability, we computed a Relative Growth Index by normalizing each series to its 2010 value = 100 (Indext_tt = 100 × Countt_tt/Count2010_{2010}2010). The resulting trajectories depict timeline trends independent of absolute volume (e.g., an index of 300 indicates a three-fold increase over 2010). Counts are compiled per keyword; a single paper may appear under multiple keywords, so the curves represent trend dynamics rather than a deduplicated corpus total. This benchmarked view supports identifying which concepts accelerated or plateaued over the period and informs priority areas for subsequent studies. Briefly, all five keywords grow relative to 2010; *agent-based model* and *behaviour model* rise steadily, *serious game* accelerates circa 2014–2019 then flattens after 2020, while *earthquake drill* and *mass evacuation* are more volatile—consistent with event-driven attention and low-base effects.

After content analysis and literature review to propose a serious game, another method was an examination of current serious game methodologies, which have comprehensive and multidisciplinary frameworks.

4. Contextual background

Earthquakes impact millions of people around the world and cause loss of life and economic and environmental losses. While structural resilience technology is improving, managing risks by changing behavioral responses before, during, and after the earthquake it is also possible. In this direction, some earthquake education

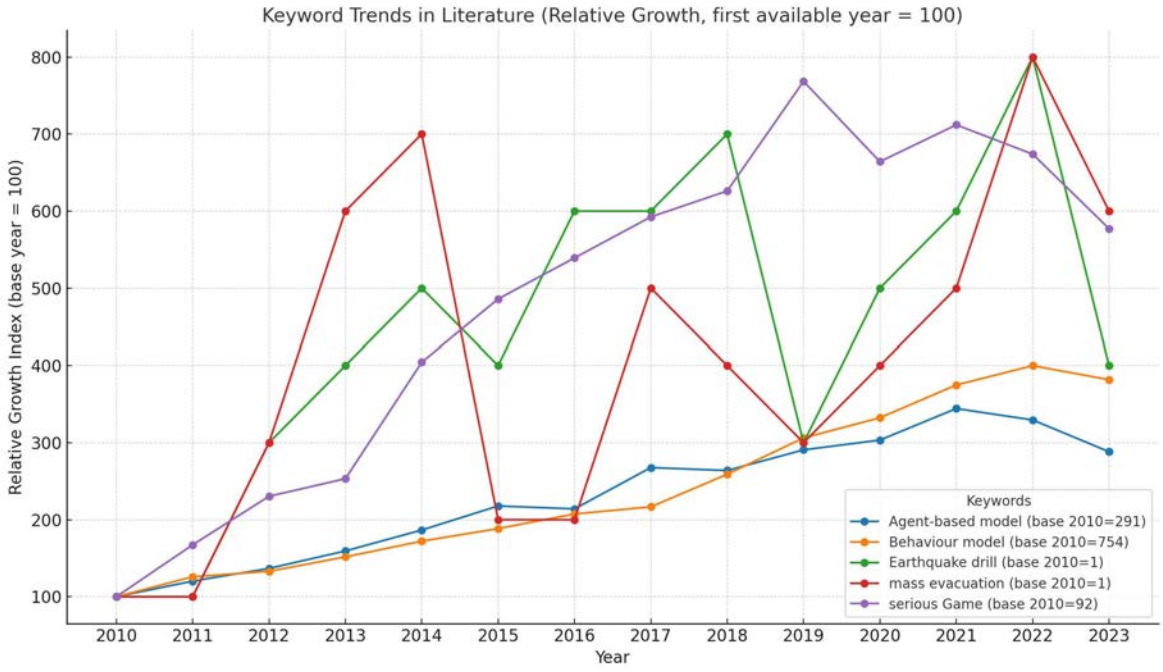

Figure 3. *Keyword trends in the earthquake-evacuation literature (2010–2023, Web of Science).*

systems cover evacuation procedures and civilian-supported systems after the earthquake worldwide. ShakeOut and NETAP training, organized every year in America in cooperation with FEMA, is another disaster training program that combines theoretical and practical training consisting of different modules and stages carried out by the American Red Cross which takes place with the participation of millions of people. These drills enable individuals and communities to learn how to behave during an earthquake (ShakeOut, n.d. ; Federal Emergency Management Agency, n.d.). Japan is known as one of the most prepared countries in terms of earthquake training and disaster preparedness. The training day, called Disaster Prevention Day, is held regularly and collectively on September 1 every year (Shaw et al., 2004). India also developed an earthquake education program called the School Earthquake Laboratory Program (SELP) to increase students' earthquake awareness. SELP has an interactive and participatory learning method, and laboratories have been established, especially in earthquake risk areas (Bansal & Verma, 2013). Chile is another country that has improved evacuation education after Japan, the National Disaster Prevention and Response Service (SENAPRED) has introduced an interactive application called "Visor Chile Prepared"; thanks to this application, anyone who wishes will be able to learn about their exposure to natural disasters based on their location. The aim is for the application to become a tool for the community to develop their planning, as well as provide the user with images of structures, roads, and topography. It allows viewing of education, health, police points, evacuation areas, emergency meeting points, and evacuation routes (Prepared Chile Map Viewer, n.d.).

Türkiye is situated in a border region where Arabian and African lands drift northwards toward Eurasia. In the northern part of the country, a major earthquake fault named the North Anatolian Fault and historically been the site of many strong earthquakes (Erdik, 2013). Between 1900 and 2023, 75 earthquakes bigger than 6.0 magnitudes took place in Türkiye, while 80.876 people died in earthquakes between 1900-2000, this number was 60.317 in the last 23 years, between 1900 and 2023, 141.179 people died, and 17 million people have been directly affected by earthquakes (Emergency Events Database [EM-DAT], 2023). In 1999 the Marmara earthquake affected seven cities with 7.4 magnitudes and caused 17.480 deaths. Lastly, on February 6, 2023, two major earthquakes occurred on the Eastern Anatolian Fault, which had 7.6 and 7.7 magnitudes, and they affected 11 cities and more than 9 million people, 50.783 people died in those earthquakes (United Nations Population Fund, [UNFPA], 2023) (Figure 4). These earthquakes were recorded as the most hazardous in the country's history, generating severe spatial problems such as the suspension of education, difficulties in temporary settlements, and challenges in meeting the needs of disadvantaged groups (Presidency of the Republic of Türkiye, Department of Budget and Strategy, 2023; Gün et al., 2025).

While earthquake risk increases yearly, the Marmara region is expected to experience a major earthquake, as experts have warned for a long time. Therefore, all the official units of Tür-

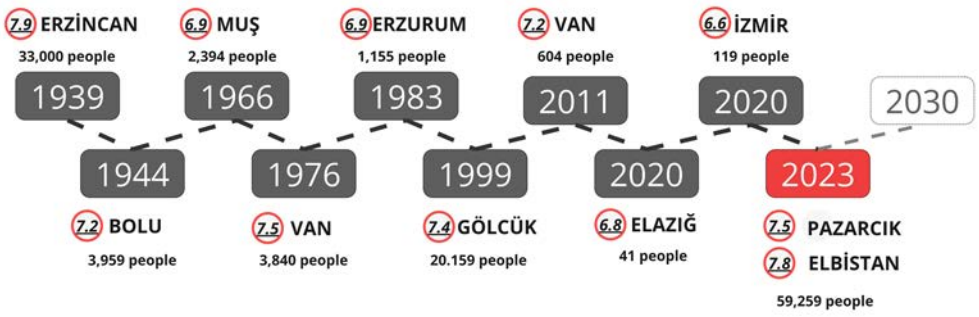

Figure 4. *Earthquakes year, magnitude, and life losses in Türkiye between 1939-2023.*

kiye should focus on disaster risk management and risk reduction strategies. In this regard, increasing knowledge and awareness about the earthquake and evacuation process it is essential to training and educating the evacuees.

The Disaster and Emergency Training Center (AFADEM), which was established in 1960 under the General Directorate of Civil Defense of the Ministry of Interior within the scope of disaster preparedness and raising awareness, has planned to provide effective, efficient, and sustainable services for training services with the mission of "creating a disaster-resilient society", AFADEM aims to improve pre and post-disaster behaviors with training such as "Disaster-ready family, disaster-ready school." Today AFADEM training facility includes classrooms for search and rescue and first aid courses. There are areas such as demolished buildings and wreckage areas for practical training (Afet ve Acil Durum Yönetimi Başkanlığı, n.d.).

Within the scope of earthquake education studies, the Japan International Cooperation Agency (JICA) and Ministry of National Education (MEB) prepared the "School-Based Disaster Education Project" in 2010 covering 80 schools in 10 provinces in order to raise awareness of teachers, students, and parents, the project working group is divided into three, the first group focuses on the implementation and dissemination of the project, the second group compares the education curriculum of Türkiye and Japan, the third group focuses on the school disaster and emergency management plan (Özmen & İnce, 2017). The second phase of the School-Based Disaster Education Project was implemented in 2019, and in this phase, contents such as proactive intervention against disasters for school administrators and teachers were updated. The Disaster Awareness Course Curriculum was developed as an elective course in lower secondary schools for grades 5, 6, and 7, and was approved by the Board of Education and Discipline in 2023. Its primary aim is to enable students to apply life skills in disaster situations, acquire first aid knowledge, understand the impacts of disasters on individuals, society, and the economy, predict possible outcomes, and internalize a culture of disaster awareness (Ministry of National Education [MoNE], 2023). Students take this course in two levels, "Disaster Awareness-1" and "Disaster Awareness-2," each consisting of 72 hours of instruction (Afet ve Acil Durum Yönetimi Başkanlığı, n.d.). In addition, the Disaster and Emergency Management Presidency (AFAD) also supported the development of updated course contents, digital learning materials, and teacher training modules (Özmen, 2023).

In the case of earthquakes, most of the studies focus on post-earthquake mitigation and reconstruction. However, pre-disaster measures have not been given enough importance, and training programs have not gone beyond annual earthquake drills. In İçme and Büyük (2023) study analyzing the curriculum for earthquake education in schools in Türkiye, they stated that there were deficiencies in the program prepared for children to receive earthquake education in schools, that classroom activities were limited to earthquake drills, behaviors that should and should not be done during an earthquake, and earthquake bag preparation, in addition, they stated that technological applications (video, simulation, augmented reality) were not included in school books to be used in earthquake education and that learning areas, learning by living and organizations were not taken into consideration within the scope of out-of-school training.

Doğan and Koç (2017), in their study investigating the increasing success rate of education through digital games, formed control and experimental groups of students whose prior knowledge was equivalent to each other, applied the traditional teaching method as in the textbooks to the control group and presented a computer-aided digital game to the experimental group, and it was observed that the academic achievement of the students in the experimental group for earthquake knowledge increased positively compared to the traditional method. In this direction, while digital games and simulations have an essen-

tial place in terms of attractiveness and retention of knowledge, their absence in the education programs of schools is a glaring deficiency (İçme & Büyük, 2023).

5. EVAC game model proposal

Contextual background describes another gap in the literature, and it has been determined that disaster trainings are limited to short narratives and videos containing theoretical information, especially at the primary school level. Traditional disaster training and drills are far from direct experience, and in unpredictable and chaotic situations such as earthquakes, it will be difficult to remember the theoretical knowledge with the increasing panic moment. Earthquake evacuation practice, which includes information about the measures to be taken immediately after the earthquake to protect against secondary disasters and about the division of labor that will trigger civilian organization sometime after the earthquake, and which is experienced in a virtual framework with specific repetitions, will both increased awareness on a social scale and facilitate the recall of information. In this direction, creating a game that will increase earthquake awareness by integrating learning objectives is possible; the game can be played in a different scenario in an immersive environment. The learning-by-doing approach can overlap and form the basis of practical and participatory evacuation training. When the games produced within the scope of earthquake studies are examined, the concept of serious games that provide the user with a new skill, education, and learning objectives comes to the fore.

According to Zyda (2005), a serious game is used in non-entertainment fields such as education, health, and communication to achieve a specific purpose. While the use of gamification is becoming widespread in the context of skill acquisition, construction of new knowledge, and interactive learning, according to Anderson, contemporary gaming technology is used to produce virtual worlds for interactive experiences that can include social interactions as well as mixed reality games that blend real and virtual interactions (Anderson et al., 2010). Games created in virtual environments give the player the chance of freedom and repeatability, allowing them to look at and interpret the problem from multiple perspectives (Marne et al., 2012). In this context, a virtual reality-based serious game model is proposed for the earthquake evacuation process, which is the behavioral component of the risk reduction strategies of the disaster management process, offering repeatable and multiplayer drills and training opportunities.

Since the serious game design process also involves knowledge building, learning objectives, and game objectives should be parallel, and the whole game creation process should be completed with the support of various experts. In this context, various methodologies exist within the scope of serious game creation in the literature. One of them, EMERGO methodology, is a study that proposes a holistic creation process including analysis, design, programming, implementation, and evaluation stages to ensure that game and learning objectives are consistent in the serious game development process (Nadolski et al., 2008). Shortly after this study, Marfisi-Schottman et al. (2010) proposed a methodology that includes pedagogical goals, design scenarios, visualization, and presentation and emphasized that cognitive experts, pedagogical experts, game designers, and graphic designer actors should act together. Jaccard et al. (2021) used a categorical approach to propose a methodology that addresses the general goals of the problem, game, and learning-oriented problem-solving those centers on the concept of learning and how to evaluate the solution from both a game and learning perspective. While the Jaccard methodology represents the building blocks and core elements of standard serious game design, it aims to be customizable for each project. The co.LAB framework is an open-access interface created by the Jaccard methodology researchers, adapted to a web platform that any serious game producer and stakeholders can use to control the development of

serious game building blocks, work distribution, and project-specific reorganization of categories. Using the Jaccard methodology and the co.LAB web application, serious game building blocks can be constructed and tracked in a collaboratively. Furthermore, Pacheco-Velazquez et al. (2023) proposed a participatory approach to develop actor action schema in the serious game model proposal phase and emphasized the importance of roles and collaborative approaches in the serious game design process. According to Pacheco-Velazquez (2023), the purpose of the serious game is to disseminate knowledge, improve the skills of the players, and make the learning process meaningful for the participants, and the primary responsible actor in this process is the pedagogical expert, and the pedagogical expert should be the team leader at every stage of the process.

The new model, which integrates EMERGO, Jaccard, and Pacheco-Valezquez methodologies, describes the theoretical framework of the serious game creation process, including the context, goals, scenario, functions, and mechanics of the game in categorization, and serves as the basis for the following study with draft game visuals. The integrated model suggests multidisciplinary teamwork using a participatory approach within this perspective. Therefore, software developers, graphic designers, pedagogical experts, cognitive experts, and subject matter experts should collectively share a standard process by considering the game and learning objectives.

The "Context and Goals" category, which includes learning and game goals, combines game developer and pedagogical expert and is the basic building block of the game design process, where an overview of the problem and initial ideas about the solution is established. According to Jaccard (2021), this category is the part that guides the development team and is used for communication with stakeholders. In the "Game Definitions" category, which covers sub-headings such as the game's goals, rules, narrative and scenario, game interfaces, the game universe, and user experience, the game developer, graphic designer, cognitive expert, and pedagogical expert work together.

The "Mechanics" category includes game and learning mechanics, rewards, incentives and interactions, software development experts, game developers, graphic designers, and pedagogical experts working together. The feedback that players receive throughout the game and their actions change the course of the game, making it a meaningful game. The new information learned is linked to previous knowledge, and the player's active participation in the learning process is linked to the meaningful learning process. When meaningful play and meaningful learning are designed to support each other, meaningful serious games emerge (Jaccard et al., 2021).

In the "Pedagogical Objectives" category, which distinguishes serious games from other game types, the pedagogical expert and cognitive expert organize the user profile, pedagogical scenario, learning objectives, and learning basics. In this category, one of the appropriate learning theories should be selected to establish the learning foundations, the content related to the knowledge and skills that the player needs to acquire should be determined or verified by professional experts, and finally, the serious game should remain embedded in the pedagogical scenario with theoretical knowledge and personal work (Jaccard et al., 2021). The "Assessment" category, sub-titled game and learning evaluation, determines how the game and its objectives will be evaluated and includes data processing and visualization processes. At this stage, the software development specialist and graphic designer play a role together (Figure 5).

The proposed game model aims to collectively gain the practice of safe and timely evacuation during and after the earthquake in a multiplayer environment. The game is being played in a university and will be played in a class of 30 students with replacement headsets and controllers given to everyone. Each student will start the game simultaneously and see the earthquake shaking start in their classrooms in a VR

environment, what to do during the earthquake shaking will be presented to the player by the game, and the students will wait safely until the shaking is over (Figure 6).

After the shaking, the evacuation process from the university building will begin, and the player will be given instructed by the game to ensure safe and timely access to the nearest emergency gathering area. At the end of the game, the player will be able to receive feedback from the game and have the chance to give feedback to the game (Figure 7).

The game aims to raise earthquake risk awareness and improve participants' evacuation knowledge and skills, in the context of earthquake evacuation, students will learn how to wait in a safe area, in an appropriate position during an earthquake, and how to evacuate from classrooms and school in a safe and timely manner immediately after the earthquake, and when they reach the emergency gathering areas, they will be able to divide the work in the gathering area according to the role distribution given by the game according to the player profile (Figure 8). The secondary objective of the game is to determine the adequacy and accessibility of the assembly area according to the current situation after evacuation.

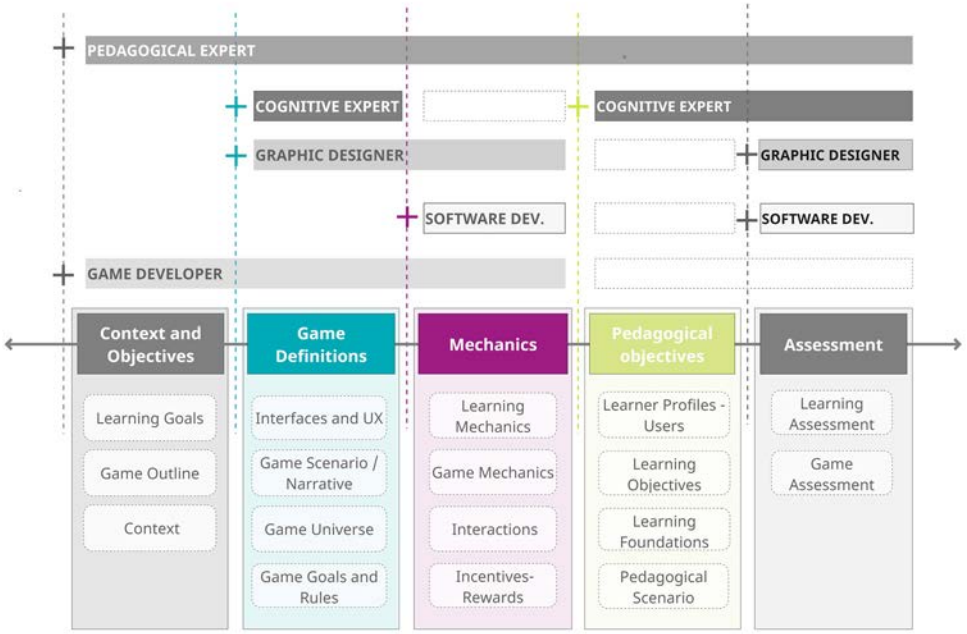

Figure 5. *New integrated model for the EVAC game development process in a structured approach.*

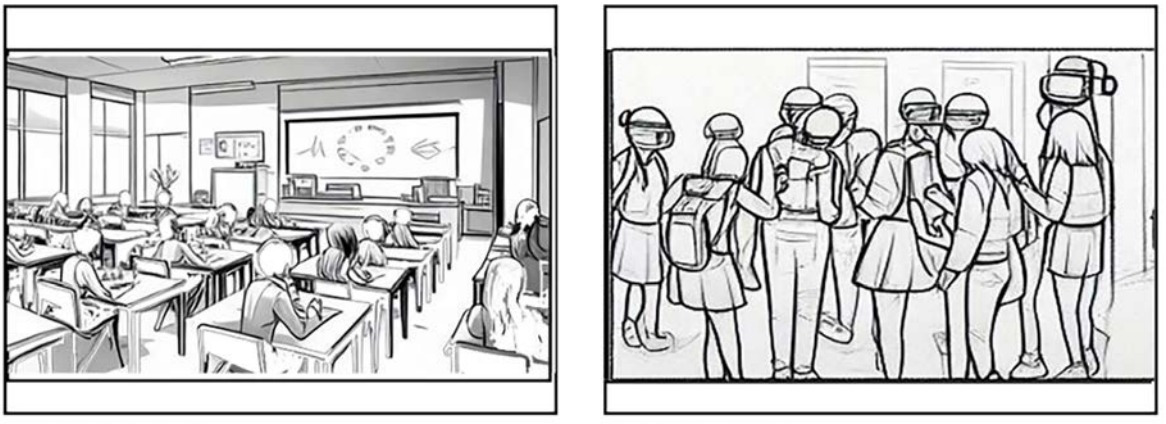

Figure 6. *Information and preparation phase of the EVAC game.*

Constructivist and socio-constructivist learning theories are used within the scope of the proposed game. Those approaches make evacuees collectively experience earthquake evacuation in a real environment, learning is considered a process, and the importance of experience in the learning process is accepted. The game universe, defined as the world in which the game will be played, is a simulation of the earthquake moment, and players should follow a role-playing "pretend" scenario. The most critical building block of the game definitions category is the "player decisions" section, as the reality to be represented and the type of fidelity will determine the reflexes and decisions players should make in the simulation. Depending on the reality being simulated, one or more of the sensory (visual, auditory, and physical), narrative (story and narratives), and cognitive (reflexes) fidelity types can be used (Figure 9).

