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YILDIZ TECHNICAL UNIVERSITY
GRADUATE SCHOOL OF SCIENCE AND ENGINEERING

A DIGITAL GAME-BASED PARTICIPATORY TOOL: EXPERIENCES FROM PERŞEMBE PAZARI PUBLIC SPACE DESIGN

Fatih Mehmet GÜLER

MASTER OF SCIENCE THESIS

Department of Applied Urban Science and Urban Innovation

Program of Applied Urban Science and Urban Innovation

Supervisor

Assist. Prof. Dr. Deniz ERDEM OKUMUŞ

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A thesis submitted by Fatih Mehmet GÜLER in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE** is approved by the committee on 16.07.2025 in Department of Applied Urban Science and Urban Innovation, Applied Urban Science and Urban Innovation (English) Program.

Assist. Prof. Dr. Deniz ERDEM OKUMUŞ
Yildiz Technical University
Supervisor

Approved By the Examining Committee

Assist. Prof. Dr. Deniz ERDEM OKUMUŞ, Supervisor
Yildiz Technical University _____

Assoc. Prof. Dr. Erhan KURTARIR, Member
Yildiz Technical University _____

Assoc. Prof. Dr. Bahar AKSEL ENŞİCİ, Member
Mimar Sinan Fine Arts University _____

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Fatih Mehmet GÜLER

Signature

Dedicated to my family

and gamers

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Fatih Mehmet GÜLER

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LIST OF SYMBOLS

CoPoint	Carbon emission score of an urban object/design
Happiness	Satisfaction index reflecting stakeholder preferences
MoneyValue	Monetary cost assigned to an urban object
NeedWater	Water consumption value of an urban object/design
n	Number of observations/participants
%	Percentage

LIST OF ABBREVIATIONS

AI	Artificial Intelligence
AR	Augmented Reality
BIM	Building Information Modeling
CAD	Computer-Aided Design
GIS	Geographic Information System
ICT	Information and Communication Technology
NGO	Non-Governmental Organization
R&D	Research and Development
SDG	Sustainable Development Goals
UN	United Nations
VR	Virtual Reality

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ABSTRACT

A Digital Game-Based Participatory Tool: Experiences From Perşembe Pazarı Public Space Design

Fatih Mehmet GÜLER

Department of Applied Urban Science and Urban Innovation
Program of Applied Urban Science and Urban Innovation
Master of Science Thesis

Supervisor: Assist. Prof. Dr. Deniz ERDEM OKUMUŞ

Public spaces are dynamic environments where different segments of society come together, offering opportunities for interaction and collaboration. However, these spaces also carry the risk of prioritizing the interests of some groups and underrepresenting the demands of others. This situation reveals the necessity of inclusive participatory approaches to ensure equal representation in urban design processes. The complexity of urban spaces has highlighted game methods as a promising approach to encourage participation that includes the perspectives of different stakeholders. Game-based approaches fill the gaps in traditional participation methods by enabling participants to express themselves, collaborate and create a common language.

However, existing participatory tools often fall short in producing data-driven results; this results in the loss of participatory inputs and prevents their effective use in urban design processes. Furthermore, the fact that participatory results are limited to physical documents prolongs the evaluation process and can have irreversible effects when implemented in design practices. These limitations

increase the need for innovative solutions that combine data-driven insights with participatory methods.

In this context, UrbanPlexity supports social sustainability through participation, economic sustainability through cost awareness, and environmental sustainability by promoting eco-friendly choices. It offers potential to guide participatory urban design in line with sustainability principles.

The research adopts a multi-layered research methodology that integrates literature review and theoretical framework development, digital tool development, pre-game interviews, practical testing of the tool, and post-game interviews and evaluation of game results. The findings show that serious games not only increase awareness but also foster engagement and provide preliminary input that supports more inclusive and sustainability-oriented urban decision-making. As a result, serious games like UrbanPlexity have the potential to support more inclusive participatory processes by facilitating connections between decision-makers, technical experts, and the public.

Keywords: Participatory urban design, Complexity, Data-driven design, Gamification, Serious game.