6. Conclusion

The evacuation process is one of the non-structural measures addressed within the scope of earthquake risk reduction strategies. Despite the panic experienced during an earthquake, a self-organized and collectively executed evacuation process can reduce the destructive impact of earthquakes and save lives. The post-earthquake evacuation process is complex and multidimensional. However, allowing evacuees to experience earthquake shaking and evacuation practices through a "learning-by-doing" approach can ensure a safer process.

Game phase

They will see the earthquake shaking start in their classrooms in VR environment. Students will wait safely until the tremor is over in a proper situation by orientation of the game.

Feedback phase

At the end of the game, the player will be able to receive feedback from the game and will also have the chance to give feedback to the game.

Figure 7. *Game and feedback phase of the EVAC game.*

Civilian supported process

it is possible to establish a well-planned, self-organized, civilian-supported evacuation scenario with the behavioral change to be gained at the community scale during and after the earthquake.

Role sharing

Within the scope of civil-based support there will be a role distribution phase given by the game according to the player profile.

Figure 8. *The EVAC game aims to create a civilian-supported system with a role-sharing approach.*

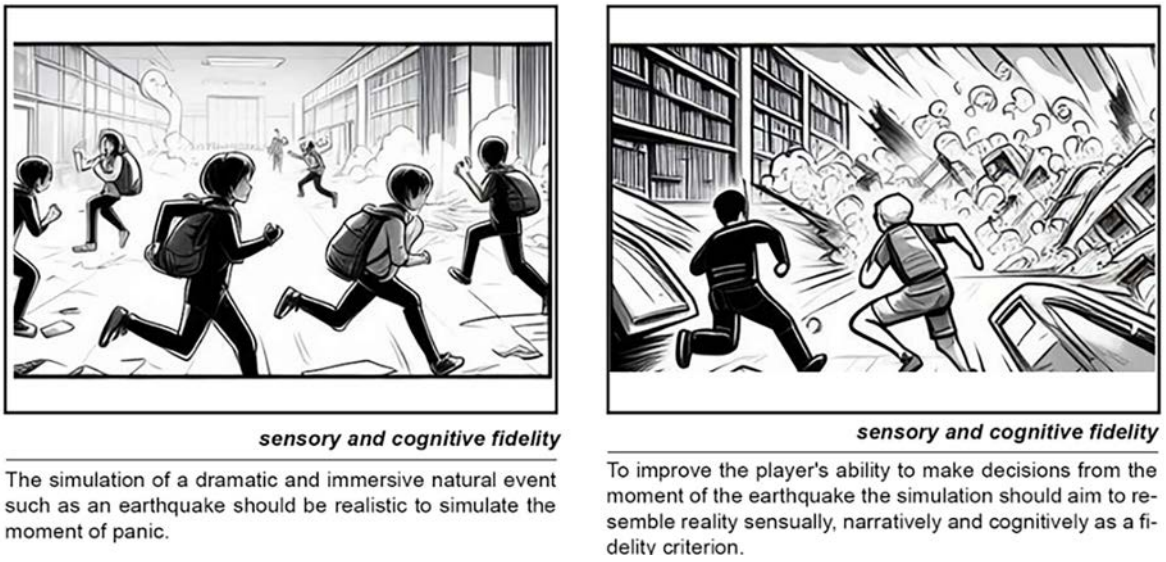

Figure 9. *Fidelity components of the EVAC game.*

In this context, we propose a serious game called EVAC. This game model aims to increase the level of knowledge and learning about evacuation scenarios on both individual and collective scales and to anticipate unforeseen problems by facilitating a safe transition to a secure area during panic. This study is designed as the first step in future research, with certain limitations. Within the scope of the EVAC game proposal, the scenario, development team, and theoretical framework of the game have been established. Since the game development phase has not yet begun, fieldwork has not been conducted, and the game has not been tested. As an immediate next step, we will run a small-sample pilot with volunteer participants once institutional ethics approval is granted and Law on the Protection of Personal Data (KVKK) -compliant procedures are in place (explicit consent, data minimization, de-identification, opt-out). The pilot will focus on pre–post evacuation knowledge, self-efficacy, route-choice accuracy, time-to-assembly, and cooperation metrics using interaction logs and questionnaires (no psychophysiological sensors at this stage).

In the long term, the aim is for a broader audience to play the game, expanding the dataset to gather more information about the evacuation process. To clarify intended use and evaluation logic, we outline representative scenarios and expected results: (i) multi-storey school building with/without a designated leader—expected shorter decision latency and fewer wrong turns with leadership; (ii) blocked exits and dynamic hazards (aftershock, alarm)—expected faster re-routing and reduced bottleneck dwell time after training; (iii) inclusive evacuation with a mobility-restricted peer—expected higher help rates and clearer task allocation with minimal penalty to time-to-assembly; (iv) building-to-assembly-area leg—expected more accurate assembly-area selection, fewer backtracks, and improved role distribution (guide/scout/helper) under time pressure. These pilotable scenarios are designed to yield actionable, quantitative signals that inform iteration on core mechanics and feedback design.

In the upcoming stages, students' evacuation knowledge and skills will be measured through various practices, particularly interviews with authorities, to collect data for the game development process. These two preliminary studies will provide different data to the development team, and the game creation process is planned to start after these stages. This study contributes to the field by proposing a comprehensive, participatory, and multidisciplinary game development approach, based on the analysis of the current situation and content, as well as identifying gaps in the literature. The EVAC game aims to improve earthquake

evacuation practices, increase awareness, and establish a civil support system with a mutual aid approach in the immediate aftermath of an earthquake. The EVAC game universe is designed to simulate the moments during and after an earthquake in the real world. With this proposed model, the foundations of the EVAC game have been laid, particularly the general framework for actor action distribution during the game production process. The VR-based evacuation game is expected to allow students to experience the earthquake and its aftermath, control the panic moment, and fulfill their duties by coping with the shock immediately after the earthquake. In the future, it is planned to obtain implicit behavioral data, such as eye movements, EEG, and other health metrics, through VR technology during panic, which will help inform decision-making mechanisms. This data will enable us to achieve results that can influence decision-makers, such as evacuation times at structural and urban scales and accessibility to emergency gathering points. In sum, the staged plan—pilot first, then extended evaluation—addresses the current limitation (no test yet) and derisks later deployment by producing early evidence on knowledge gains and behavioral outcomes under socially realistic conditions.

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A framework for concept formation in architectural and interior design education

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Abstract
This paper introduces a framework for student learning during the concept formation and development phases of architecture and interior design. The framework, introducing "guiding domains", attempts to integrate case-based and research-based learning within three education applications with theoretical and practical components: a lecture, a short-term workshop, and an integrated course. An overview of these applications is followed by research findings concerning student perspectives on their learning. Student feedback includes survey results from the first two applications and reflection essays from the third. The findings reveal positive learning outcomes whereby the guiding domains expand student perspectives, clarify their understanding of concept development, and encourage diverse projects. The paper contributes to design education by proposing an integral framework for concept development that can be applied in different educational contexts to enhance the theoretical and practical components of student learning.

Keywords
Case-based learning, Concept formation, Design education, Guiding domains, Research-based learning.

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1. Introduction

Education in architecture and interior design is founded on the design studio. Here, students are expected to engage in the creative design process with the required level of complexity. Design educators believe that the final output is not the only significant component of design pedagogy; the design process is also critical because it fosters critical thinking and creativity. With research-based learning, students can examine the content and create critical questions surrounding the concept formation (Salama, 2008; 2013). Accordingly, as Park et al. (2022) suggest, focusing on the concept exploration and analysis processes is effective for design education.

Through descriptive models of design, researchers have investigated how the design process develops, with a focus on the phases of design given multiple constraints acting on it (Lawson, 1997). Abdelhameed (2017) states that the design is composed of several phases, including problem definition, concept formation, creating new ideas, and forming compositions. Folch et al. (2019) also put forward that the creative process of design is comprised of three stages, including preparation, ideation, and verification/evaluation. Darke's (1979) research of prominent architects and their design process revealed that a primary generator or concept envisioned by designers in the initial phases of design pre-structures how the design will progress in later stages.

As Ghim (2022) suggests, the initial stages of the design process are often without a clear structure, which leads to ambiguity not only for the working designers but also their collaborators in practice. With propositions to enhance concept generation methods in design education that offer students a variety of pathways, Eilouti (2021) highlights the need for methods that are not confusing, applicable in the early stages of design process, and usable for a variety of design problems. In this paper, we address these issues by first presenting framework through which we incorporate the various tools and methods that have been used by designers through case studies, introducing "guiding domains", referred to as the domains of design knowledge that have potentials to give inspiration for concept formation. Afterward, we propose the understanding and use of guiding domains within three educational modules for students of architecture and interior design. The very first module aims to introduce the guiding domain concept to students as well as support case-based learning, which is a "lecture-based module". In the second module which follows the "lecture-based module", "short-term workshop", students can apply the guiding domains to their design studio projects. "Integrated elective courses" is the module in which lectures, workshops, and research-based design are combined for better digestion and understanding of concept development phases by students. Finally, we evaluate the effectiveness of these modules for student learning through students' feedback and learning outcomes.

Through this framework proposal, which actually integrates both case-based and research-based learning methods, we are aiming to add to the current literature that allows the students to have a deeper understanding and comprehension of the design process. At the same time, the guiding domains suggested by the framework aim to cultivate the critical understanding and creativity of students.

Regarding this framework and aims, the research questions of the study are as follows:

- What is the perceived efficiency of these three educational modules of the "guiding domains" by students' feedback?
- Regarding the students' feedback, what are the opportunities and challenges of these three modules of the "guiding domains"?
- How is the navigation of early stages of concept development and formation integrated by "guiding domains"?

With the help of these research questions, we are aiming to ensure a new understanding of concept formation with the help of "guiding domains" within three educational modules, both theoretically and prac-

tically, which can guide students in the concept development process of their design projects.

2. Background

This section discusses various methods for concept creation by referencing concept development approaches, design domains, and case-based studies from the existing literature.

2.1. Concept development methods

Concept generation combines critical or evidence-based processes and produces many options through irrelevant inspirations (Eissa, 2019). The concept can be found or produced from any written or visual sources that describe the project's main features and how it will look, feel, or evoke a feeling of the past. The visual concept can only find its expression in the space during the process (Dodsworth & Anderson, 2015). Choi and Kim (2017) argue that learning design theories should be a prerequisite to the design thinking process, especially during concept development, where the process is not based on finding the correct answers. Design educators have, therefore, explored educational applications across courses whereby theoretical and practical knowledge are interconnected and support each other (AboWardah, 2019; Fernando, 2006; Raein, 2004).

Numerous studies have focused on creativity and concept generation to investigate their sources and how they are approached in different design fields. These can be clustered into three main groups: those related to scientific approaches and aspects (Hickman & Kiss, 2010; Amiri, 2011), those related to creative thinking and creativity (Teal, 2010; Budge et al., 2013; Dineen & Collins, 2005; Laamanen et al., 2023), and those considering approaches in different levels of education (Gürel & Potthoff, 2006; Karppinen, 2008).

2.2. Design domains

According to Schön (1983) and Cross (2001), the initial step in concept formation, problem framing, occurs when designers choose particular aspects of the problem to focus on and explore. The restructuring and reframing of the problem continue during further stages of design (Cross, 2001). As such, "frame creation" is a foundational design activity (Dorst, 2011), where a repertoire of "design domains" is utilized (Schön, 1983). Likewise, Sarkar and Chakrabarti (2017) point out that designers rely both on domain knowledge (the specific knowledge base required for a design discipline) and process knowledge (the ability/act of designing that runs across disciplines) when given a design problem.

Across design disciplines, the aim of bridging the gap between research and design has often led to the development of methods that guide idea generation based on varying design domains. For example, an "experience matrix" is used for product design development that foregrounds the three knowledge domains, namely user activities, product components, and operation environments, which are then fed into a structured design process (Ghim, 2022). Eliouti (2018; 2021) proposes eight possible generators of concepts in architectural design studios, introduced as keywords: theme, analogy, metaphor, experience, symbolism, context, scheme, and scenario. According to Makstutis (2018), architectural concepts can take their reference from locations, drawings of history, physical and/or material features, or the purpose of the proposed building using different approaches. Similarly, Van Dooren et al. (2018) posit that designers operate within and across the five domains—space/form, material/structure/climate, function/route, site, and context—to develop their design principles. Inspirations can also take other forms, such as metaphors or analogies (Choi & Kim, 2017).

Based on their research and designer/student feedback, educators who have proposed conceptual tools (Eliouti, 2021; Ghim, 2022) suggest that educational approaches should be clear with a degree of focus and sensitivity to time constraints. Thus, although there is a consensus on the significance of equipping practitioners with the knowledge and tools to enhance the conceptual formation and development stages, what these tools are, and how they can be introduced

to design education remains underexplored.

In the initial phases of design, designers, both novice and experienced, tend to refer to existing design knowledge at that time, which may be founded upon their personal experience or those of others who have come before. As such, rather than creating a new frame, often, an existing frame is utilized (Sarkar & Chakrabarti, 2017). Therefore, to expand the knowledge base, besides one's own experience, designing precedents or utilizing case-based methods can be a fundamental support.

2.3. Case-based method

Among many other resources, design practitioners rely on precedents throughout different phases of the design process, including initial concept formation (Akin, 2002; Heylighen & Neukermans, 2002; Jagtap, 2018). For example, analyzing the idea-generation phases of fashion designers, textile designers, and interior designers, Laamanen and Seitamaa-Hakkarainen (2014) found that, among other sources, existing and previous designs were often primary generators for new designs. Therefore, they suggest, "Novice designers could be instructed to conduct careful investigations of existing designs and analyze the context, using various multimodal mediums" (p. 212).

Although design practice utilizes case-based methods, they are not adequately and systematically utilized within design education (Breslin & Buchanan, 2008). Design precedents can be rich sources that help the designer share related conceptual knowledge explicitly (Oxman, 2004). Analyzing the design process of architectural students within a studio context, Doğan (2013) found that particularly when students have problems in progressing from initial diagrams to actual spatial schemes, the instructors' leading them to the analysis of precedents was a fruitful method.

The analysis of cases develops both the theoretical and instrumental knowledge of the students. Akin (2002) suggests that, with the guidance of instructors, students derive knowledge from the cases through deep investigation and analysis. Accordingly, cases can support instructors in framing what is being communicated in a successful way, which can then open up venues for students' design applications and reflection (Breslin & Buchanan, 2008). Cases can allow discussions that establish the theory-practice relationship in the first years of design education, as often observed by educators (Doğan, 2013; Mahmoodi & Bastani, 2023), students are often reluctant and struggle to start a project and navigate through the design process. Therefore, a systematic presentation of design domains, as applied in successful case studies, can provide a venue where students can establish a firm understanding of concept formation tools that they utilize in their design processes.

3. Educational and research context

Given this background, we ask in this study how educators can guide novice designers to encourage frame creation so that they creatively engage with the design problem. We, therefore, believe that a framework to guide students in sources of concept generation could be beneficial. Even though frameworks are proposed within design educational contexts, and educators have time and again stressed the importance of case-based learning in design, a teaching module that utilizes case-based learning as a fundamental aspect has not been proposed. Practical educational applications that embody the rich existing resources of the built environment to direct students' idea generation are, therefore, a relevant and significant contribution to design education.

Accordingly, we first discuss three instructional applications of the framework with varying degrees of student involvement. Application 1 comprises a single-phase theoretical module, where a lecture offering "guiding domains" includes accompanied design precedents, encouraging case-based learning. The "guiding domains" refer to the domains of design knowledge that architects/interior designers can turn toward, starting from the concept formation phase of a design problem,

to guide their design process. Application 2 comprises the lecture followed by a workshop, where students apply the guiding domains to their design work, applying the theory to design practice. Application 3 focuses on a semester-long elective course on concept formation and development. In the course, the lecture and supportive tasks are followed by a research-based process where "guiding domain" inquiries structure students' concept generation for a design problem. The students end the course with a reflective essay about their learning experience. We inquire about the effectiveness of each application through our research on students' perspectives. The data is collected through surveys and written essays by students and analyzed through quantitative and qualitative methods.

In the following sections, after a brief description of the educational context of the three applications, we introduce the research methodology and findings from the student feedback regarding their learning experience in each context. Table 1 summarizes the instructional applications and research design.

This table represents the data of three different instructional applications—lecture, workshop, and elective course—applied in different universities. While the first three rows focus on the instructional variations, the last four rows compare the research instruments and participants, as well as data collection and analysis methods suitable for each instructional application. The following figure (Figure 1) shows examples from three different instructional applications' process.

3.1. Instructional application 1: Lecture

The first application was presented to 2nd and 3rd-year students of architecture and interior design across three universities. In the lecture, we introduced five sources of concept formation and development, namely "guiding domains", not only as theoretical frames but also as they are

Table 1. *Instructional applications and research design.*

	Application #1	Application #2	Application #3
Instructional tools	Lecture on Concept Formation and Development (CFD)	Lecture on CFD + workshop	Integrated elective course
Context of delivery	Three universities (Yaşar, Atılım, Başkent)	Yaşar University	Bilkent University
Duration of instruction	Two hours	Two hours + four hours	14-week course, three hours per week
Research on student learning: instruments	One survey following lecture	Two surveys, following lecture and workshop	Student reflection papers
Duration of research	Delivered six times between 2017-2020	Delivered twice: 2019 and 2020	Delivered twice: 2018 and 2019
Participants	217 students	50 students	40 students
Data collection and analysis methods	Likert scale questions-Descriptive statistics of response frequencies Open-ended questions-content analysis	Likert scale questions-Descriptive statistics of response frequencies Open-ended questions-content analysis	Text with student focus on design process reflection - thematic analysis

Figure 1. *Instructional applications.*

actively applied in successful design cases within specific contexts. The framework was based on the literature on design methods and thinking (Laseau, 2001; Lawson, 1994; 1997), an analysis of many international and national examples, and twenty years of personal professional experience in architectural/interior design practice (Altay & Porter, 2021).

We introduced the five guiding domains: Symbolism (the representational aspect of a design), site (the cultural, historical, and geographical contexts of the location), program (building type considering the major building function, studying precedents of similar types), geometry (2D/3D geometric relations, proportional systems, typological analysis, etc.), and structure (the system of construction) (Figure 2). These domains are not meant to be limiting or exclusive; rather, they are open to additions and modifications via research and inquiry, particularly during the initial phases of design.

The lecture discussed both architectural and interior design cases for each guiding domain, enriched by designers' written and visual communication during the design phases, such as sketches, models, and progress diagrams. This way, the lecture exposed to the students both the domain knowledge and the process knowledge (Sarkar & Chakrabarti, 2017).

Each guiding domain was presented with 4-7 examples, with a total of around 25 examples. The following cases are some of those discussed: for symbolism, Tadao Ando's Church of Light, Osaka and A. Ragıp Buluç Architects' Expo 98 Turkish Pavilion, Lisbon; for site, Steven Holl's Kiasma Museum of Contemporary Art, Helsinki and SITE's Studio & Offices, Bayard Building, New York; for program, SOM's National Museum of the United States Army, Washington DC, and OMA's Public Library, Seattle, and Prada Store, New York; for geometry, Steven Holl and Vito Attonci's Storefront for Art and Architecture, New York, Frank Gehry's Guggenheim Museum, Bilbao, and Conde Nast Cafeteria, New York; for structure, Álvaro Siza Vieira's Expo 98' Portuguese Pavillion, Toyo Ito and Cecil Balmond's Serpentine Pavilion, London, and Toyo Ito's Pavilion, Bruges.

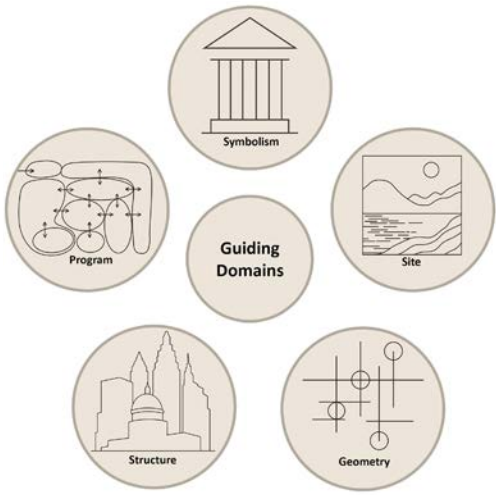

Figure 2. *Guiding domains.*

3.2. Instructional application 2: Lecture and workshop

The second application was applied in the 2015 and 2019 Fall Semesters for second-year interior design students at Yaşar University. In 2015, after the morning lecture, a workshop called "The Wall" was conducted. Students were asked to design a divider panel/unit to be integrated into their café environment as assigned for a group project. While working on their project, they had to focus on at least two guiding domains to formulate their concept: symbolism, site, geometry, program, and structure. In their final design, the students were expected to reflect and give hints about the identity and design concept of the café (Figure 3).

In 2019, after the morning lecture, a workshop related to the students' main project area was conducted called "A Refreshment Stand for İzmir Wildlife Park". Each group of students designed a three-dimensional refreshment stand, which also represented the main café it was part of (Figure 4). As before, students were expected to use at least one of the guiding domains as a source of inspiration while developing their design solutions.

3.3. Instructional application 3: Elective course

The third application was applied as an elective course for third and fourth-year interior architecture students at Bilkent University in the 2017-2018 semesters, named "Concept Formation and Development in Design Process". As before, the guiding domains were initially introduced through the extended lecture. The students also studied and discussed design methods based on key readings from Darke (1979), Forester (1985), Schön (1983), and Zumthor (1998). The course was also enhanced by other student-centered methods (Altay & Porter, 2021), such as exploring the campus and enhancing students' concept formation via sketching skills.

A project was then introduced to students: "You are here: More than Just a Point in the Map". The students were asked to compose a "design in-

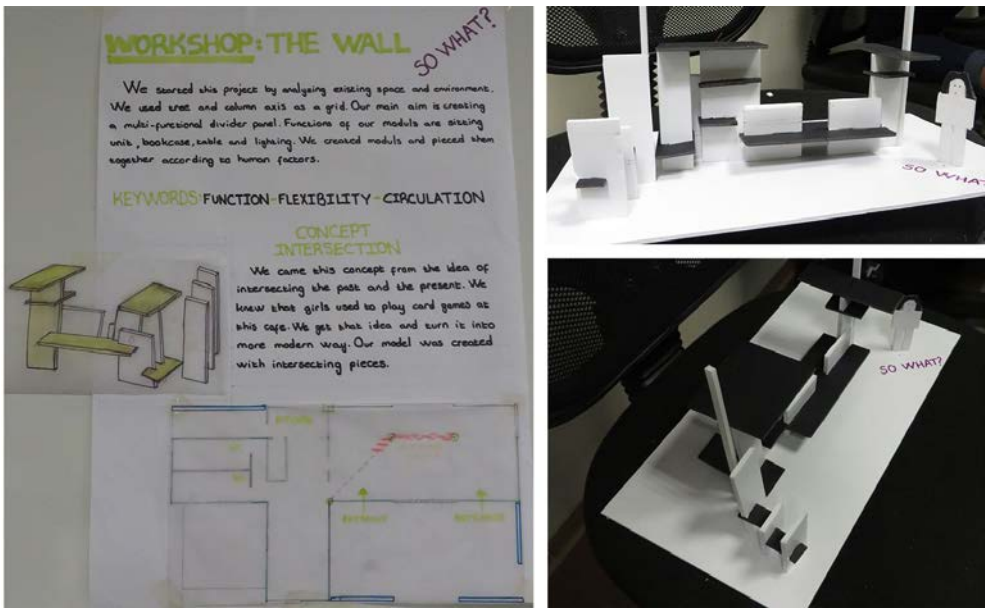

Figure 3. *Student work from the workshop "The Wall".*

tervention" for university building interiors (the Faculty of Engineering conference hall foyer and Faculty of Music and Performing Arts Concert Hall foyer, respectively).

In groups of 3-4, the students first researched (for three weeks) the building, focusing on the chosen guiding domains for their inquiry. Afterward, each group designed an "intervention" in the foyer based on their research. The main requirement was for the concept to be derived from their researched guiding domain. They also incorporated findings from other groups' research and feedback from instructor critics. The students presented their work to a final jury (Figures 5 and 6). A week after the juries, the students wrote reflection essays about their overall learning experience. They explored the impact of research and other factors on their design process, major challenges, and knowledge transfer to the future.

4. Research on student feedback on learning

In this section, following an explanation of the research instruments on student learning, the feedback from students regarding applications 1, 2, and 3 is analyzed.

4.1. Material and methods

4.1.1. Participants and settings

In the research phase, the participants were the students who participated in the lectures, workshops, and the thirteen-week course. Application 1 (Lecture) spanned across three universities, with a total of 217 participants. Of these, 125 students were from Yaşar University, İzmir; 63 students were from Atılım University, Ankara; and 29 students were from Başkent University, Ankara. Yaşar University consisted of second-year interior design students, Atılım University consisted of fourth-year architecture

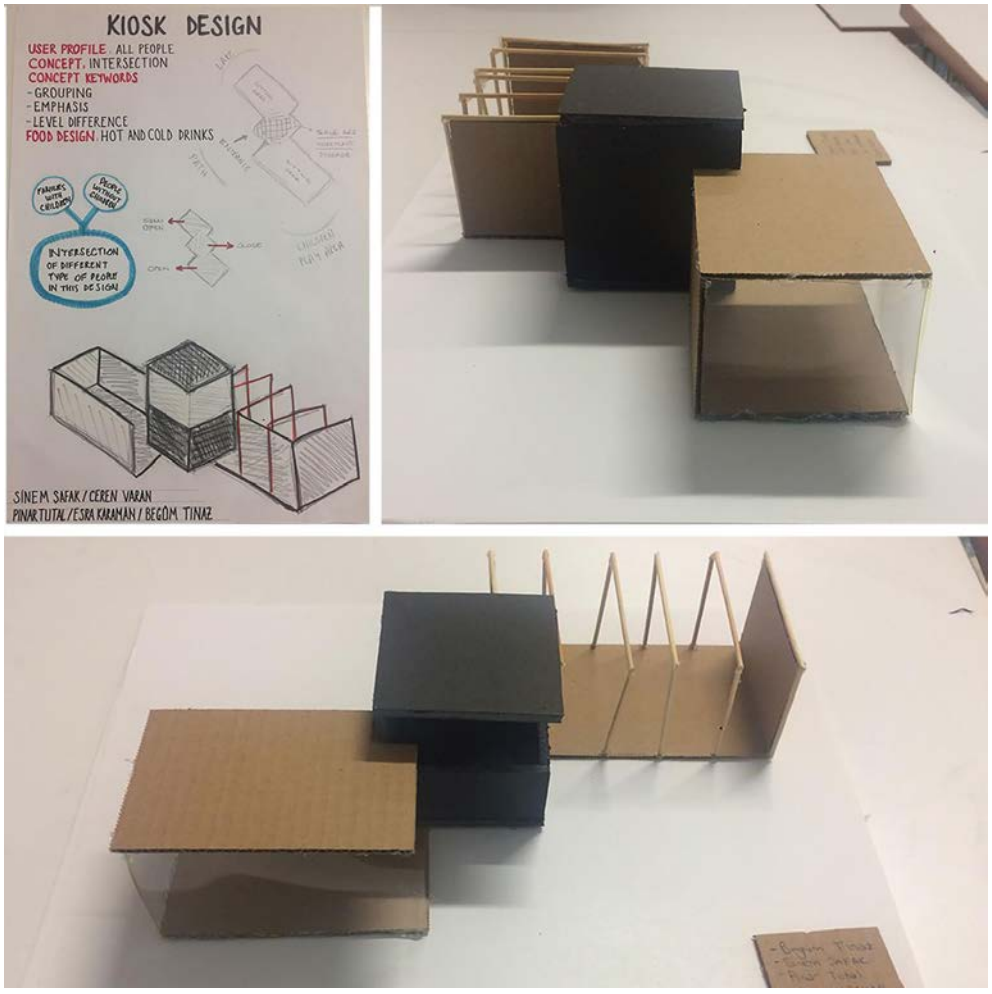

Figure 4. *Student work from the workshop "A Refreshment Stand".*

Figure 5. *Student work in the foyer, "A Different Perspective", based on site.*

Figure 6. *Student work in the foyer, "Structure of Sound: The Harp", based on geometry and symbolism.*

students, and Başkent University consisted of a mixture of third-year architecture and interior design students.

Application 2 took place twice in Yaşar University in İzmir, with a total of 50 participants answering the survey. Of these, 23 attended the workshop in 2019 and 27 in 2020. All were second-year interior design students.

Application 3, on the other hand, was delivered in Bilkent University in Ankara. The elective course was offered primarily to third- and fourth-year interior design students, with a small number (approximately 10%) of second-year students. Over two consecutive terms, 40 students attended the course, submitting reflection papers.

4.1.2. Data collection

As shown in Table 1, the main research instruments for the first two applications were questionnaires that the students completed after the lecture or workshop. In design education, student feedback surveys have been adopted (Altay, 2017; Charlesworth, 2007; Christian, 2018), helping the instructors improve instructional design. The questionnaire was developed based on previous studies on the investigation of student perspectives in higher educational contexts (Altay et al., 2016; Feldman, 2007). The questionnaire primarily explored how the students perceived their learning after each application. The first five structured questions (for Applications 1 and 2) related to the application's effectiveness in various learning domains, followed by two open-ended questions that focused on their learning experience and suggestions for development. It was handed out immediately after the applications.

For Application 3, which spanned a whole semester, the data consisted of reflection papers that the students wrote at the end of the semester, presenting their perspectives on the learning process. The papers varied between 1,300 and 2,500 words. Writing reflection papers was part of the pedagogical program, since reflection is a significant part of learning, enhancing

self-knowledge, and situating one's own experience to guide future action (Ryan, 2013).

4.1.3. Data analysis

For Applications 1 and 2, the closed-ended answers were analyzed through descriptive statistics. For this, student answers were interpreted where each answer sequentially corresponds with an increase of numerical value: "1=Completely disagree, 2=Disagree, 3=Neutral, 4=Agree, 5= Completely Agree". The findings were represented as mean values of each response.

All students answered the open-ended questions with one- to five-sentence responses. These short responses were analyzed through content analysis based on thematic coding (Krippendorf, 2013). As Krippendorf suggests, content analysis is a widely used method to analyze open-ended interviews and focus groups, whereby the researchers derive mainly qualitative inferences from the pre-composed and directed questions (2013). Thus, each text is always contextual and qualitative. The frequency counts of each theme are a supportive and convenient method for summarizing these inferences, rather than the defining aspect of content analysis (Maxwell, 2010). When deciding on sharing the frequencies/percentages of each person commenting, we referred to the following suggestion by Maxwell (2010, p. 178): "Counting the number of instances of things in different categories can be interpreted in variance terms, as creating a nominal scale variable and measuring the frequency in each category. However, it can also be interpreted in process terms. If participants in a study repeatedly make a particular claim or perform a particular action, presenting this fact in numbers isn't necessarily conceptualizing it in terms of variables but can be seen as simply describing the occurrence and distribution of the claim or action in that setting or set of individuals."

For Application 3 student reflection papers, a qualitative thematic analysis was carried out to analyze the content (Boyatzis, 1998; Braun & Clarke, 2006). For this stage of research, we do not provide the counts per theme since the themes were revealed through a reading of the rich text that the students provided regarding their learning experience. Thus, rich thematic descriptions, as voiced by the students themselves, gained significance, and we explicated the themes with quotes that best presented the students' perspectives. The analysis was primarily conducted by the first author. The preliminary coding session took place over two months, during which the identification of the main themes took place. Afterward, from the papers, a subset of data (15%, as suggested by O'Connor & Joffe, 2020) was randomly chosen and coded by the second author. There was consistency with the coding, with one deviation of additional code, which was discussed together to reach a consensus regarding integration and rewording. With a further revision of the literature and theoretical constructs, the authors revisited the data to finalize the four emergent themes. Finally, the thematic content analysis of Applications 1 and 2 was revisited to ensure clarity and consistency in wording.

We see the utilization of the above research methods and analytical procedures throughout architectural and educational literature that analyzes participant views and/or student works. These include a descriptive analysis of closed-ended Likert scale questions (Qureshi, 2019), thematic content analysis of open-ended questions (Kepez & Ust, 2020), and mixed-method approaches (McGee et al., 2022; Ceylan & Soygeniş, 2019; Çalıkuşu et al., 2023).

4.2. Application 1 (lecture) findings

This section covers feedback surveys of sessions from three universities, covering 217 students. Table 2 presents the responses to the closed questions.

According to the survey results, students found the lecture very effective in terms of developing their understanding and relevant to their academic and practical uses. The majority of students said the lecture was clear and easy to comprehend, and they thought the information would be useful not only for their other classes but also for the formulation and development of their design projects. The lecture af-

fected students positively in terms of overall effectiveness.

To better understand the effects of the presentations, open-ended questions were used. These questioned what, if any, were the most positive/effective learning aspects of the lecture, as well as suggestions for the future. Overall, 128 of 217 (59%) participants made additional comments to the open-ended questions. The emergent themes are shown in Table 3.

Regarding the first theme, students mostly commented on their increased understanding and awareness of concepts in architecture and interior design (81%). Students appreciated how the concept "reflects space" or "helps solve design problems". For some students, previous knowledge became more settled and clarified in their minds. Moreover, many students noted that they gained a variety of perspectives and new ideas through the lecture, which enhanced their creativity.

Regarding the second theme, students gained an insight into the design process through the lecture (54%). They improved their awareness of the steps and phases of conceptual design development. Some students also realized how specific tools could be used successfully and were essential parts of the process, such as investigation and research, use of bubble diagrams, drawing and sketching, and making models.

The third theme revolved around interest and focused on one specific guiding domain (32%). The focus varied from one student to another but included all the introduced domains: geometry and structure, contextual factors like topography and site, symbolic aspects, and function. One additional and architecturally significant feature for which students reported increased awareness was "light". Many of them had taken less interest in this feature before the lecture.

Table 2. *Student learning from the lecture: Structured survey results.*

	Questions:	Mean out of 5 (N = 217)
1	Attending the lecture increased my understanding and awareness about the subject.	4.47
2	The lecture was clear and understandable.	**4.52**
3	The lecture subjects can support other courses.	4.35
4	I intend to use what I have learned to form and develop my own design projects.	4.46
5	Overall, the lecture was positive and effective.	**4.59**
	1=Completely disagree, 2=Disagree, 3=Neutral, 4=Agree, 5= Completely Agree	

Table 3. *Student learning from the lecture: Emergent themes (N=128).*

	Main theme (learning)	N	%
1	Enhancing concept/idea formation and development **knowledge**	104	81
2	Insight into the design **process** and impact on concept	69	54
3	Understanding of a **specific guiding domain**	41	32
4	Case-based learning through design **precedents**	38	30
	Main theme (suggestions)		
5	Effective enough; no improvement needed	75	59
6	Format of slide presentation / verbal presentation	38	30
7	Increasing number/type of cases	25	20

Some students also noted specifically that looking at design precedents and cases through the lens of conceptual analysis was particularly helpful (30%). They commented that "seeing worldwide examples opened their minds" and "helped see the environment with new perspectives".

Regarding suggestions, many students (59%) commented that no improvements were needed and stated their appreciation for the lecture. The majority of suggestions (30%) related to the format of the slide presentation, as well as the speech pace and quality of verbal presentation. Suggestions included adding videos and background sound to slides, more breaks, and increasing interactivity between students and instructors. These were incorporated into the lecture in the following years. Another main theme pertained to the type and quality of the example cases (20%). Many of the students wished to have more cases, whether architectural or interior examples. One student also suggested including student work for discussion and analysis.

In total, the greatest percentage of the students found the lecture supportive in terms of enriching their knowledge of concept formation and the design process. According to the students' feedback, the lecture was effective enough to provide insight into the design process and impact on the concept idea.

4.3. Application 2 (workshop) findings

This section presents the findings on student learning after the workshops that followed the lecture at Yaşar University, covering 50 students. The students were asked to complete two separate learning feedback surveys after the whole learning module, the first survey on the lecture (the results of the first have been presented above), and the second on the workshop. The survey questions regarding the workshop were in a similar format to those of the lecture. Table 4 presents responses to the closed questions.

As Table 4 shows, the students mostly agreed with the workshop's learning outcomes, particularly their intention to apply what they have learned in future design projects. However, they reported slightly lower confidence in their ability to transfer concepts learned in the lecture to the workshop context. The educational value and long-term relevance of the workshop in the students' learning process are also reflected in the strong consensus that it enhanced creativity, supported other courses, and helped them develop distinctive projects.

The survey also included open-ended questions. These questioned what, if any, were the most positive/effective learning aspects of the workshop, as well as suggestions for the future. Almost all students (47 out of 50, 94%) commented briefly on what they learned the most and provided suggestions to improve the workshop experience. Table 5 summarizes the themes that emerged from the open-ended questions, with the number of students making each comment.

Table 5 shows that attending the workshop increased many students' concept formation and development skills (45%). It also helped them to reflect on or transform an idea or concept into a design. They were able to refer to knowledge obtained from the lecture (Application 1) during the design process. While some thought that their analytical skills had developed, others felt that they had cultivated creativity, particularly through the emergence of new ideas.

Following their specific focus of inquiry, some students (26%) also commented on one specific guiding domain that they had learned more about and incorporated into their design. Moreover, some students stated that the workshop helped them to look into the details of the project.

In terms of developing conceptual skills and having a structured learning approach, the workshop was found successful. Time management, visual thinking and presentation skills, and teamwork were listed as the other notable skills learned. Students indicated that the workshop contributed to their essential professional and collaborative competencies. Meanwhile, the students suggested increasing of the duration -due to wanting more time

Table 4. *Student learning from the workshop: Structured survey results.*

	Questions:	Mean out of 5 (N=50)
1	Attending the workshop increased my understanding and awareness about the subject.	4.34
2	I was able to transfer concepts from the morning lecture to my own work.	4.14
3	This workshop can support other courses.	4.34
4	I intend to use what I have learned to form and develop my own design projects.	**4.42**
5	This workshop has been effective for my creativity.	4.31
	1=Completely disagree, 2=Disagree, 3=Neutral, 4= Agree, 5=Completely Agree	

Table 5. *Student learning from the workshop: Emergent themes (n=47).*

	Main theme (learning)	N	%
1	Enhancing concept/idea formation and development **skills**	21	45
2	Development of a **specific guiding domain**	12	26
3	Time management	9	19
4	Visual thinking and presentation **skills**	9	19
5	Teamwork	5	11
	Main theme (suggestions)		
6	Effective enough; no improvement needed	12	26
7	Expansion of allocated **time**	13	28
8	Suggestions for project delivery methods	10	21

for presenting their ideas, and for feeling less pressure. Accordingly, further iterations can include longer duration in workshops, and structured support for effectively communicating their final products. Through these revisions, the impact of the workshop on the skills and professional development of the participant can be maximized.

4.4. Application 3 (elective course) findings

This section covers findings on themes derived from individually submitted reflection essays a week after project presentations (in groups). The essays were assessed via formative assessment, where students would earn 5% of the overall course grade upon submission alone. Since the students evaluated the impact of all stages of the course, the major topics were formed around four key themes that were repeated across the students' perspectives, with a focus on design process supports and challenges (Table 6).

The first theme, "uncertainty", was a challenge encountered particularly in the initial phases of the design. The lack of a functional requirement or brief, as well as the expectation to generate a concept based only on a specific guiding domain, created a sense of unease. In short, "freedom" became a "constraint":

The major challenge was also the conflict: an undefined design problem whose answer was hidden in it… It was like treasure hunting (R2).

The only information given was the location of the project, and what was asked of us was to come up with a design idea. To give an example of how I felt: it was like someone asked me to swim when I didn't even know how to swim (R10).

Table 6. *Student learning from the course: Emergent themes (N=40).*

	Main theme (Challenges and supports)
1	Dealing with uncertainty
2	Research into guiding domains
3	Sketching and writing
4	Teamwork and instructor feedback

As the process progressed, students navigated through the uncertainty, relying on certain support. The primary support was, as the second theme suggests, their research. The research into one of the guiding domains seemed to be the initiating and guiding aspect of the concept generation:

While the concept is a guide for the design, research is a guide for the concept (R2).