ÖZET

Kamusal Mekân Tasarımı için Dijital Oyun Tabanlı Katılımcı Bir Araç: İstanbul Karaköy Perşembe Pazarı Deneyimi

Fatih Mehmet GÜLER

Uygulamalı Kent Bilimi ve Kentsel İnovasyon Anabilim Dalı

Uygulamalı Kent Bilimi ve Kentsel İnovasyon Programı
Yüksek Lisans Tezi

Danışman: Dr.Öğr.Üyesi Deniz ERDEM OKUMUŞ

Kamusal alanlar, toplumun farklı kesimlerinin bir araya geldiği, etkileşim ve iş birliği olanaklarının ortaya çıktığı dinamik mekânlardır. Ancak, bu alanlar bazı grupların çıkarlarının önceliklendirilmesi ve diğer grupların taleplerinin yeterince temsil edilmemesi riskini de barındırır. Bu durum, kentsel tasarım süreçlerinde eşit temsiliyeti sağlamak amacıyla kapsayıcı katılım yaklaşımlarının gerekliliğini ortaya koymaktadır. Kentsel alanların karmaşıklığı, farklı paydaşların bakış açılarını içeren katılımı teşvik etmede oyun temelli yöntemleri umut vadeden bir yaklaşım olarak öne çıkarmıştır. Oyun tabanlı yaklaşımlar, katılımcıların kendilerini ifade etmelerini, iş birliği yapmalarını ve ortak bir dil geliştirmelerini sağlayarak geleneksel katılım yöntemlerindeki boşlukları doldurmaktadır.

Bununla birlikte, mevcut katılım araçları çoğu zaman veri temelli çıktılar üretme konusunda yetersiz kalmakta; bu da katılımcı girdilerin kaybolmasına ve kentsel tasarım süreçlerinde etkin biçimde kullanılmalarının engellenmesine yol açmaktadır. Ayrıca, katılım sonuçlarının yalnızca fiziksel belgelerle sınırlı kalması değerlendirme sürecini uzatmakta ve tasarım uygulamalarında geri

döndürülemez sonuçlara neden olabilmektedir. Bu sınırlılıklar, katılım yöntemlerinin veri temelli içgörülerle bütünleştirilmesini sağlayan yenilikçi çözümlere olan ihtiyacı artırmaktadır.

Bu bağlamda, UrbanPlexity, sosyal sürdürülebilirliği katılımla, ekonomik sürdürülebilirliği maliyet farkındalığıyla ve çevresel sürdürülebilirliği çevre dostu tercihleri teşvik ederek desteklemektedir. Bu yönleriyle araç, katılımcı kentsel tasarımı sürdürülebilirlik ilkeleri doğrultusunda yönlendirme potansiyeline sahiptir.

Araştırma, kuramsal çerçeve oluşturma ve literatür taramasının yanı sıra dijital araç geliştirme, oyun öncesi mülakatlar, aracın pratik uygulaması ve oyun sonrası mülakatarı ve değerlendirme süreçlerini içeren çok katmanlı bir metodoloji benimsemektedir. Bulgular, ciddi oyunların yalnızca farkındalığı artırmakla kalmayıp, aynı zamanda katılımı teşvik ettiğini ve daha kapsayıcı ve sürdürülebilirliğe odaklanan kentsel karar alma süreçlerini destekleyen ön veriler sağladığını göstermektedir. Sonuç olarak, UrbanPlexity gibi ciddi oyunlar, karar vericiler, teknik uzmanlar ve halk arasında köprü kurarak daha kapsayıcı katılım süreçlerini destekleme potansiyeline sahiptir.

Anahtar Kelimeler: Katılımcı kentsel tasarım, Karmaşıklık, Veri odaklı tasarım, Oyunlaştırma, Ciddi Oyun.

The transformation of public spaces in today's cities is increasingly intertwined with discussions around democracy, inclusiveness and sustainability. With the density and diversification of urban environments, the design of these shared spaces is no longer seen as the sole responsibility of experts, but rather as a process that requires the participation of multiple stakeholders. This transformation reflects a growing awareness that citizens, municipal authorities, designers and community actors must jointly shape a built environment that reflects local needs, cultural dynamics and long-term ecological concerns.