The more deeply we did research, the more guidance we found. Afterward, everything emerged automatically because we had a good substructure (R30).

Some students specifically explained in detail how the research led them to the guiding design idea:

Analyzing user behavior in detail to understand programming gave me an analytical perspective with the look of a designer (R2) (guiding domain: program and use).

The research outcomes reminded us that buildings are witnesses like the people living in them. We felt this deeply when we had an interview with the architect while listening to his memories (R22) (guiding domain: context- history).

Students mentioned that conducting research on-site, with the attentive experience of the building grounds, was an essential element of concept development:

We went to the building several times to analyze different users. However, we could not get a clear concept idea for weeks. Then one day, we heard music coming softly from the room through us. At that moment, I already knew that we would design something related to sound (R25).

Another significant support during the design process, comprising the third theme, was their increasingly free and confident use of sketching and writing:

We kept a personal journal to write our keywords while trying to generate our forms, and it helped us a lot (R18).

One of the lectures that influenced me a lot was about freehand sketching. Your mind works in collaboration with your hand. Thus, despite working on the computer, it is important to develop concepts with your hand drawings (R25).

As a fourth theme, teamwork and instructor feedback emerged as effective supports. While teamwork enabled shared responsibilities, the conversations helped them gain new perspectives and open up their habitual thought patterns:

As all our group members are different individuals with different backgrounds, knowledge, tastes, memories, etc., many ideas were improved through brainstorming (R37).

Teamwork could also be a challenge, however, and a basis for further reflection:

I had too many group projects, and coordination was a huge problem for too many groups and courses… I might have worked more with the group members and should try to communicate more (R39).

The following comment summarizes the overall impact of the different modules throughout the design process:

The readings, in-class discussions, and cases (in the lecture) that we investigated were very valuable in creating the thinking map for the first stages of the design process. Then, the research and critique parts guided the design. Besides these, the most important part was coordination between group members (R1).

Dealing with uncertainty was one of the most important supports/challenges faced by the students during the design process, at the same time giving them a chance to resolve uncertainties

and overcome them with learned tools. Having a more structured approach for exploring relevant frameworks as well as supporting in expressing and documenting ideas both visually and textually can be considered upon the students' feedback. Teamwork and instructor feedback was also stated as another challenge, which can also be defined as sources of support, showing the crucial role of collaboration in facilitating the learning process.

5. Discussion

The various effects of different instructional approaches—short-term lectures, workshops, and semester-long courses—are highlighted in this study through the student learning outcomes. According to the findings, combining applications provides a more comprehensive learning experience, whereas each method offers different aspects. Application 1 (short-term lectures) was found to be greatly effective by the students in improving their understanding of concept formation. While the importance of well-structured content delivery was highlighted, clarity and understandability received the highest ratings. Although the relevance of the lecture was rated lower than other courses, it was suggested that better interdisciplinary connections and more real-case examples can enhance the integration of their knowledge.

In terms of developing concept formation and design thinking, Application 2 was evaluated as successful with improvements in their skills for developing and refining ideas. Due to the interactive nature of the workshop, students could find a chance to apply their theoretical knowledge, improve their problem-solving skills, and engage in creative exploration. Plenty of students noted some difficulties in converting lecture concepts to workshop tasks, whereas the majority of the students evaluated the workshop as beneficial. According to these findings, more invisible integration between instructional components can be suggested to strengthen knowledge application. According to the students' feedback, they improved their time management, visual thinking and presentation skills, and teamwork. Extending workshop duration, structuring the exercises more in detail, and offering alternative project delivery formats, including interactive sessions and/or collaborative exercises, were some of the suggestions for improvement.

In Application 3 (elective course), managing design uncertainty, articulating ideas, and structuring their research were some of the challenges that students faced, whereas the course successfully supported independent learning and knowledge transfer. Students were able to navigate the difficulties throughout the concept design process with the help of utilizing tools such as in-depth research on the guiding domain, reflecting on their site experience, team and instructor communications and relying on brainstorming via sketching/writing. They were thus able to arrive at successful, creative outcomes with strong conceptual foundations. In their suggestions, students highlighted the additional need for instructor feedback as well as clear project expectations.

The results of student surveys show that the framework proposal in this paper successfully boosts the student's understanding of concept generation, including its process, enlarges their point of view, and fosters their creativity. A structured approach is provided through guiding domains, which also help students navigate the design process and express their ideas more effectively (Application 1). Analysis of design precedents through an analytical framework is achieved by theoretical instruction while their insights are converted into conceptual design outcomes in practical application (Application 2 and Application 3). With this approach, which defined a common language between instructors and students, clearer communication and more in-depth engagement to design concepts were facilitated.

When all three instructional methods were compared, the findings suggest that Application 1 (short-term lecture) provides a theoretical foundation, Application 2 (workshop) assures exploration by hand and fosters creativity, and Application 3 (semester-long course) enables more in-depth learn-

ing and reflection. This data highlights the significance of keeping a balance between these approaches for achieving an optimal learning process. While structuring future courses, more cohesive integration between these elements can be considered so that students can efficiently convert their knowledge between different instructional formats.

6. Conclusion

Cultivating students' ability to efficiently and effectively solve and handle design problems is one of the main targets of design education, which is mainly allied with their capacity for creating ideas in the early design phases. In this study, a framework of "guiding domains" for encouraging students in their design projects of various scales is proposed, guiding them to generate and improve their concepts. Students were engaged in both case-based and research-based learning, supplying valuable feedback on the efficiency of the framework that can be conducted by incorporating all three educational applications with their theoretical and practical components. Our educational applications support Teal's (2010) understanding that concepts articulate complex problems, inviting designers to dwell on them by taking action. In that respect, while the lecture enhanced students' understanding of the built environment via case-based learning, which is a powerful learning tool (Doğan, 2013; Oxman, 2004), the applications via the workshop and course led them to cultivate skills to turn theoretical concepts into design outcomes through reflection-in-action (Schön, 1983) and constructive exploration (Teal, 2010).

In addition to the efficiency of the "guiding domains", this research also defined some additional learning outcomes. Through the collaborative nature of the practical applications, the significance of peer learning is reinforced, in which students can experience teamwork, critique, and knowledge exchange (Budge et al., 2013). Another important finding of this research is related to time management, where some students found the short duration of the workshop as a constraint, while others interpreted it as a catalyst for having idea generation faster and problem-solving more creatively. In the meantime, research-driven elective courses with a longer duration enable students to search guiding domains in detail, supporting more flawless conceptual development. All these findings underline the importance of keeping time constraints and collaboration levels in a balance for better alignment with specific learning objectives.

This research contributes to the literature on design education by proposing a structured method that connects theory and practice in the early stages of the design process, which are addressed across different years and courses in the curriculum (Saghafi, 2021). It introduces strategies that focus on the initial phases of design and supports their implementation through case-based and research-based tools within the framework of "guiding domains." In line with the recommendations of Eliouti (2021) and Ghim (2022), this approach helps address a gap in design pedagogy and offers a framework that can be adapted to different disciplines. The study offers a new model that can be applied to different courses, project types, and various educational settings with the help of case-based and research-based approach integration within a flexible framework. To reinforce its adaptability and relevance, this method was applied across multiple universities. For achieving a deeper conceptual understanding in students, this study highlights the importance of occupying students in reflective and hands-on approaches, which is similar to the emphasis of Salama (2013) on experiential learning.

Although this study has valuable insights, it also has certain limitations to be noted. Cultural and institutional differences as contextual factors, which may have a direct impact on students' learning outcomes, need further research to examine the applicability of the framework in diverse educational settings. In addition to this, the engagement of the students with the framework can be affected by various student levels, as well as different academic backgrounds, and need more controlled studies to evaluate its ef-

fectiveness under different conditions. Further research can also be reserved for framework adaptation in other design-related disciplines to decide its broader applicability.

In general, this research emphasizes the importance of structured guidance in the early phases of design education, specifically concept generation, to show that a well-defined framework can improve the ability of students in terms of generating and developing design concepts effectively. Also, educators and instructors can better support their students while navigating the design process complexities by the refinement of balance between theoretical learning and hands-on application.

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Walkability and stress: Insights from Generation Z during global disruption

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Abstract
This study examines the intersection of urban design and urban living conditions by exploring the relationship between perceived walkability and stress management among Generation Z college students in Istanbul during the COVID-19 pandemic. Walkability, essential for comfortable and safe pedestrian navigation, fosters resilient communities, while stress adversely affects individual well-being and social interactions. The research aims to understand how the built environment's physical components impacting walking habits influence mental well-being, particularly stress levels. This research delves into various interconnected variables to enhance the design and policy of urban living conditions. By examining the relationships between perceived walkability, stress levels, and physical environmental factors, the study aims to provide valuable insights that can inform the development of healthier, more supportive urban neighborhoods. Focusing on Generation Z—typically more active and significantly impacted by pandemic isolation—the study involved university students across Istanbul. The Neighborhood Environment Walkability Scale and the Perceived Stress Scale were used to measure perceived walkability and stress management. The findings demonstrated statistically significant associations between perceived walkability and stress levels, alongside notable gender-based differences. These results highlight the critical role of urban design in enhancing urban living conditions outcomes. The study proposes design and planning recommendations to improve neighborhood walkability, contributing to better psychological outcomes and overall urban living conditions as well as the creation of public policies that prioritize physical activity and psychological outcomes, ultimately fostering more livable and resilient communities.

Keywords
Design and physical features, Generation Z, Public health, Stress management, Walkability.

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1. Introduction

Stress, stemming from physical and psychological reactions to life's stimuli, profoundly impacts individuals' well-being by hindering goal attainment and inducing negative emotions (Pettinger, 2002). Managing stress involves identifying and mitigating stressors, essential for maintaining physical and mental well-being (Gümüştekin & Öztemiz, 2004). Conversely, walking offers a plethora of benefits, including stress reduction and enhanced social interaction (Cervero & Kockelman, 1997; Fonseca et al., 2022). Walkability, ensuring safe and comfortable pedestrian access, contributes to vibrant communities (Southworth, 2005).

Stress does not occur spontaneously but is influenced by various environmental factors. Individuals do not respond to stress in the same way; some are more affected while others are less affected. It is possible to group factors that create stress related to oneself, the surrounding environment, and work (Saldamli, 2000). On the other hand, walking has numerous positive effects on human life, such as socialization, health, connectivity, and increased human activity (Cervero & Kockelman, 1997). Walkability, on the other hand, refers to ensuring that pedestrians can reach specific points comfortably and safely in the built environment (Southworth, 2005). Cities with walkable criteria are more social and vibrant. The act of walking not only has transportation significance but also shapes the character of the urban dweller (Wang et al., 2019). Walking reduces stress, protects against many diseases, enriches human activities, and plays a unifying role in fostering social interactions, aiding individuals in perceiving space differently (Fonseca et al., 2022). There are certain components that affect walkability. One of them is the distinction made by Boarnet and Crane (2001) between social and physical factors. Social factors influence individuals' preference for walking, while physical factors enhance the desire to walk. Variables that influence the act of walking include mixed land use, human-scale design, connectivity of roads, physical structure of streets, physical structure of sidewalks, and compatibility with older settlements (Sendich & American Planning Association, 2006).

Walkable areas are safe spaces where residential and commercial activities coexist, public transportation is convenient, social ties are strong, and people can interact (Massengale et al., 2014). Physically walkable neighborhoods are well-perceived and have a positive impact on neighborhood users, encouraging them to walk based on the perception created (Wood et al., 2010).

Walkability is greatly influenced by intergenerational differences. Particularly, Generation Z (individuals born between 1997 and 2012) is believed to have different views and be influenced by various factors when it comes to walkability, as they do in many other aspects. According to a study conducted by Larkin et al. (2018), there are three significant factors that affect Generation Z: advancing technology, growing up in uncertainty, and realism. All these factors have directly influenced the development of Generation Z individuals. With distinct desires and behaviors compared to the previous generation, Generation Z has brought about various changes. Many sectors, such as the economy, education, technology, and fashion, are working to adapt and develop services that cater to this generation (Dovey & Pafka, 2020).

The aim of this study is to examine the relationship between perceived walkability and stress levels among Generation Z university students and to contribute to wellness-oriented urban design strategies by integrating environmental psychology perspectives.

To achieve this aim, the study sets out to: (i) Evaluate perceived walkability in different neighborhood environments using the NEWS (Neighborhood Environment Walkability Scale) scale; (ii) Measure participants' perceived stress levels using the PSS (The Perceived Stress Scale); (iii) Identify correlations between walkability features and stress responses; (iv) Analyze gender-based differences in perception and stress and; (v) Offer design-based insights for enhancing urban well-being based on empirical findings.

1.1. Background

Modern society is increasingly recognizing that humans and culture are integral parts of the natural environment, and that there is a strong connection between human well-being and environmental conditions (Jackson, 2003). It is important to acknowledge that individuals are constantly interacting with their surroundings in their daily lives and are greatly influenced by the characteristics of the physical environment. The interaction between human well-being, human activities, and the physical environment is fundamental. In this interaction process, it is crucial to avoid harming the natural systems upon which the biological and physical environment depend (Çelik, 2006). The physical environment inherently represents the features that enhance or diminish opportunities for behavior and outcomes (Wattchow et al., 2014). Being healthy is closely linked to maintaining a lifestyle that includes healthy eating, physical exercise, and reduced stress, encompassing the physical environment (Bratman et al., 2012).

Individual behaviors are influenced by both the social and physical environment. Unlike a causal relationship between physical activity and health, the role of the physical environment is relatively more significant in determining levels of physical activity. In order to stay healthy, individuals should engage in regular physical activity, and the physical environment should be structured to facilitate this. Levels of physical activity show a significant decline with increased sedentary behavior, leading to adverse well-being outcomes (Transportation Research Board & Institute of Medicine, 2005). Therefore, it is essential to create an environment that encourages physical activity and supports individuals in maintaining an active lifestyle for their urban life quality.

The concept of stress, on the other hand, widely used and experienced by many individuals, has been present since the creation of humankind, despite the increasing number of studies conducted on it. Stress is a psychological state that is commonly used and experienced by everyone. The term "stress" was initially used in the field of physics (Okutan & Tengilimoğlu, 2002). Physicist Robert Hooke first defined stress as the relationship between an object and the external force applied to that object. Physicist Thomas Young explained stress as the response of matter to an external force applied against its resistance. After its use in the field of physics, the concept of stress began to be used in the fields of psychology and medicine. For stress to occur, individuals need to be influenced by their environment or surroundings (İnal, 2019). Stress arises from the physical and psychological responses to stimuli encountered or experienced throughout life. It leads to psychological, emotional, and physical tension, resulting in adverse effects on the human body (Pettinger, 2002).

The industrialization that began in the 19th century in cities laid the foundation for modern planning, characterized by adverse health conditions, inhumane circumstances, and overcrowding. As a result, urban planning was scientifically addressed. In the 21st century, efforts in the economic, social, and physical environments have become crucial for improving urban well-being. While the health discipline addresses issues such as obesity, chronic illnesses, and sedentary lifestyles to provide a healthy environment for urban users, urban planning discipline addresses environmental problems caused by car usage, high-density settlements, and accessibility (Dinçer, 2011). In the literature, environmental stressors, such as crowding and noise in urban contexts, have been found to significantly contribute to stress in individuals (Evans & Cohen, 1987).

In modern urbanized societies, both acute and chronic stress are increasingly recognized as significant issues. Research indicates that crowding, fear of crime, and traffic noise are associated with violence and aggression. The impact of stress on mental well-being has become a serious urban living conditions concern, particularly for those living in urban environments. Stress management is vital for maintaining health, and preventing stress-related disorders is crucial in urbanized soci-

eties. Both built and natural environments can influence perception and have direct or indirect effects on individuals' mental well-being. Therefore, examining and addressing ways in which the environment may negatively impact mental well-being is essential (Jiang et al., 2023). The arrangements made in urban spaces have always been of great importance for human society. Being a "city dweller" has always come with responsibilities. Individuals are residents of the city, and the development of urban communities depends on individuals. The structures, groups of structures, infrastructure, transportation, social facilities, and the organizations that operate them all contribute to the essence of the city. Considering that the city is a human creation, efforts should be made, both physically and socially, to ensure that design promotes healthier environments (Fırat, 2006).

During the pandemic, there have been studies conducted on individuals' physical environments and stress. The continuation of the outbreak and the discovery of its adverse consequences over time have increased the level of stress in society. Symptoms that may reach the psychiatric diagnosis dimension, such as anxiety disorders and depression, can be observed in stress reactions. In a study conducted with 7,143 university students in China after the outbreak, which was defined as "COVID-19," 21.3% experienced mild, 2.7% moderate, and 0.9% severe anxiety symptoms. In a study by Wang et al. involving 1,210 participants in different cities in China, looking at the psychological effects of the outbreak at the end of January and the beginning of February, it was indicated that 28.8% showed anxiety symptoms, 16.5% showed depression symptoms, and 8.1% showed stress symptoms. A survey conducted by Rossi et al. in Italy with 18,147 participants via the internet examined the impact of the pandemic and quarantine process on people's mental well-being. The study revealed that 37% of the participants experienced post-traumatic stress symptoms, 22.9% had adjustment disorders, 21.8% had a high perceived stress level, 20.8% had anxiety symptoms, 17.3% had depression symptoms, and 7.3% had sleep disorder symptoms above the cut-off point for diagnosis. A study conducted by Odriozola-Gonzalez et al. (2020) with 3,550 adult individuals in Spain via the internet showed that 44.1% of the participants had depression, 37% had stress, and 32.4% had anxiety symptoms above the cut-off point for diagnosis. These few studies suggest that some psychiatric diagnoses may increase. Infectious diseases, by their nature, leave fear and anxiety on individuals and also affect their daily relationships. Like other natural disasters (e.g., tsunami, earthquake, etc.), infectious diseases are also referred to as disasters, and the impact of disaster events on individual psychology is not random. Moreover, the response can vary depending on the conditions the individual is in and the level of exposure to the disaster. Therefore, like all disasters, the ongoing pandemic process also affects individuals psychologically. Especially during this period where efforts are being made to slow down the spread and transmission of the virus, the precautions taken create stress. The effect of these measures is the sense of loss. Undoubtedly, these feelings have a negative impact on an individual's psychological well-being (Işıklı, 2020).

1.2. Importance of walking and walkability of streets

Rapoport (1991) identified two environmental characteristics of streets in his study. The first involves the formal/physical features of streets, while the second emphasizes the need to examine streets in terms of activity (social) and use. Streets cannot become living spaces without a functional definition of the linear area between buildings and streets. Streets become living spaces only when they are designed together with public social spaces and physical features that allow specific activities within their surrounding settlements. As a result, the characteristics of the environment are defined as the interactions between the components that constitute the environment, as well as the interactions between individuals and between individuals. Therefore, the

environment is not just a physical space with boundaries shaped by individual activities. It is an important part of the behavior model with social attributes (Alpak et al., 2018).

Walking is the cheapest and simplest form of transportation used in people's daily lives. Walking increases communication among individuals and allows for economic and social relationships. Walking has many positive effects on human life, such as socialization, health, cohesion, and increased human activities (Cervero & Kockelman, 1997). Walkability, on the other hand, ensures that pedestrians can reach specific destinations comfortably and safely in the built environment (Southworth, 2005).

Walking, in addition to being a recreational activity, is fundamentally a means of transportation. In urban outdoor spaces, the movement of individuals, which is the most basic form of transportation, is essentially a simple act of walking. When it comes to interacting with other people and the physical environment, "pedestrian movement" emerges as a convenient and easy mode of transportation. For a life in the urban space that relies on establishing healthy human relationships, pedestrian movement needs to be strongly and effectively organized. Meaningful and appropriate pedestrian flows and movements are essential requirements. Urban areas that prioritize pedestrian movement in transportation and planning concepts highlight their social functions. These types of spaces enable pedestrian movements in terms of social, physical, and perceptual characteristics. Walking is recommended as a therapeutic activity against various negative emotions and illnesses such as stress and cardiovascular diseases. The benefits of walking can be summarized as follows:

- Enrichment of human activities and human interactions
- Perception of space from a different perspective
- Impact on human well-being
- Facilitating socialization and having a unifying role in social life
- Being an environmentally friendly and cost-effective mode of transportation, among others.

Pikora et al. (2003) as cited in Tekel & Görer (2016) divide the components that influence walkability into two categories. The first category is the physical criteria of the urban built environment, and the second category is individual responses. It is also mentioned that both objective and subjective measurements should be used to determine the effects of these factors on walkability.

Yin (2013) provides the answer to the question "What makes a place walkable?" by stating that it is the characteristics of the route (path/permission) connecting the starting and ending points of walking journeys. According to Yin, walkability is modeled based on two main components: built environment and social environment. It is also divided into four subcategories and two separate groups:

- Activities and uses
- Accessibility
- Safety and image
- Sociability.

These four categories reflect how individuals interact with the environmental, physical, and social characteristics of a neighborhood (Yin, 2013).

Alfonzo (2005), on the other hand, evaluates the hierarchy of walking needs within the context of environmental variables that influence individuals' decision to walk. In Alfonzo's proposed hierarchy of walking needs model, "feasibility" is situated at the bottom level of environmental factors. For the walking activity to occur, circumstances that lead individuals to desire walking need to emerge first. The individual's responsibilities, time, and mobility determine the shaping of walking behavior. Accessibility is placed in the second level of this hierarchy. The quality of pedestrian spaces, connections between uses, and pedestrian infrastructure impact accessibility. Accessibility encompasses the variety of destinations that can be reached within a specific time frame. Access to public transportation areas, recreational spaces, and non-residential uses positively affects walkability, while elements such as rivers, closed residential clusters, and disruptions in the continuity of walking paths have a negative impact on accessibility. Safety refers to the individual's protection against crime.

Comfort is an environmental factor that provides convenience and ease while walking. Satisfaction indicates how attractive and enjoyable an area is for walking. During the intermediate process, individual characteristics such as biological, psychological, and demographic factors; societal characteristics such as sociological and cultural factors; and spatial characteristics such as climatic, topographic, and geographical data all influence walkability. The proximity and diversity of areas within walking distance, such as cafes, shops, recreational activities, play an important role in achieving walkability (Tekel & Görer, 2016).

2. Method

This study adopts an ecological psychology perspective and utilizes the theory of affordances as its theoretical foundation. The theory of affordances offers a comprehensive framework for understanding and elucidating the essential qualities of environments from a psychological standpoint. In the context of walkability research, affordances refer to the various features and attributes of urban environments that afford opportunities for pedestrian activity and interaction. By examining the concept of affordances within the context of walkable urban environments, this study seeks to explore whether the availability of affordances differs across settings characterized by variations in urban design and infrastructure. Understanding these differences is essential for enhancing the walkability of urban areas and creating environments that support diverse pedestrian needs and activities. Moreover, by investigating the relationship between urban design elements, such as street layout, green spaces, and pedestrian amenities, and the perceived affordances for walking, this research aims to contribute to the development of strategies for designing and planning more pedestrian-friendly cities. Ultimately, by leveraging the theoretical insights provided by ecological psychology and the theory of affordances, this study endeavors to inform urban planners, policymakers, and designers in their efforts to create more inclusive, accessible, and multi-functional urban environments conducive to pedestrian activity and well-being.

2.1. Research design

Given the focus of this study on comprehending attitudes and utilizing them as indicators of behaviors in the context of walkability, the survey approach emerged as the preferred methodology. The survey included four main sections: (1) perceived walkability based on the adapted Neighborhood Environment Walkability Scale (NEWS-A), (2) perceived stress assessed using the 10-item Perceived Stress Scale (PSS), (3) context-specific questions about walking behaviors and built environment features, and (4) demographic data. NEWS-A items were measured using a 4-point Likert scale (1 = Strongly Disagree to 4 = Strongly Agree), while PSS items followed a 5-point frequency scale (0 = Never to 4 = Very Often). Additional contextual questions included categorical and multiple-choice formats, and demographic variables were a mix of open-ended and categorical responses. To ensure consistency in spatial reference, participants were instructed to evaluate their environment based on their immediate neighborhood, defined in the survey as areas located within a 10–15-minute walking distance from their home. This definition provided a shared understanding of "local vicinity" and aligned with the walkability-related questions throughout the survey.

In the first part of the survey, the instrument employed to assess perceived walkability and its association with physical activity was the Neighborhood Environment Walkability Scale (NEWS). Developed as a 54-item self-report measure, NEWS serves to evaluate the perceived design features of neighborhoods in relation to physical activity and transportation. With its comprehensive set of questions, NEWS enables researchers to gauge participants' perceptions regarding various environmental attributes that may influence their walking behaviors, such as the presence of sidewalks, proximity to destinations, safety, and

aesthetics. The survey utilized a 4-point Likert scale without a neutral option (1 = Strongly Disagree to 4 = Strongly Agree) to encourage more decisive responses and reduce central tendency bias. This forced-choice format was intentionally selected to prompt participants to take a clear stance, particularly when assessing subjective perceptions of their urban environment. Previous studies have shown that removing the midpoint can minimize indecisiveness and enhance response reliability when evaluating attitudes (Chyung et al., 2017; Johns, 2005; Kulas et al., 2008). By utilizing NEWS, this study aimed to delve into individuals' subjective experiences and perceptions of their neighborhood environments in the context of walkability, providing valuable insights into the factors shaping their walking behaviors and overall physical activity levels.

In the second part of the survey, the Perceived Stress Scale (PSS) was also employed to measure the stress levels experienced by individuals over the last month during the pandemic. This scale, developed by Cohen, Kamarck, and Mermelstein, is widely used in psychological research to assess the degree to which situations in one's life are appraised as stressful. It provides a framework for understanding the personal perception of stress, allowing researchers to gauge the impact of various life circumstances on an individual's psychological well-being.

The final section of the survey consisted of seven direct questions related to participants' experiences with the pandemic and their physical environments. Participants were instructed to reflect on their experiences over the past six months of the pandemic and select the responses that best matched their personal situations. This approach aimed to capture a comprehensive view of the individual impacts and adaptations during the pandemic, facilitating an in-depth analysis of how these factors influenced their daily lives and well-being.

When analyzing the data, the chi-square test was employed to explore correlation relationships, alongside descriptive statistics for further insight.

2.2. Targeted population and sampling

Generation Z university students were chosen as the focus of this study due to their unique characteristics and experiences during the COVID-19 pandemic. As a cohort known for their high levels of digital literacy, social activism, and adaptability to technological advancements, Generation Z has been significantly impacted by the pandemic-induced isolation measures. Before the pandemic, this demographic was typically active in their neighborhoods, engaging in various social and recreational activities. However, with the onset of the pandemic, they were forced to adapt to remote learning and limited social interactions, leading to potential changes in their perceptions of their neighborhood environments and their levels of physical activity. By studying this specific group, the research aims to provide insights into how pandemic-related disruptions have influenced their perceived walkability and stress management, thereby contributing to a better understanding of urban design and urban living conditions strategies tailored to the needs of Generation Z and similar cohorts.

To gather the necessary data, a broad approach was taken to include a diverse representation of Generation Z university students from Istanbul. Participation requests were sent to all 58 universities in Istanbul (13 state, 45 private). Students from 43 universities (6 state, 37 private) participated voluntarily. Initially, 510 individuals joined the study. However, after removing data that did not meet the study's criteria, the final analysis was conducted with 301 participants (n=301).

3. Findings

This study examines the participation of university students in Istanbul, Türkiye. Istanbul is home to a total of 58 universities, including 13 state universities and 45 foundation universities. For the purposes of this study, students from a total of 43 universities participated. The study sample consisted of 301 participants,

with 28% male and 72% female students. Age distribution ranged from 18 to 26 years old.

3.1. Descriptive findings toward physical environment

The first part of the survey focused on individuals' perceptions of their neighborhoods and surrounding environments. Participants were asked about the types of housing available in their vicinity, the presence of stores, facilities, and other amenities, access to these facilities, the condition of local streets, the availability of walking and cycling areas, the aesthetics of the nearby environment, and neighborhood safety.

To assess the walkability of participants' physical environments, they were asked about their mode of transportation to school before the pandemic and, if walking, the approximate duration of their commute. According to the findings, the majority of participants (241) did not walk to school, while the remaining participants are distributed across various walking durations.

As shown in Figure 1, the data highlights the percentage of participants who reported that various facilities are accessible within a 1–5 minute walk. Essential services such as grocery stores, supermarkets, and public transportation are perceived as highly accessible within this short range, which reflects the strengths of a well-connected urban layout. However, accessibility to non-essential services shows greater variability, indicating potential gaps in service distribution that could be addressed to improve overall neighborhood functionality and convenience.

The distribution of responses regarding the accessibility of recreation centers reveals significant insights. As shown in Figure 1, only 7.6% of participants reported that a recreation center was within a 1-5-minute walking distance from their homes, while 13.0% indicated a 6-10-minute walk. Additionally, 10.0% stated that it took 11-20 minutes to reach a recreation center, 7.0% reported a 20-30-minute walk, and 3.7% mentioned that it took over 30 minutes. Notably, a substantial 58.8% of participants responded with "none or don't

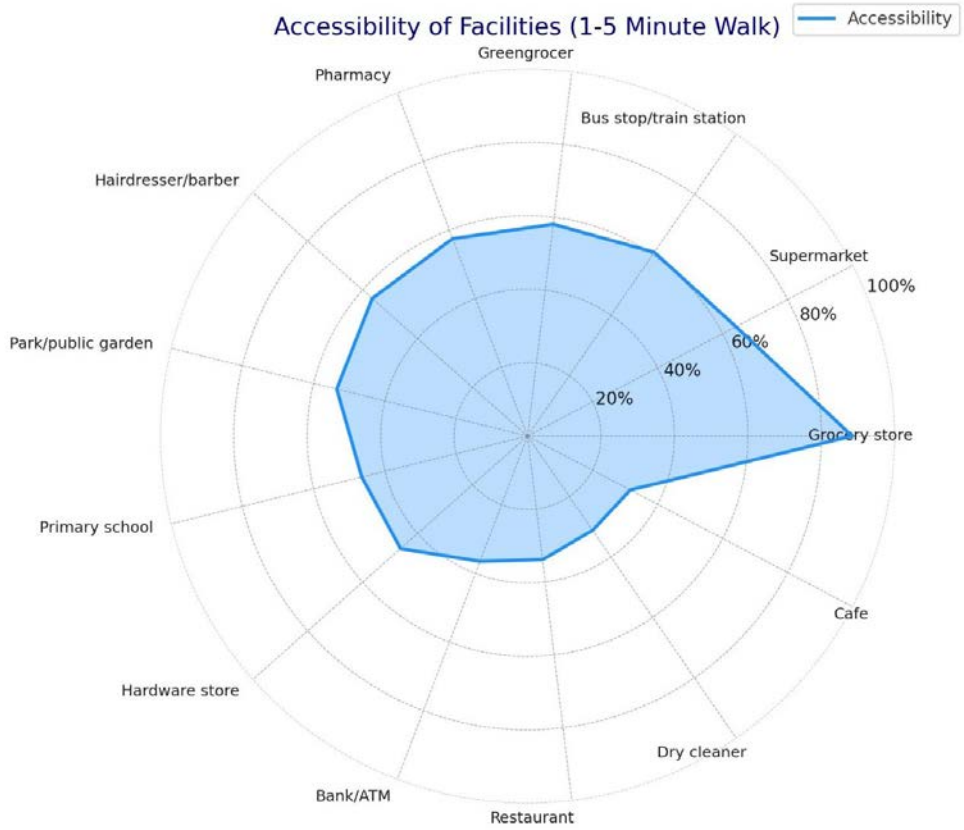

Figure 1. *The distribution of the facilities within a 1-5 minute walking distance from participants' homes.*

know," indicating either a lack of awareness or absence of recreation centers within a convenient distance.

The distribution of responses regarding the accessibility of recreation centers reveals significant insights. Key findings on recreation center accessibility include the following:

- Immediate Accessibility: Only 7.6% of participants reported that a recreation center was within a 1-5-minute walking distance from their homes.
- Moderate Accessibility:
- 13.0% indicated a 6-10-minute walk to reach a recreation center.
- 10.0% reported an 11-20-minute walk.
- 7.0% mentioned a 20-30-minute walk.
- Limited Accessibility: Just 3.7% indicated that reaching a recreation center took over 30 minutes.
- Lack of Awareness/Access: A significant 58.8% of participants selected "none or don't know," suggesting either a lack of knowledge about recreation center locations or their absence within reasonable walking distances.

This distribution highlights that while some participants have moderate access to recreation centers, the majority face significant limitations or are unaware of such facilities within a convenient distance. This finding suggests that recreation centers are significantly less accessible compared to other essential services. The high percentage of participants who responded with "none or don't know" highlights a potential gap in the availability or visibility of recreational facilities in the neighborhood. This disparity underscores the need for improved planning and communication regarding recreational amenities, which are vital for promoting health-related behaviors and social well-being among residents. Ensuring better distribution and awareness of recreation centers could enhance the overall quality of life and community engagement in the area.

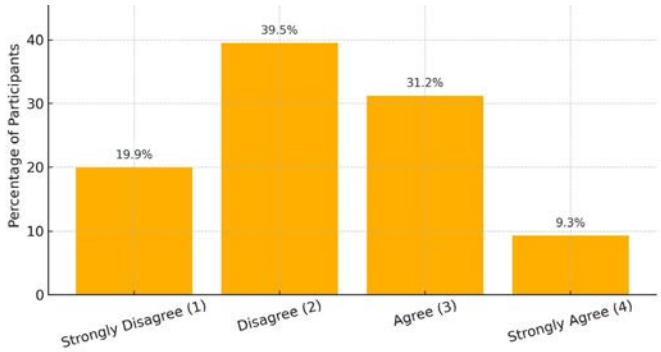

Figure 2. *The distribution of the participant agreement with the statement: "There are pedestrian crossings (marked or unmarked) to help people cross busy streets in my neighborhood".*

The survey also addressed the availability of pedestrian crossings in neighborhood streets to assist pedestrians in safely navigating busy areas. As the results highlight a significant concern regarding pedestrian safety and infrastructure in the surveyed neighborhoods in Figure 2, the high percentage of participants who disagreed or strongly disagreed with the availability of well-marked pedestrian crossings suggests that many areas may lack sufficient infrastructure to ensure safe pedestrian movement. This deficiency can deter walking as a mode of transportation, potentially increasing reliance on vehicles and contributing to traffic congestion. Conversely, the 40.6% of participants who agreed to some extent on the availability of these crossings indicate a partial implementation of pedestrian-friendly initiatives. However, the overall sentiment leans towards a need for significant improvement in pedestrian infrastructure to enhance safety and walkability in urban neighborhoods. To further quantify this response pattern, participant ratings on the 4-point Likert scale yielded the following results: M = 2.30, SD = 0.89, SE = 0.05, indicating moderate levels of agreement with notable variability across the sample.

The survey results reveal contrasting perspectives on neighborhood aesthetics (see Figure 3). A significant portion of residents feel the absence of sufficient trees along the streets, indicating a potential gap in urban greening initiatives that could enhance the visual appeal and environmental quality of the area. Participant responses revealed that a considerable proportion either disagreed (39.5%) or strongly disagreed (25.9%) with the statement on tree-lined streets, while only 34.6% agreed or strongly agreed. To quantify these perceptions, analysis yielded: M

= 2.17, SD = 0.96, SE = 0.06, indicating a below-average agreement level with relatively high variability in responses.

Conversely, responses concerning interesting things to observe while walking reflect a more positive view, with 20.3% expressing agreement and 79.7% expressing disagreement. This suggests that while natural landscaping may be lacking, other aspects of the urban environment may provide visual or cultural stimulation. Supporting this, the computed values were: M = 1.90, SD = 0.87, SE = 0.05, reflecting low agreement and relatively consistent perceptions across participants. These findings underscore the importance of holistic urban design that not only prioritizes green infrastructure but also enriches the pedestrian experience with diverse and appealing elements, thereby fostering a more vibrant and enjoyable community space.

The combined figure (Figure 4) offers a comprehensive view of residents' perceptions of two significant urban issues: traffic congestion's impact on walkability and safety concerns during evening walks. Regarding traffic congestion, 52.2% of participants expressed disagreement with the assertion that traffic makes walking unpleasant or difficult (13.3% strongly disagree and 38.9% disagree). However, 47.9% agreed that traffic issues negatively impact walkability (36.9% agree and 11.0% strongly agree), showcasing a nearly equal division among residents. This bifurcation indicates a substantial variation in pedestrian experiences, possibly influenced by the specific urban layout and traffic management measures in different parts of the neighborhood.

In terms of safety, the majority of participants feel secure in their neighborhoods during evening walks, with a combined 68.4% disagreeing (31.9% strongly disagree and 36.5% disagree) that crime rates deter them from outdoor activities. However, a notable 31.5% of participants agreed to some extent (19.9% agree and 11.6% strongly agree) that safety concerns are a barrier.To further quantify these perceptions, statistical analysis yielded the following results:Traffic congestion – *M = 2.46, SD = 0.86, SE = 0.049*; and Safety concerns at night – *M = 2.11, SD = 0.98, SE = 0.057*.

These values indicate moderate levels of agreement regarding both issues, with greater variability observed in perceptions of safety. Such findings emphasize the need for targeted urban planning interventions that address traffic congestion and enhance pedestrian safety and comfort. Implementing traffic calming measures, improving crosswalk visibility and safety, and promoting alternative transportation modes could mitigate the negative impacts of traffic on the pedestrian environment. Effective management of traffic issues is crucial for fostering a walkable, pleasant, and safe neighborhood, which not only enhances the quality of life for residents but also

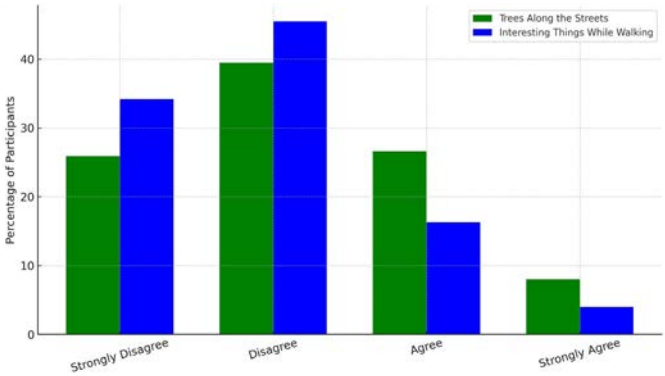

Figure 3. *Combined distribution of responses towards trees (Participant agreement with the statement "There are trees along the streets in my neighborhood.") and interesting things while walking (Participant agreement with the statement: "There are many interesting things to look at while walking in my neighborhood").*

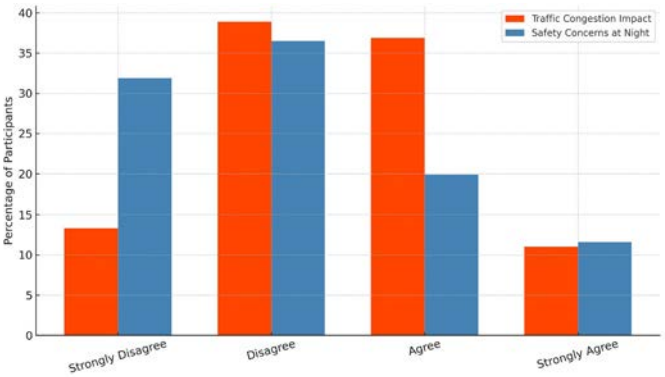

Figure 4. *Combined distribution of responses concerning traffic congestion's impact on walkability (Participant agreement with the statement: "There is too much traffic on nearby streets making it unpleasant or difficult to walk") and safety concerns (Participant agreement with the statement: "Crime rates in my neighborhood make it unsafe to go on walks in the evening." during evening walks.*

contributes to the overall sustainability of urban areas.

These findings underscore the importance of targeted interventions, such as traffic calming measures, improved crosswalk safety, enhanced street lighting, and community engagement initiatives, to create walkable and secure neighborhoods that foster residents' well-being and overall urban sustainability. Such interventions are crucial for improving safety perceptions and encouraging residents to maintain healthy lifestyle choices by feeling secure in their outdoor environments.

3.2. Descriptive findings toward stress level

The second part of the survey focused on measuring the stress levels experienced by individuals during their last month of the pandemic period. A total of 10 questions from the Perceived Stress Scale (PSS) were included, and participants were requested to respond to these questions based on their personal experiences. The analysis of perceived stress levels among participants using the PSS reveals a significant trend towards moderate and high stress levels, with the majority reporting these conditions (see Figure 5). This pattern underscores the profound psychological impact of the pandemic on individuals, highlighting a prevalent sense of stress that may be attributed to the ongoing health crisis and its numerous social and economic repercussions. The prevalence of moderate stress as the most common stress level, peaking at a specific score within this category, suggests that while extreme stress is less common, a substantial portion of the population is experiencing a heightened level of stress that could potentially lead to more severe well-being outcomes if not addressed. To summarize the overall distribution quantitatively, stress levels yielded a mean score of 22.92 (SD = 6.91, SE = 0.40) on the PSS, indicating a moderate average stress level with noticeable variability across participants.