At the same time, the question of how these inclusive ideals will be embodied in practical planning contexts has not yet been clarified. Traditional participation tools such as public meetings, interviews and design workshops are inadequate in terms of expressing different voices, providing a basis for meaningful discussions and transforming feedback into design outcomes. These methods appear to be time-consuming, technocratic and difficult to access, especially for communities with low design literacy or limited institutional power. As a result, participation may become merely symbolic, reinforcing existing power asymmetries rather than promoting genuine inclusion.

Instead of relying solely on conventional methods that often fail to secure meaningful public involvement, this study focuses on the use of digital tools that incorporate game mechanics to structure and enhance participatory processes in urban design. Serious games, designed with the intention of facilitating decision-making and conveying complex ideas through interactive scenarios, allow users to engage with spatial configurations, observe the consequences of their choices, and express their preferences in a more tangible and comprehensible way. While serious games have found widespread use in areas such as education and health, their methodological contribution to urban design has yet to be systematically explored through practice-based research.

This study addresses this gap by proposing and testing a serious game titled UrbanPlexity, designed to enhance participatory decision-making in the context of public space design. By transforming abstract urban planning concepts into interactive experiences, UrbanPlexity enables diverse actors to meaningfully engage with the design process, generate data-rich feedback, and contribute to more inclusive, transparent, and sustainability-oriented planning outcomes. In

doing so, the research positions serious games as a promising mechanism to connect decision-makers, experts, and the public, while advancing theoretical and practical understandings of digital participation in urban contexts.

1.1. Problem Statement

In contemporary urban planning practice, public space design increasingly demands participatory approaches that are inclusive, transparent, and responsive to diverse stakeholder needs. However, traditional participatory methods often fall short in fostering meaningful engagement due to their time-consuming nature, lack of interactivity, limited inclusiveness, and weak visualization of design outcomes. These shortcomings are particularly pronounced in complex urban environments like Istanbul, where socio-spatial inequalities and contested public spaces hinder participatory urban decision-making.

At the same time, advances in digital technologies and game-based methodologies offer new opportunities to rethink participatory planning processes. Serious games and digital gamification strategies have demonstrated potential in fields like education, health, and environmental governance, yet their integration into urban design remains underexplored and methodologically fragmented. While emerging examples (e.g., Minecraft-based participatory tools) show promise, there is still a lack of context-specific, evidence-based digital tools that translate participatory design processes into actionable and sustainable spatial outcomes, particularly in rapidly urbanizing and socially complex cities.

This research addresses this gap by developing and testing UrbanPlexity, a digital serious game designed as a participatory tool for public space configuration. Through a case study of Karaköy Perşembe Pazarı, the study critically examines how game-based mechanics, multi-actor engagement, and urban design metrics can be synthesized into a digitally mediated framework that promotes inclusive, creative, and sustainable public space development. The project seeks to evaluate the potential of this system software to improve planning, expand the scope and promote climate sensitive design. The game is framed as both a technical solution and a combined democratic disruptive governance.

1.2. Aim and Objectives

The central aim of this thesis is to investigate the potential of gamified digital environments in enhancing participatory urban design processes. In this context, the study investigates whether serious games that are designed for specific purposes, have structured interactions and produce real-world results are effective tools for strengthening dialogue among different stakeholders in the city and increasing citizen participation. The research positions UrbanPlexity, a digital participatory game developed by the author, as an experimental model to understand whether play-based interaction can support inclusive and sustainable spatial decision-making.

Building on this aim, the thesis seeks to assess how game mechanics can operate concepts such as co-creation, multi-actor collaboration, and informed decision-making in a participatory setting. Focusing on the example of Perşembe Pazarı in the Karaköy district of Istanbul, the study examines how participants with different social and professional backgrounds engage in urban design scenarios in a goal-oriented and simulated digital environment. Through pre- and post-game evaluations, it becomes possible to trace shifts in perceptions, agency, and contributions of participants across categories such as citizens, municipal actors, experts, and NGOs.