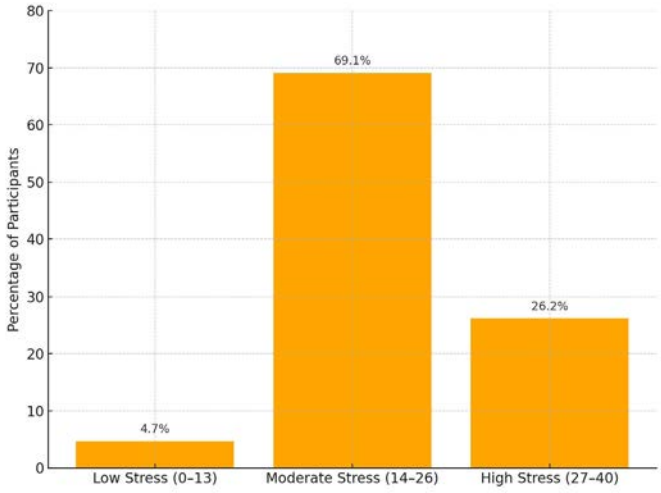

Figure 5. *The distribution of perceived stress levels among participants.*

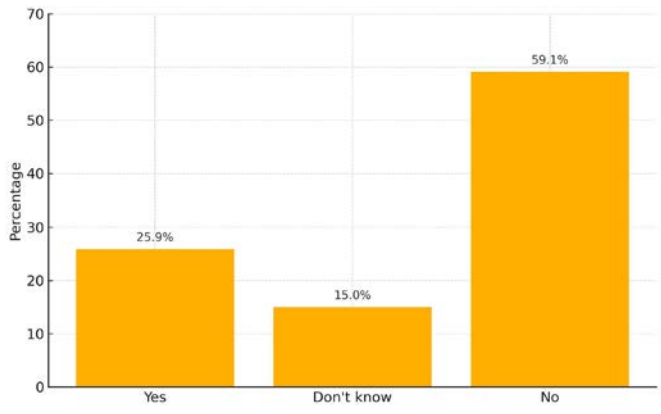

Figure 6. *The distribution of perceived adequacy of walking areas during the pandemic.*

3.3. Descriptive findings toward participants' walking activities and their physical environments

The survey data indicates a significant perception among participants that walking areas in their neighborhoods were inadequate during the pandemic (see Figure 6). A large majority expressed dissatisfaction with the availability and quality of walking spaces such as bike paths, parks, recreational areas, and waterfronts, which were critical for maintaining physical and psychological well-being during lockdowns. This sentiment highlights a gap in urban planning and the need for more resilient infrastructure to support urban living conditions in crisis situations. Statistical analysis of the responses (M = 1.67, SD = 0.86, SE = 0.05) reveals a clear tendency toward negative evaluations, underscoring the perceived insufficiency of walking areas across the sampled neighborhoods.

The survey reveals a substantial decrease in walking activities among participants during the pandemic

compared to pre-pandemic levels (see Figure 7). A significant 72.1% of participants reported a reduction in their walking activity, while only 16.9% indicated an increase, and 11.0% reported no change. This trend highlights the profound impact of pandemic-related restrictions and altered daily routines. Statistically, responses yielded a mean score of M = 1.45 on a 3-point scale (1 = Decreased, 2 = No Change, 3 = Increased), with a standard deviation (SD) = 0.77 and standard error (SE) = 0.04, indicating a clear skew towards reduced activity. These findings underscore the need for adaptive urban strategies that sustain physical activity even under movement restrictions. Interestingly, the small group that increased their walking suggests that for some, walking became a compensatory form of physical activity amidst the closure of gyms and recreational facilities.

The survey explored how physical and environmental features within neighborhoods influenced walking activities during the pandemic, focusing on sidewalk continuity and width. As shown in Figure 8, the majority of participants reported that these features had no significant impact on their walking activities, suggesting a degree of adaptability or indifference to these factors under pandemic conditions. However, a notable proportion of responses indicated a positive impact, reflecting that well-maintained and continuous sidewalks can enhance the walking experience, possibly encouraging more physical activity during restrictive times. Conversely, the negative responses highlight areas where improvements in urban infrastructure could potentially increase outdoor activity levels. The mixed impact underscores the importance of considering urban design in urban living conditions strategies, particularly in fostering environments that support physical activity during crises like a pandemic.

Statistical summaries:

- For sidewalk continuity, the responses yielded a mean score of M = 2.17, with a standard deviation of SD = 0.64 and a standard error of SE = 0.037.
- For sidewalk width, the mean score was M = 2.12, with a standard deviation of SD = 0.66 and a standard error of SE = 0.038.
- These scores, centered around the neutral-midpoint of the scale, further support the interpretation of nuanced and mixed effects perceived by participants.

Participants were also asked to evaluate the relationship between their outdoor walking activities and perceived safety in their neighborhood during the pandemic. As shown in Figure 9, nearly half (49.5%) of the participants reported that their sense of safety had no impact on their walking activities, while 20.6% indicated a positive influence and 29.2% reported a negative impact. These results suggest a complex perception of safety during the pandemic, where for many individuals, safety did not pose a barrier to walking. However, the substantial proportion of negative responses underscores the importance of urban safety enhance-

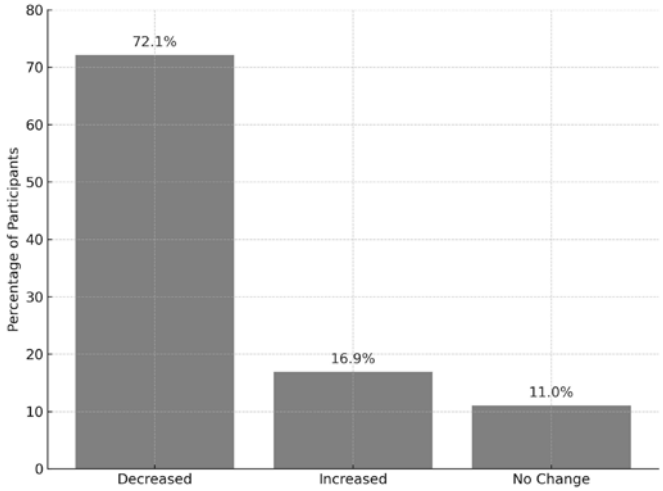

Figure 7. *The distribution of participants' reported change in walking activity before and during the pandemic.*

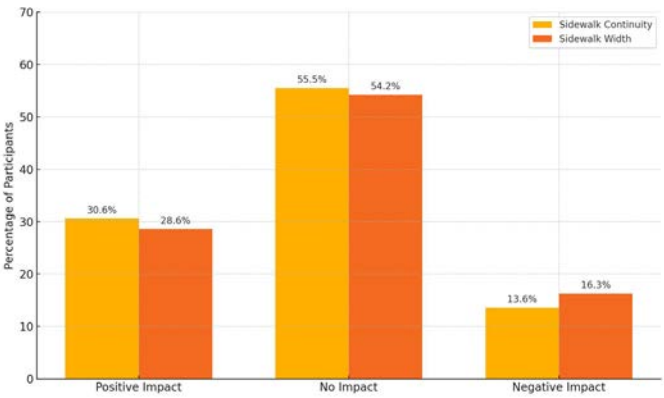

Figure 8. *Perceived impact of sidewalk continuity and width on walking activities during the pandemic.*

ments, particularly during crises that alter public space usage. The computed average score for this item was M = 1.91 (where 1 = positive, 2 = no impact, 3 = negative), indicating a general leaning toward neutrality or slight negativity. The standard deviation was SD = 0.70, and the standard error was SE = 0.05, reflecting a moderate dispersion of responses. These findings reinforce the significance of psychological comfort and perceived safety in encouraging sustained physical activity during disruptive events such as a pandemic. (See Figure 9).

3.4. Correlational findings

In the correlational analysis section of our study, we explore the associations between various neighborhood characteristics and the perceived stress levels among residents. Utilizing statistical methods such as the Pearson Chi-Square test and Fisher's Exact Test, we aim to uncover the nuanced impacts that factors like neighborhood safety, parking availability, street conditions, sidewalk presence, and local crime rates have on individual stress perceptions. Following table summarizes the correlational findings:

The correlational results presented in Table 1 reveal several important patterns highlighting the relationship between environmental stressors and perceived stress levels among residents. Notably, neighborhood safety was significantly associated with stress levels ($\chi^2(4) = 13.673$, $p = .008$, $n = 301$), suggesting that lower perceptions of safety correspond with higher stress. Similarly, crime-related concerns—both during the daytime ($\chi^2(6) = 20.754$, $p = .002$; Fisher's Exact Test = 18.226, $p = .003$) and evening hours ($\chi^2(6) = 23.465$, $p = .001$; Fisher's Exact Test = 20.342, $p = .001$; $n = 301$)—were strongly associated with elevated stress, underscoring the psychological toll of perceived insecurity in both daily activities and after dark. These findings are consistent with prior studies indicating that perceived crime and safety risks significantly influence mental well-being, reduce feelings of comfort in public spaces, and deter outdoor mobility, especially in vulnerable populations.

Additionally, poor physical infrastructure such as uneven streets ($\chi^2(6) = 14.747$, p = .022; Fisher's Exact Test = 16.255, p = .008; n = 301) and insufficient sidewalks ($\chi^2(6) = 13.572$, p = .035; Fisher's Exact Test = 12.361, p = .040; n = 301) was also significantly associated with higher stress levels. These features likely increase discomfort, fear of accidents, and reduced willingness to engage in walking-based activities, thereby compounding psychological strain. Similarly, difficulty in parking in local shopping areas (p = 0.045), while seemingly mundane, appears to be another stress-inducing factor, likely due to its cumulative effect on daily frustrations and time management.

Together, these findings provide a holistic view of how the built environment and perceived security interact to shape psychological experiences. They emphasize the need for integrated urban design and public safety strategies that simultaneously enhance both the physical walkability infrastructure and social safety, in order to promote not just functional but also emotionally supportive neighborhoods.

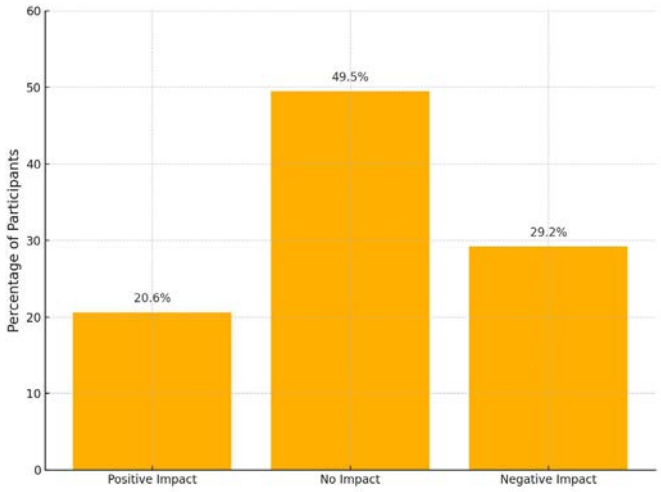

Figure 9. *Impact of perceived safety on walking activities during the pandemic.*

4. Discussion

The findings of this study elucidate the critical relationship between urban design, walkability, and stress management, particularly among Generation Z university students in Istanbul during the COVID-19 pandemic. By employing the Neighborhood Environment Walkability Scale (NEWS) and the

Table 1. *Correlational findings.*

Neighborhood Characteristic	Statistical Test Used (p-value)	Key Findings
Neighborhood Safety	Pearson Chi-Square (p = 0.008)	Higher levels of perceived stress are significantly associated with lower neighborhood safety.
Difficulty Parking in Local Shopping Areas	Fisher's Exact Test (p = 0.045)	Difficulty in finding parking correlates significantly with increased stress among residents.
Uneven Streets	Fisher's Exact Test (p = 0.008)	Uneven street conditions are significantly linked to higher perceived stress levels.
Sidewalk Availability	Fisher's Exact Test (p = 0.040)	Lack of adequate sidewalks is significantly associated with higher stress, emphasizing the need for better pedestrian infrastructure.
High Crime Rates	Fisher's Exact Test (p = 0.022)	High crime rates in neighborhoods are significantly correlated with increased stress among residents.
Daytime Safety Concerns Due to Crime	Fisher's Exact Test (p = 0.003)	Daytime safety concerns due to high crime rates are strongly linked to higher stress levels.
Evening Safety Concerns Due to Crime	Fisher's Exact Test (p = 0.001)	Evening safety concerns significantly exacerbate stress, highlighting the need for enhanced safety measures after dark.

Perceived Stress Scale (PSS), the research provided both descriptive and correlational insights that inform urban planning and urban living conditions policies.

The descriptive analysis indicated that the majority of participants did not walk to school before the pandemic, suggesting that the infrastructure may not adequately support pedestrian transit. Despite the accessibility of essential services like grocery stores and public transportation, the significant lack of recreation centers and the perception of insufficient pedestrian crossings highlight areas needing improvement. These findings suggest that while basic amenities are available, recreational and safety infrastructure lag, which are crucial for promoting regular physical activity and psychological outcomes.

Interestingly, the aesthetic appeal of neighborhoods received mixed reviews. While some participants found their surroundings engaging, the lack of natural elements like trees was a notable shortfall. This points to the need for a holistic approach to urban design that combines green spaces with aesthetically pleasing urban elements to enhance walkability and community engagement.

The pandemic's impact on walking activities was profound, with a notable decrease in walking during the lockdown. This highlights the need for adaptable urban spaces that can support physical activity even during restrictive times. Furthermore, the mixed responses regarding sidewalk quality and perceived safety underscore the importance of continuous investment in pedestrian infrastructure and community safety measures.

The correlational analysis revealed significant associations between neighborhood characteristics and perceived stress levels. Key findings include:

- *Neighborhood Safety*: Higher levels of perceived stress were significantly associated with lower neighborhood safety (p = 0.008). This underscores the importance of safe urban environments in mitigating stress and promoting mental well-being.

- *Parking Difficulty:* Difficulty in finding parking in local shopping areas correlated significantly with increased stress ($p = 0.045$). This suggests that even car-dependent aspects of urban design can impact stress levels, highlighting the need for comprehensive transportation planning that includes both vehicular and pedestrian needs.
- *Street and Sidewalk Conditions:* Uneven street conditions ($p = 0.008$) and lack of adequate sidewalks ($p = 0.040$) were significantly associated with higher stress levels. These findings emphasize the importance of maintaining high-quality pedestrian infrastructure to support mental well-being.

Crime Rates and Safety Concerns: High crime rates ($p = 0.022$) and safety concerns during both daytime ($p = 0.003$) and evening ($p = 0.001$) were strongly linked to increased stress. This highlights the critical need for effective policing, community engagement, and urban design strategies that enhance safety.

The findings of this study are broadly consistent with prior research on the relationship between neighborhood environments and perceived stress. Previous studies have similarly highlighted how environmental stressors such as crime rates, lack of pedestrian infrastructure, and traffic-related concerns contribute to increased psychological distress among urban residents (Frumkin, 2002; Giles-Corti et al., 2016). For example, studies have shown that neighborhood safety and fear of crime are significant predictors of reduced outdoor activity and higher stress, especially among women and elderly populations (Lorenc et al., 2013; Foster & Giles-Corti, 2008). Likewise, the importance of walkable environments, including well-maintained sidewalks and access to local amenities, has been emphasized as crucial not only for promoting physical activity but also for supporting mental health and reducing stress (Sarkar et al., 2018; Giles-Corti et al., 2016). Our results align with these findings, reinforcing the argument that urban environments play a key role in shaping both the physical and psychological well-being of residents. The current study contributes to this growing body of literature by offering context-specific evidence from a Turkish urban setting, thereby enhancing the geographic diversity of research in this domain.

The study's findings highlight essential urban planning implications, particularly the need to prioritize walkable neighborhoods, enhance safety, and incorporate both functional and aesthetic elements into city design. Emphasizing the unique needs of Generation Z, urban planners should focus on creating inclusive spaces that reduce perceived stress and support healthy behavior. Additionally, the importance of resilient infrastructure is underscored, advocating for adaptable urban spaces that can support urban living conditions during crises.

The following summarizes key implications for urban planning drawn from this study's findings.

- Enhancing Walkability: Urban planners should prioritize the development of walkable neighborhoods by improving pedestrian infrastructure, ensuring the availability of recreational facilities, and incorporating green spaces. These elements are essential not only for promoting health-related behaviors but also for reducing stress.
- *Safety and Security:* Addressing safety concerns through better lighting, increased police presence, and community watch programs can significantly reduce stress levels and encourage outdoor activities.
- *Holistic Design:* Incorporating both functional and aesthetic elements in urban design can enhance the overall quality of life. Trees, parks, and visually appealing elements should be integral parts of urban planning.
- *Inclusive Planning:* Recognizing the diverse needs of different population groups, particularly younger generations, is crucial. Generation Z, with its unique characteristics and preferences, should be considered in urban planning efforts to create spaces that meet their needs and promote their well-being.
- Resilient Infrastructure: The pandemic has highlighted the need for resilient urban infrastructure that

can support urban living conditions during crises. Flexible use of spaces and the availability of safe, open areas for physical activity should be prioritized.

5. Conclusion

While the COVID-19 pandemic presented certain methodological challenges, it also provided a unique context in which the effects of environmental factors such as walkability could be examined under heightened conditions of stress and mobility restriction. Although some degree of stress may be attributed to general anxieties related to the pandemic, the Perceived Stress Scale (PSS) captured participants' broader psychological responses, which were then correlated with their perceptions of the built environment. This approach enabled the study to explore how environmental design features contributed to stress regulation during a time when individuals were especially sensitive to their immediate surroundings. Moreover, Generation Z—being digitally connected yet spatially constrained—offered a distinctive lens through which the restorative potential of walkable environments could be interpreted. This study contributes to understanding the relationship between walkability and perceived stress, particularly among Generation Z students in Istanbul during the COVID-19 pandemic. It finds that increased walkability correlates with reduced perceived stress, suggesting the potential of walkable environments to support mental resilience in urban populations. The findings align with existing literature highlighting the mental health benefits of physical activity and walkable urban environments (e.g., Southworth, 2005; Cervero & Kockelman, 1997). They also confirm previous studies that link environmental quality—such as sidewalk conditions, safety, and access to amenities—to psychological well-being (e.g., Wood et al., 2010; Jiang et al., 2023). The gender-based differences in stress and walkability perception also echo past research noting the variability of stress experience across demographic lines. However, the study reveals that recreation centers and well-maintained sidewalks remain limited or underrecognized in many neighborhoods. This reflects a gap in the implementation of walkable design principles, which calls for policy attention. Overall, the research supports the notion that urban form can significantly shape public mental health outcomes, especially during periods of disruption. Future studies may consider integrating more direct measures of well-being or longitudinal assessments to further understand causality. Integrating qualitative insights from residents could also enrich findings.

While this study identified important patterns linking perceived walkability to stress levels among Generation Z participants, it is important to acknowledge that participants resided in varied urban environments. These contextual differences may influence how built environment features are experienced. Although the study utilized descriptive statistics to illustrate key trends, correlational analysis was also applied to explore the relationship between walkability and stress perceptions. Future studies could build on these findings by incorporating spatial clustering or typological comparisons to better capture environmental variability and its effects on health-related perceptions.

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Rural continuity and change in Late Antiquity in Rough Cilicia: A case study on Yanıkhan

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Abstract
This study investigates the resilience, adaptability, and continuity of rural settlements in Rough Cilicia during Late Antiquity, focusing on Yanıkhan as a modest yet representative example. Employing an architectural and urban perspective, it analyzes how socio-economic, geographical, and historical turning points shaped settlement patterns over time. The research offers new insights into the integration of Hellenistic urban planning elements and the adaptive use of Late Antique structures, contributing to the understanding of rural dynamics in Byzantine Anatolia.
Drawing on fieldwork, architectural surveys, and historical analyses, the study examines settlement layouts, infrastructure, and construction techniques. By shifting attention from individual buildings to the broader organization of the settlement, it emphasizes the layered and adaptive nature of Yanıkhan's development. These findings enrich the study of rural settlement continuity and transformation within historical contexts, with implications for understanding similar sites across the region.

Keywords
Late Antiquity, Rough Cilicia, Rural settlements, Urban transformation, Yanıkhan.

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1. Introduction

Rural activities and industry are vital for supporting both the economies of urban centers and the broader provisioning networks across the Mediterranean. Constantine's decision to relocate the capital to the East increased supply needs. This may have contributed to the growth of rural activities in provinces such as Isauria. Political events, reflections of the demands of a Christianized society from urban environments and settlements, and territorial losses in the east and west, including the provinces of Northern Africa and Egypt, marked the onset of a Transition Period (7th–9th centuries) (Ousterhout, 2019, p. 245). These changes created a demand for grain and other supplies from Anatolia, paving the way for an increasingly rural medieval society in the Eastern Mediterranean. Consequently, many urban centers shrank or disappeared, while their populations transitioned to a more rural way of life. Rural development, influenced by the need to supply the capital and the impact of central administration, was particularly evident in Eastern Rough Cilicia. At the same time regional needs significantly impacted the structural development of the area. Especially from the 6th century onward, with the increase in Arab raids, Eastern Rough Cilicia, defined by the natural boundary of the Lamos River and its valley, became a strategic frontier for the Byzantine state (Durak, 2013, p. 146). This natural division—originally described by Strabo as the boundary between Rough (Tracheia) and Flat (Pedias) Cilicia—continued to shape the region's historical and administrative development (Strabo, Geographika, 14.5.1). In this context, rural areas of Rough Cilicia may have contributed to the provisioning of military personnel and food supplies.

Overall, rural areas in Byzantine society were essential for food production, tax revenue, military support, security, and social resilience. Despite the presence of large urban centers like Constantinople, the empire remained predominantly rural, and the stability of rural structures directly underpinned the strength and continuity of urban centers. Rough Cilicia can be considered one of the regions where amplified rural industry can be studied on a broad scale. It is well-documented that agricultural activities were widespread across the rural settlements of the region, with the production of olive oil and wine being particularly prominent. These industries were central to the local economy and demonstrate the sustainability and adaptability of rural life in the region. Yanıkhan, a settlement dating back to the Hellenistic period, exemplifies this rural continuity, reflecting both stability and resilience within the region. Demonstrating the concept of a komepolis (village-city), Yanıkhan's economic and social structure integrates both rural and urban elements. While major centers like Seleucia and Olba dominated the region, smaller, isolated settlements such as Yanıkhan developed unique settlement patterns shaped by the surrounding natural landscape. Unlike the better-documented monumental sites, settlements like Yanıkhan provide insight into the lived experience of rural communities and their architectural adaptation to challenging terrain.

A key aim of this study is to explore the processes of development and transformation within rural areas in light of historical turning points and to reassess the settlement patterns of medium and small-scale communities from both architectural and urban perspectives. In doing so, it also seeks to contribute to the architectural documentation of such sites, addressing gaps in earlier research and providing a baseline for future studies. Interpreting historical contexts through a contemporary lens brings unique challenges, particularly in understanding how key turning points have shaped the socio-economic and urban dynamics of this region over time. In Eastern Rough Cilicia—a rugged terrain nestled between the Lamos (modern Limonlu) and Kalykadnos (modern Göksu) rivers—geographical and environmental factors have markedly influenced local development (Figure 1). This challenging landscape provided settlers with both protective isolation and limited resources, profoundly impacting the architectural and urban formation of

settlement structures. The study approaches Yanıkhan's transformation through concepts from landscape archaeology and resilience theory, focusing on architectural continuity, spatial adaptation, and local agency.

Yanıkhan, situated within this mountainous region, serves as a compelling example of rural adaptation and its enduring legacy across centuries. This study examines the evolution of Yanıkhan's settlement structure, tracing its architectural, economic, and social transformations from the Hellenistic period through Late Antiquity and beyond. By reevaluating Yanıkhan's settlement organization within an architectural and urban framework, this paper seeks to redefine the concept of rural settlement as it applies to this specific region. The evolving identity of Yanıkhan reflects broader trends in rural organization, resilience, and transformation, offering valuable insights into the long-term development of settlement structures across the ages. In framing the study, landscape archaeology provides a conceptual approach for examining settlements as dynamic and interconnected systems shaped by both environmental constraints and human agency. Rather than viewing Yanıkhan as a static collection of structures, this perspective highlights how natural topography, resource distribution, and socio-political networks influenced its spatial organization and architectural development. Resilience theory further informs the analysis by emphasizing the adaptive strategies through which communities responded to shifting political, economic, and environmental pressures. Together, these frameworks enable a nuanced interpretation of continuity and transformation, situating Yanıkhan within broader debates on rural adaptation and long-term settlement dynamics in marginal landscapes. Through its emphasis on architectural continuity and systematic documentation, the study also offers a reference model for future interdisciplinary research on rural resilience, particularly in peripheral regions.

Figure 1. *Geographic map of Yanıkhan: The map illustrates the location of Yanıkhan between the Lamos (modern Limonlu) and Kalykadnos (modern Göksu) rivers in Rough Cilicia.*

2. Methodology

The methodological framework of this study combines detailed fieldwork, architectural documentation, and elevation-based spatial analysis to systematically record and interpret the settlement, drawing on data collected at Yanıkhan between 2020 and 2021. Terrain and built features were recorded in high detail using total-station equipment, while photogrammetric aerial imagery supported the mapping of circulation paths, housing clusters, and unbuilt areas that might otherwise have been obscured by vegetation or surface loss.

The resulting site-based dataset was integrated into a doctoral GIS database, enabling spatial cross-referencing with other rural settlements—an integration that, although outside this article's scope, significantly enhances our understanding of regional settlement patterns, spatial organization, and interconnectivity.

Previous work in Rough Cilicia has often focused on monumental church architecture; in contrast, this study emphasizes the wider settlement fabric through meticulous documentation and comparative analysis. Direct historical sources for small-scale settlements are scarce, so the methodological approach relies heavily on archaeological interpretation, morphological analysis, and architectural typology.

To further situate our approach, we draw on comparative studies from across the Byzantine world. Research in western and central Anatolia has identified region-specific patterns of rural expansion and contraction through settlement surveys and environmental archaeology (Izdebski, 2017, pp. 82–90). Similar methodologies on the Aegean islands (Kondyli, 2022) and in central Greece (Vionis, 2017) have highlighted the roles of topography, connectivity, and resilience in structuring rural landscapes. Investigations at Kilise Tepe in the Göksu Valley represent one of the rare excavation-based studies at a Byzantine rural settlement; although various surface surveys and documentation projects exist, direct excavation remains very limited (Jackson, 2015; see also Ousterhout, 2019, p. 647).

While environmental and political contexts differ between regions, these collective findings offer valuable insight into interpreting rural space through interdisciplinary, landscape-based methodologies. In particular, recent debates on rural settlement categories—kome, chorion, and komepolis—enrich this study's interpretive framework and help situate Yanıkhan within broader discussions of hybrid rural-urban formations in the Byzantine countryside.

3. Historical background and general context

Addressing the historical transformations and critical turning points in the region is essential for understanding the context in which rural settlements and Yanıkhan developed. Eastern Rough Cilicia, located between the Kalykadnos (modern Göksu) and Lamos (modern Limonlu) rivers, underwent a significant urbanization process beginning in the 2nd century BCE during the Seleucid period (Akçay, 2019, p. 80; Aşkın, 2010, pp. 83–88; Durugönül, 1995, p. 75). Roman influence intensified in the last quarter of the 1st century BCE, and the construction wave that began during this period reached its peak in the late 2nd and early 3rd centuries (Kaplan, 2011, p. 109). By the late 4th century, the province of Isauria had gained a considerable strategic position, emerging as a frontier province with increasing military significance (Kurt, 2018, p. 821). In the late 5th and early 6th centuries, architectural activities surged once more with the construction of additional residences and churches, transforming previously settled areas into larger and more complex communities (Mitchell, 2016, pp. 497–500; Mörel, 2016, p. 22).

Researchers generally agree that the period between the 4th and 7th centuries marked a dynamic phase in the region's development, characterized by significant construction and expansion (Varinlioğlu, 2008a, p. 49). From the 6th century onward, it is widely accepted that many settlements in the region faced abandonment due to factors like Arab invasions, outbreaks of

disease, and broader socio-economic challenges. Recent interdisciplinary studies have also emphasized the role of climatic fluctuations, particularly the shift to cooler and drier conditions after the mid-6th century, in shaping rural resilience and land-use strategies (Haldon et al., 2014). These shifts may have compounded other stressors, and in the case of Yanıkhan, the absence of new construction phases after the 6th century could reflect a functional transformation or contraction of the settlement, possibly linked to environmental pressures. While its topographical seclusion might have offered protection from immediate threats such as Arab incursions, long-term environmental changes may have exerted pressure from within. Therefore, instead of abrupt abandonment, Yanıkhan might have undergone a gradual reconfiguration in response to both internal and external dynamics. However, how much the mountainous micro-region between the Lamos and Kalykadnos rivers was affected by these events remains a matter of debate. The rugged, rocky, and difficult-to-access terrain of this area provided a level of natural protection, allowing the region to remain relatively isolated.

These challenging geographical conditions limited external access, yet local communities developed an intricate internal network of paths and passages, which facilitated movement within the area. This micro-region between the Lamos and Kalykadnos rivers is filled with familiar routes known to the local inhabitants, enhancing its defensive advantage and making it relatively isolated from outside threats.

The isolated and sheltered nature of the region likely enabled the continuation of local economies. Relying on agriculture and pastoralism as primary sources of livelihood, local communities maintained a self-sufficient economy, which could have minimized the impact of external disruptions. This inward-facing organization likely strengthened social resilience, allowing communities to remain economically and socially vibrant even in the face of outside pressures.

In this context, the mountainous area between the Lamos and Kalykadnos rivers may have provided local populations with both a refuge and a stable area for ongoing economic activity. Despite external threats, these communities managed to preserve a unique way of life, maintaining social and economic vitality within the region.

Based on studies of the region's history and the construction of buildings utilizing polygonal and mortarless techniques, Yanıkhan's history can be dated back to the 2nd century BCE. Additionally, at least two churches and some other structures were erected during the Late Antique centuries. Medieval towns occasionally underwent considerable renovations that altered their historical structure, making it challenging to revive their original layout. However, the different periodic layers and settlement structure are explicable in this specific case, as Yanıkhan's distinct architectural elements and construction techniques allow for a clearer understanding of its chronological development. One of the key methods used in dating this settlement has been the analysis of wall construction techniques: mortarless polygonal stone walls are attributed to the Hellenistic period, while walls constructed with mortar using ashlar and roughly shaped rubble stones are associated with Late Antiquity. Despite being considerably unperceivable through a walk among the ruins of the settlement, thorough documentation clearly reveals the medieval urban structure, which has been occupied since the Hellenistic era. The Hellenistic grid system is still plainly visible in the housing area, and this structure has remained mostly unchanged. It is difficult to offer an explanation for the continuity of this pattern. Subject to topography, it is crucial to note that the primary axes of the settlement were altered during Late Antiquity, and this change is obviously discernible.

Historical primary sources do not provide specific information about such settlements, and as a result, scholars are confined to relying on archaeological data obtained from surveys and excavations. The majority of the data related to the Yanıkhan settlement presented in this study has been obtained through extensive field research. The fieldwork data was primarily gathered

through aerial photography (Figure 2) and precise on-site measurements using a total station. Without detailed documentation and aerial photography, understanding the structure of the settlement layout is challenging due to dense vegetation and significant damage. Although its accessible location has attracted interest, previous investigations have mainly focused on the two main churches—North and South—and have not provided a broader perspective on the settlement as a whole (Cortese, 2022; Gough, 1965; Hild & Hellenkemper, 1986; Hill, 1985). Other structures, whose original functions are not fully understood, may have served functions related to infrastructure, production, storage, and possibly even commercial activities, and are of great importance for a comprehensive understanding of the settlement.

Upon examining the entire settlement of Yanıkhan, it is crucial to observe the Hellenistic grid system alongside Late Antique structures. In many instances, this pattern could not be discerned as clearly as in this case, which aids in better understanding the transition of the settlement pattern. Nevertheless, as the current data is based solely on surface observations, it is difficult to draw definitive conclusions without more detailed excavation. Within the continuity between the Hellenistic and Byzantine periods, the lack of prominent Roman interventions is particularly noticeable. Specifically, the extensive and monumental Roman constructions commonly observed in central cities seem to be missing in this rural region (Elton, 2019, pp. 76–77). This lack of visible Roman-period traces on the surface likely reflects the characteristics of small rural settlements in this area, where construction practices were shaped by different priorities during that time. Considering the socio-economic dynamics of the period and the region's adaptation to its environmental and political context, it can be suggested that rural life persisted in a sustainable manner during this era.

It can be noted that in Late Antiquity, not all functional elder structures in rural areas were demolished; they continued to be in use, sometimes with altered functions. Moreover, the new structures required for the era found optimal positions within the settlement, resulting in a harmonious integration of old and new.

This comprehensive examination suggests that analyzing specific types of structures in rural settlements may not be sufficient for a full understanding of the area. From an academic perspective, it becomes evident that further comprehensive studies of other small and medium-sized rural settlements in the Eastern Rough Cilicia region are necessary.

4. Settlement layout and architectural description

Yanıkhan is situated about 6.5 km inland from the coast, near the southwestern boundary of the Lamos Valley. It lies along a road that begins south of the Lamos River and

Figure 2. *General aerial photograph of Yanıkhan.*

leads northward to the present-day Esenpınar District, which continues northward towards the ancient city of Olba. Considering the natural boundary formed by the Lamos Valley to the northeast, there is no reason to doubt that this road served as the main route for access to the settlement in ancient times as well. With its relative proximity to the coast, Yanıkhan offers easy access to both coastal and inland areas. The settlement was established on forty-two hectares of land with an incline of roughly 11 percent. The structures had been constructed to accommodate the sloped terrain through a method of terracing the land. Settlement serves as a notable example of how terrain shapes settlement patterns. Based on measurements, if we take the southern church as the center point and set the ground level at ±0.00, the northern church is positioned at +5.00 meters, while the marketplace building is located at -5.00 meters (Figure 3). Data gathered from field studies indicates that the Hellenistic grid system remains prominently intact within the housing area, showing minimal alteration over time. The remaining structures, with their polygonal walls, are one of the prominently visible characteristics of this section of settlement. The continuity and traceability of the Hellenistic grid system are important for understanding the urban characteristics of the period. This grid system, observed in major Hellenistic cities such as Miletos, Priene, and Pergamon, is indicative of its effectiveness in rural areas as well as in urban planning.

Like a majority of other settlements in the region of similar sizes and functionalities, Yanıkhan is not enclosed by fortified walls, and access is available via the main road along the southwestern boundary, now a modern asphalt route

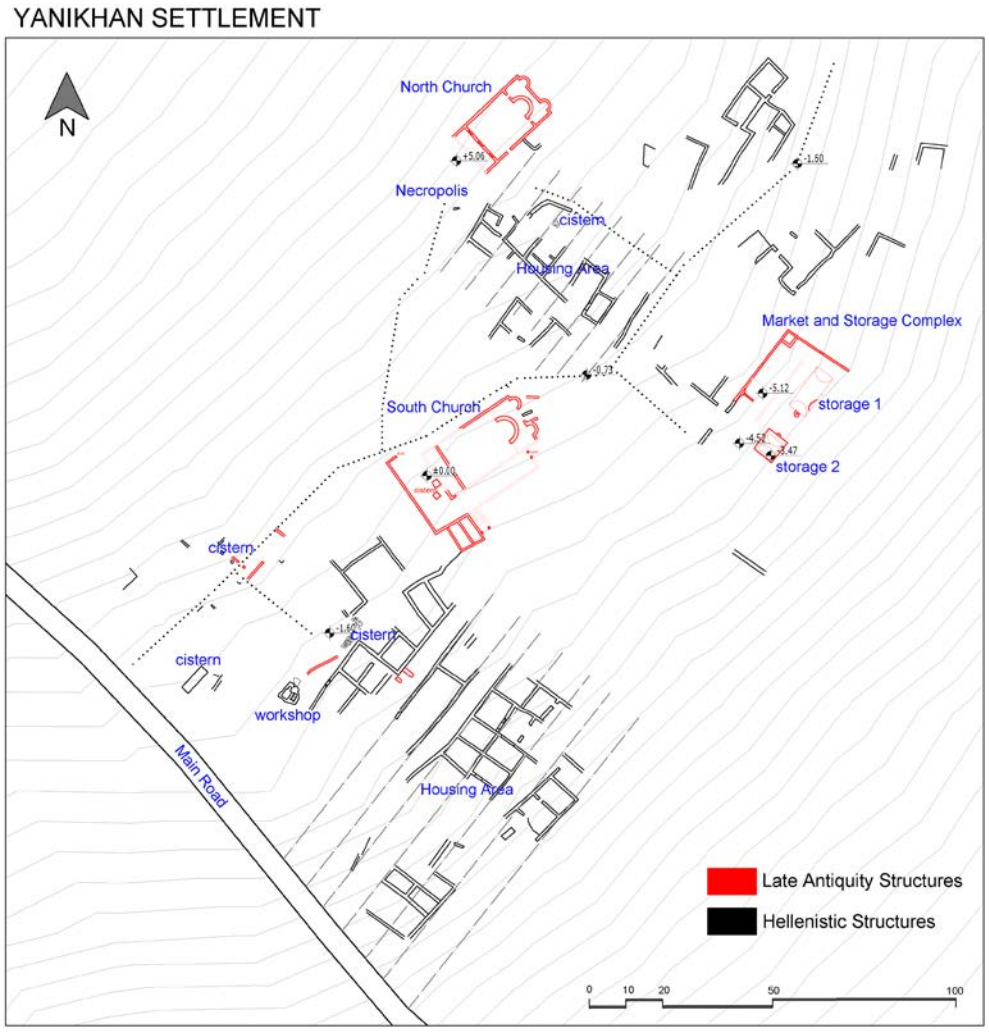

Figure 3. *Yanıkhan Settlement Plan: This plan illustrates the layout of the settlement, showing the Hellenistic grid system and Late Antique structures.*

for vehicles. Its location along a road and ease of accessibility are notable features; however, it is worth noting that not all settlements in the region with similar characteristics have such convenient access. Among the other numerous small, medium, and large-scale settlements within this distinctive micro-region between the Lamos and Kalykadnos rivers during Late Antiquity, examples fortified with walls and/or castle towers are scarce. In case of their existence, these fortifications generally took shape during the Hellenistic period. Yanıkhan was certainly in use during Late Antiquity, but its continuity into the transitional period (7th–9th centuries) remains unclear. The lack of fortifications may indicate either sufficient natural protection or abandonment, making defensive structures unnecessary.

The settlement is positioned parallel to the slope in a southwest-northeast orientation, and an internal road perpendicular to the main road and parallel to the slope leads to the inner parts of the settlement. It can be presumed that the inner road, accessible from the main road, functioned similarly during periods of active use of the settlement, considering its relationship with the topography and urban environment. However, it should also be noted that the inner road underwent revisions with new structures added during Late Antiquity. Access from the southwestern border of the settlement to the northeastern border is achieved by walking approximately 270 meters along this inner road. Along the way, it forks to provide access to settlement zones and buildings. The original paving stones of the path connecting the entrances of the South and North churches have been partially preserved to this day. This path may have functioned as a processional route linking the entrances of the two churches. Additionally, based on the organization of the church structures within the settlement, it appears that the internal road system was also renovated to align with this layout.

The general layout of the settlement, taking the South Church as a reference point, is as follows: a residential area lies to the south of the church, a storage and market area to the northeast, a second residential area extending northeastward from the north, and finally, the North Church situated further to the north. While the settlement plan is largely discernible, it should be noted that certain sections have been lost or left with indistinguishable traces due to recent use by local residents. In particular, the area between the market and the southern residential zone cannot be clearly identified without excavation.

Residential structures, most of which date from the Hellenistic period, are situated to the southwest and can be accessed via the first road branching south from the main route (Figure 4). Along the road leading to the southern residential area, cisterns and a clearly identifiable workshop have also been preserved. Dense vegetation and sloping terrain make access to this area challenging. The grid plan of the residential structures appears to have been in use during Late Antiquity. Although these structures, built with a polygonal construction technique, are largely preserved, additional walls were added to some of the original buildings during Late Antiquity. Door lintels with cross symbols, possibly carved at a later time, are also visible.

Figure 4. *Aerial photo of the southwest housing area.*

Another grid-planned residential area is also visible between the North and South churches, although many buildings in this zone are significantly damaged. Some polygonal wall structures and door frames remain partially intact in situ, and a cistern has been identified within this area. The residential zone extends into the northern part of the settlement, which is one of the sections where structures are more deteriorated, with remnants not well-preserved to the present day.

Due to the current condition of the housing areas, determining the population size that the settlement might have supported, as well as estimating the number of residential structures, is challenging without conducting extensive archaeological excavations. The grid-like layout and interconnected arrangement of buildings in residential areas leave open the question of whether these structures can be considered independent units. Although some studies focusing on church structures within the settlement provide various estimates for the number of residential buildings, these figures remain largely hypothetical (Cortese, 2022, p. 181; Hild & Hellenkemper, 1986, p. 83).