The overarching objective is to develop a methodological and conceptual model that situates digital serious games not merely as engagement tools but as frameworks capable of producing qualitative and spatial data to inform planning practices. In this way, the thesis contributes to the ongoing debate on digital participation by proposing a new platform, the "Participatory Input" approach, which lies between symbolic and powerful forms of participation. This structure is envisioned as a bridge between expert-led planning and citizen-informed decision-making, where design knowledge is neither diluted nor monopolized, but guided by pluralistic input collected through structured gameplay.

1.3. Research Questions and Hypothesis

This research examines the potential of gamification, particularly through a digital serious game, and aims to reveal its contributions to participatory urban design in the context of strengthening stakeholder participation, facilitating inclusive decision-making processes, and supporting sustainability-oriented urban development. The main objective is to investigate how a game-based approach can not only foster collaboration among different urban actors, such as citizens, designers, and policy makers, but also serve as a participatory tool that can produce informed, fair, and sustainability-oriented design outcomes.

The study examines whether integrating serious games into urban design processes can overcome the limitations of conventional participation methods by offering a more interactive, accessible, and engaging environment for stakeholder interaction.

The fundamental question that guides this research is: How can a serious game enhance participatory urban design processes by encouraging stakeholder participation, facilitating collaboration, and supporting sustainability-oriented decision-making processes? This fundamental question paves the way for examining how gamification techniques can contribute to more democratic design processes by enabling the active participation of multiple actors and enabling them to consider environmental, economic, and social dimensions of urban sustainability. The research conducted from this perspective aims to determine to what extent serious games can support inclusive and self-reflexive urban design processes.

The research further explores specific aspects of the application of serious games in participatory urban design. One area of inquiry concerns the limitations and challenges of implementing such tools, including potential technological, social, or institutional barriers that may affect their efficacy or accessibility. Another critical dimension involves evaluating how well the serious game can integrate principles of sustainability into the decision-making process, encouraging participants to approach public space design with greater awareness of long-term environmental, economic, and social impacts.

Additionally, the study seeks to understand to what extent serious gaming can improve participants' ability to express and refine their design ideas, particularly for individuals with limited technical knowledge or design experience, thereby enhancing their comprehension of public space planning and empowering them to engage more confidently in participatory processes, even in non-participatory settings.

Based on this framework, the study hypothesizes that incorporating gamification into participatory urban design through a user-friendly, engaging, and voluntary tool can establish a sustainable feedback mechanism. This mechanism is expected to foster a deeper understanding of urban sustainability, strengthen inclusive stakeholder involvement, and empower participants to make more informed, reflective, and responsible design decisions. Through this hypothesis, the study positions digital serious games as transformative tools capable of redefining participatory planning practices and contributing meaningfully to the development of more resilient, equitable, and sustainable urban environments.

1.4. Thesis Methodology and Structure

This thesis adopts a multi-layered research methodology that integrates literature review and theoretical framework development, digital tool development, pre-game interviews, practical testing of the tool, and post-game interviews and evaluation of game results. Positioned at the intersection of sustainability, participatory urban design, gamification, and data-based decision support mechanisms, this study investigates how serious game UrbanPlexity can function as a participatory design tool that supports a more inclusive, sustainable, and data-driven urban planning practice. The methodological framework enables the creation, implementation, and critical evaluation of a digital participatory environment that combines conceptual and practical dimensions. Based on the Karaköy Perşembe Pazarı case study, this approach allows for the exploration of how diverse stakeholders interact within a simulated planning environment, providing insights into their spatial strategies, sustainability priorities, and perceptions of participatory engagement.

As shown in Figure 1.1, the research process is structured in five interconnected phases: defining the problem and generating research questions and hypotheses,

reviewing the literature and developing the conceptual framework, designing the gamified research model, implementing the game, and finally evaluating the results. These phases form a coherent flow that moves the project from conceptual inquiry to applied validation and synthesis. Each phase builds directly on the previous one, providing an iterative structure for developing, implementing, and evaluating the UrbanPlexity tool.