Generally, in family-oriented feudal settlement patterns, particularly in the southeastern and eastern regions of Anatolia, housing systems often expand organically with need-based additions as families grow. A similar process may have influenced the housing fabric in this settlement. Given that these structures were initially built in the Hellenistic period and later likely underwent modifications and expansions during Late Antiquity, the current layout suggests a possible model of organic, need-driven development.

The South Church (Figure 5), situated almost at the center of the settlement, follows a typical regional plan but is distinguished by the addition of an atrium and a south corridor, placing it in a more specialized position in terms of liturgical activity, facilitating specific liturgical practices, and potentially serving as a central point for communal gatherings and religious ceremonies. Including its narthex and eastern chambers, it measures 30.71 by 14.87 meters. While the wall fragments provide a broad layout of the construction, the South Church's structural stability is severely deteriorated. The apse wall rises to the height of the lower level of the window opening, while the eastern chambers and north wall remain partially intact. The remaining sections of the structure can be traced at ground level through the wall remnants.

Access to the atrium of South Church, which is rectangular in shape and measures 22.70 by 8.30 meters, is provided from the north and south. There are two entrances: one is a door on the northern wall that connects to the road continuing from the north side of the church, and the other is accessible via stairs from the south. The church is situated on sloping terrain; thus, the elevation difference at both the north and south entrances is resolved with steps. Additionally, within the atrium, there are two underground cisterns. No traces of door openings or thresholds have been found on the western wall of the atrium; however,

Figure 5. *Plan (left) and aerial photo (right) of the Yanıkhan South Church.*

this may be due to the wall having collapsed down to ground level, making identification difficult. To the south of the atrium, west of the stairway entrance, remnants of walls suggest the presence of two rectangular rooms oriented in a north-south direction. It is challenging to hypothesize the functions of these rooms.

At the eastern end of the south corridor, there is a door opening that leads either to a room or to the outside. It has not been possible to determine whether this corridor terminates in a room, as previously suggested by Hill (Hill, 1996, p. 259). Currently, this part is in a completely ruined state and is covered with a pile of rubble, making it impossible to identify its south wall. However, based on the findings of Hild and Hellenkemper, as well as Hill, and considering the existing structural traces, it is suggested that the width of the corridor may be 5.45 meters. Adjacent to the walkway, a stairway provides access to the lower entrance on the south side. These stairs, which connect to the southern corridor of the church, are opposite the narthex, and it is likely that there is a door in the narthex corresponding to these stairs.

Approximately at the center of the two apsidal rooms located to the east of the church, there exists an arched recess interpreted as a burial structure. When the location of this structure is measured precisely and mapped, it becomes evident that its relationship with the apsidal rooms does not correspond with the plan proposed by previous researchers (Cortese, 2022, pp. 182–183; Hill, 1985, p. 95; Hill, 1996, pp. 256–260). It is posited that this structure functioned as a martyrion, where the relics of the saints referenced in the inscription associated with the church were likely housed. While the possibility of this interpretation remains, questions concerning whether the burial niche was constructed contemporaneously with the church or whether the church was erected over an existing burial site continue to be relevant. To the east of the northern chamber of the church, a partial wall remains from the Late Antique period, running parallel to the road, and has been identified behind the arched grave. This formation is significant in terms of emphasizing the road axis at this point, and this road continues northward.

The North Church stands approximately 60 meters north of the South Church (Figure 6). It shares a similar plan with the South Church but lacks an atrium or a surrounding walking corridor. Measuring 25.92 meters by 13.75 meters, including its narthex and eastern passage. It is understood that the church was constructed on a necropolis area, suggesting a potential function related to burial rituals. At the narthex and the eastern chambers of the church, there are chamasorion-type graves carved into the bedrock. The condition of the building is better than that of the South Church. The outer walls, apse, and dome remain in situ. Fragments of columns and bases lie inside the church. The church's main walls were constructed with rough-cut rubble stones, while the apse walls and the dome were built using larger, finely cut ashlar blocks (Figure 7).

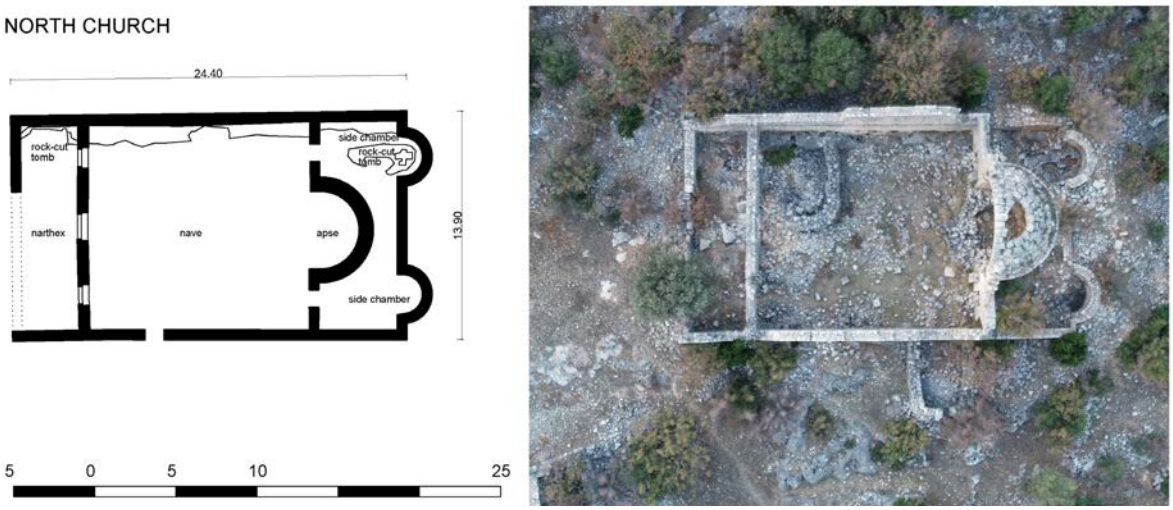

Figure 6. *Plan (left) and aerial photo (right) of the Yanıkhan North Church.*

Figure 7. *Southwest aerial view of Yanıkhan North Church.*

The exact construction dates of the churches remain uncertain [1], as verifying any theory is not possible without conducting excavations in the area. No comprehensive excavations have yet been carried out in the Olba region that could serve as a reference for similar-sized rural settlements. Nevertheless, considering that churches in the region are generally dated to the 5th and 6th centuries, a similar timeframe can be proposed for these structures. The inscription found on the lintel of the main door of the naos in the South Church indicates that this settlement was regarded as a significant religious site. This suggests that the church might have attracted not only the local inhabitants but also visitors from outside the settlement. In this context, the roles and functions of other structures, along with the religious buildings, gain considerable importance in understanding the overall organization of the settlement.

Churches in Rough Cilicia were integral to both the religious and social fabric of these communities. They were not merely places of worship; they also acted as community hubs, playing a central role in the local economy and governance. Often built in strategic locations within settlements or along important trade routes, these churches connected rural areas with urban centers, reinforcing the expanding Christian network. The basilica-style architecture, typical of Late Antiquity, was commonly used, with adjustments to the challenging terrain. Local limestone was a key material, and spolia was frequently incorporated, offering both practical benefits and symbolic connections to the region's past.

One of the significant additions from Late Antiquity in the settlement is a complex that includes storage facilities and possibly market-related structures (Figure 8). The building measures approximately 24 meters by 20 meters, presenting a monumental scale competing in size with the major religious structures. The northwest and northeast walls of the structure are constructed of rubble stone and have partially survived to the present day. The flooring traces observed on the northwest wall suggest that the structure is a two-story building with a partial basement. It is evident that the main structure has been positioned on a vaulted substructure to the east, taking advantage of the terrain's slope. The internal dimensions of this vaulted structure, which is below the ground level, measure 5.35 meters by 13 meters. To the

south, there is another smaller vaulted structure built at the same level. The internal space of this smaller structure is nearly square, measuring 4.80 meters by 4.82 meters (Figure 9).

It is difficult to make a definitive restitution of the building based on the existing traces; however, there is a wall trace at the center of the building that runs longitudinally at ground level. As indicated by the perpendicular wall traces, it is likely that the structure features a plan consisting of adjacent, sequential rooms. A doorway has been identified in the northeast wall of the building. The northwest wing comprises two stories of sequential rooms above the basement, while the section accessible through this door may have served as an enclosed courtyard located above the vaulted substructure. Also, traces that can be followed southwest of the northwest wall suggest that the existing structure may continue in that direction. Additionally, the rock-cut sections revealed at the basement level of the northwest wall are noteworthy.

The building's multifunctional design is evident. One of its primary functions was likely related to storage, supported by the two vaulted structures that appear to have been constructed specifically for this purpose. The market complex exhibits structural adaptations reflective of its multifunctional use, with storage units and upper-level spaces designed to meet differing load requirements. It is well-known that storage structures typically have thicker walls to withstand the pressure exerted by the grain stored within (Rickman, 1971, p. 2). Accordingly, the ground-level storage units in this complex feature walls measuring 75–110 centimeters in thickness, designed specifically for storage purposes. By contrast, the walls of the superstructure, likely functioning as shops or perhaps an inn, measure only approximately 45–55 centimeters in thickness, reflecting the reduced structural demands of these spaces (Figure 10).

Despite its significance as an important Late Antique structure within the settlement, the market complex has remained largely unstudied, with Hill's brief remark being the only reference

Figure 8. *Plan (left) and aerial photo (right) of the Yanıkhan market and storage complex.*

Figure 9. *Interior views of underground storages: North storage (left) and south storage (right).*

Figure 10. *North wall of the market building.*

to its existence, noting a central marketplace and a three-storeyed public building (Hill, 1996, p. 256). Although the exact function of the potential section comprised of sequential rooms is difficult to ascertain, it is highly likely that this area served as a public market within the settlement.

The existence of such a large-scale structure within this medium-sized settlement highlights its importance, offering insights into storage systems and possibly commercial activities. Rather than functioning solely as a self-sufficient rural unit, the settlement may have played a wider role in its micro-region, supporting not only its own population but also nearby communities. Its religious, social, and economic features suggest a level of organizational complexity that, while modest in scale, extends beyond what is typically expected from a small village.

5. General evaluations on the settlement layout - classifying and defining Yanıkhan

Rural settlements in Late Antiquity were small to medium sized communities sustained by agriculture and pastoralism. Despite their challenging environments, such as the rugged terrain of Rough Cilicia, they played a significant role in local economies and maintained connections with urban centers through trade, religion, and administrative networks. Their resilience reflected an ability to blend long-standing traditions with adaptive innovations, enabling them to endure socio-economic changes.

Churches, as central institutions, served both religious and socio-economic functions. In Rough Cilicia, they symbolized authority and continuity while also stabilizing local economies through land ownership and agricultural production. These structures were integral to the community, offering both spiritual and material support during periods of crisis.

Yanıkhan reflects the impact of Christianization during Late Antiquity. Christianity brought significant changes to the social structure, leading to architectural transformations in the settlement. However, these changes did not erase earlier elements; instead, new structures were layered upon existing ones, enriching the architectural fabric. The settlement features two main churches and a monumental market building, all constructed in the same period. These churches and the market building became central to both the physical and social organization of Yanıkhan. The churches served as places of worship and community centers, while the market structure likely supported storage and commercial activities. Together, these structures organized the social and economic life of the settlement. Yanıkhan, therefore, exemplifies a transformation that integrates old and new elements, highlighting the evolution of rural settlements in Late Antiquity, especially as a modest rural example. Its layered architectural fabric, combining pre-Christian and Christian elements, illustrates both the resilience of traditional settlement pat-

terns and the adaptability of local communities to new religious, social, and economic realities.

Although many rural settlements within the same micro-region exhibit common construction periods and share similar building materials and techniques—particularly the use of local limestone and traditional masonry—there are also notable differences in terms of site scale, functional diversity, architectural detailing, the number of churches, and preservation levels. For example, settlements like Karakabaklı and Işıkkale feature more refined masonry in domestic buildings, which may suggest the presence of wealthier households (Varinlioğlu, 2008a, 2008b). In contrast, the absence of Late Antique structures in Adamkayalar and Mancınıkkale implies that these settlements may have been abandoned earlier or did not undergo a phase of transformation. At Takkadın, the presence of a medieval fortification (Özdizbay & Dinçer, 2018, pp. 173–174) indicates a reorganization of the settlement with a defensive function, while Kanlıdivane (ancient Kanytella), with its multiple churches, clearly functioned as a regional religious center (Eyice, 1976; Eyice, 1980). These selected examples illustrate how settlements subject to similar environmental and historical conditions can nonetheless develop diverse architectural and social configurations. While this discussion includes only a few representative cases, the broader region exhibits a wide range of rural settlement types that reflect both continuity and transformation. In this context, Yanıkhan occupies a significant position—not only as a representative case of rural resilience but also as a site with distinct spatial and functional characteristics that merit close study.

In addition to religious and residential structures, some rural settlements in the region also contain towers, indicating a spatial organization shaped by strategic positioning. Some of these towers were originally built in the Hellenistic period and continued to be used during Late Antiquity, often undergoing renovations. One of the most prominent examples is the tower at Uzuncaburç. Others, such as the Gökburç structure in the Ovacık settlement, appear to have been constructed anew during the Late Antique period. The continued use or construction of these towers suggests a persistent need for surveillance, defense, or symbolic authority in the rural landscape and reflects local concerns for security and control. The absence of such structures in Yanıkhan, contrasted with their presence at strategic sites, also highlights the variability within the micro-region and underlines the importance of localized factors in shaping rural settlement patterns.

The question of how rural settlements in mountainous Cilicia should be defined is central to this discussion. In this respect, the terminology used in Byzantine sources—such as kome, chorion, or polis—offers valuable insight into how these places were conceptualized during their active periods.

In distinguishing between urban and rural areas in mountainous Cilicia, Prokopius's definition of a "polis" provides valuable insight. According to Prokopius, for a settlement to be considered a polis, it must contain public structures such as baths, fortifications, churches, and cisterns, which serve both functional and symbolic roles in defining urban space (Procopius, 1940, On Buildings, 2.10.22). While urban settlements in mountainous Cilicia might be marked by these communal structures and greater social complexity, rural settlements often lack such extensive public infrastructure, presenting challenges in applying a uniform classification across all rural areas. The presence of churches or their number, settlement size, proximity to main roads, interrelations with neighboring settlements, economic foundations, and defensive features are critical factors for distinguishing between different types of rural settlements. For instance, a rural settlement with multiple churches may serve as a religious hub for surrounding villages, granting it a more central role within the local network. Likewise, rural settlements connected to main routes or fortified areas may hold additional economic or strategic importance, differentiating them from more isolated, smaller-scale farming communities. Therefore, categorizing rural settle-

ments in mountainous Cilicia requires a nuanced approach that considers their geographical location, social functions, and economic activities, rather than a one-size-fits-all classification.

In the Byzantine period, rural settlements were classified by various terms according to their functions and sizes, with the concepts of kome and chorion standing out in this context. Initially, the term kome was used mainly in narratives and stories; however, from the 3rd century onward, it began to appear more widely in written texts to describe rural settlements (Kazhdan, 1997, pp. 43–44). The term kome generally refers to smaller and modest settlements that primarily subsisted on agricultural activities. These settlements were dependent on administrative and religious centers and did not possess economic independence. Additionally, kome-type settlements had limited production and commercial activities, though they maintained connections with larger centers in the rural landscape (Lefort, 2002, pp. 235–238). In contrast, chorion described economically developed settlements with connections to nearby villages and played a central role in the rural landscape (Haldon, 1999, pp. 102–104; Harvey, 1989, pp. 52–55). These concepts provide a fundamental framework for understanding the social and economic organization of rural Byzantine society.

Additionally, studies reveal that terms like metrokomia and komepolis have been used to describe mixed settlement models that, while primarily rural, incorporated certain urban characteristics. Morrisson and Sodini (2002, p. 179) observe that such settlements combined rural and urban features; for example, a village with multiple churches could serve as a religious center for surrounding villages, thereby assuming a more central role within the local network. Similarly, rural settlements connected to major roads or fortified by walls could hold greater economic or strategic importance compared to isolated agricultural communities. Kazhdan also references such settlements under the term komepolis, describing these mixed-function settlements as incorporating both rural and urban elements (Kazhdan, 1991, p. 2168).

In the case of Yanıkhan, it can be suggested that the settlement was not limited to agricultural production but also functioned as a religious center, potentially serving as an attraction point in the region. In this respect, Yanıkhan might be distinguished from smaller kome settlements in terms of its social and economic significance. However, the academic debate remains open regarding the most appropriate classification for a settlement of this scale and function. Given its religious, commercial, and social connections to other surrounding settlements, Yanıkhan may be considered an important settlement that combines village-city characteristics within the Byzantine rural system and could possibly be categorized under the term komepolis. In this respect, Yanıkhan not only provides insight into a specific rural community but also offers a lens through which broader regional dynamics and classification challenges in Late Antique Rough Cilicia can be better understood.

6. Conclusion

In the case of Yanıkhan, it appears that the settlement was not solely focused on agricultural production but also played a role as a religious hub, possibly acting as a focal point of interest within the region. Yanıkhan embodies the persistence, adaptability, and layered transformation of rural settlements, revealing the vital role these communities played in the social and economic structure of the Byzantine world. From its origins in the Hellenistic period through the transformations of Late Antiquity, Yanıkhan offers a nuanced perspective on how a rural settlement could navigate and adapt to historical shifts while preserving a unique identity. The largely preserved Hellenistic grid plan, together with the integration of ecclesiastical architecture, underscores Yanıkhan's capacity to balance continuity with change, maintaining a cohesive settlement framework across centuries.

Set within the challenging terrain of Rough Cilicia, Yanıkhan's resilience speaks to the strength of its inward-focused economy, rooted in agriculture and resourcefulness. This self-suffi-

ciency, along with its strategic location and connections with nearby settlements, enabled Yanıkhan to endure external pressures and remain a cohesive community. In contrast to larger urban centers, Yanıkhan is a representative example of the settlements of the aforementioned micro-regional model where both economic stability and social cohesion were achieved without the fortifications or extensive public infrastructures typical of larger Byzantine towns.

Yanıkhan's evolution reflects broader patterns of rural resilience and transformation, but it also offers insights specific to the unique socio-economic fabric of Cilicia. Through the lens of komepolis, or village-city, Yanıkhan's structure merges rural stability with certain urban characteristics, suggesting a model of settlement that defies simple classifications. This blend of roles illustrates a complex rural landscape, where Christianization introduced new forms of social and architectural organization that harmonized with existing traditions rather than replacing them outright.

Such resilience—evident in both architectural adaptation and socio-economic continuity—demonstrates how local communities negotiated long-term change while maintaining functional coherence. Yanıkhan thus provides a grounded example of how resilience and adaptability were spatially and materially manifested in marginal landscapes of the Byzantine countryside.

Moreover, the comprehensive architectural documentation carried out in this study contributes to the visualization of rural transformation across time. The mapping of elevation levels, spatial organization, and building typologies not only strengthens our understanding of Yanıkhan itself but also provides a methodological framework for assessing other rural sites with similar diachronic layering.

As such, this case highlights the importance of fine-grained, site-specific studies in revealing the diversity and complexity of rural settlement patterns in Late Antiquity.

Its rich architectural layering and spatial coherence provide critical material for future comparative studies on rural adaptation and continuity. Future research and excavations in Yanıkhan and similar settlements will be crucial for uncovering the micro-regional dynamics of Rough Cilicia that sustained these communities and furthering our understanding of the diverse Byzantine countryside.

Endnotes

[1] Hild and Hellenkemper generally dated the churches in Rough Cilicia to the late 5th or early 6th century (Hild & Hellenkemper, 1986, pp. 80–85). As an alternative interpretation, Hill suggested that the churches in the Yanıkhan settlement might date back to the late 4th century, basing his argument on an inscription he identified on the lintel block at the main entrance from the narthex to the naos of the South Church (Hill, 1985, pp. 93–97; Hill, 1996, pp. 256–262). Hill believed that this inscription might bear the name of Matronianus, Comes Isauriae, mentioned in Codex Theodosianus IX.27.3, a 5th-century collection of Roman laws issued under Emperor Theodosius II. Later, Arabella Cortese re-evaluated this inscription, suggesting that the Southern Church could be associated with local saints such as Saint George, Konon, Christopher, Kerykos, and Ioulitta. These saints were known as important protective figures in the region and played a significant role in worship practices during their active period, making it likely that the church could have attracted visitors from the surrounding areas if it was popular as a sacred site (Cortese, 2022, pp. 179–184).

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