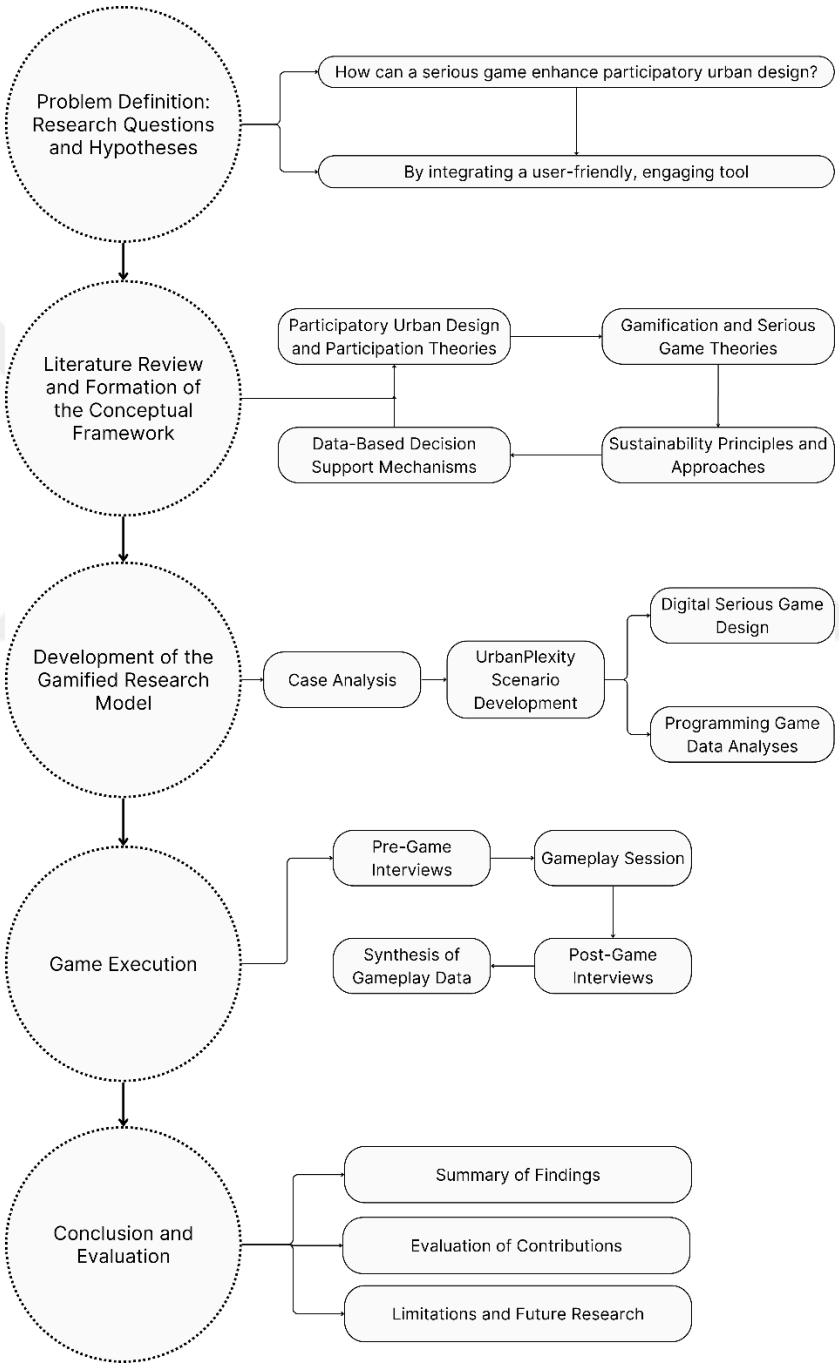

Figure 1.1 Main **s**tages of UrbanPlexity **r**esearch **f**ramework

In the first stage, the problem is defined by determining the main research question and hypothesis. The research question asks how a serious game can strengthen participatory urban design processes by encouraging stakeholder participation, facilitating collaboration and supporting sustainability-oriented decision-making processes. The hypothesis suggests that a user-friendly, interactive and voluntary gamification tool can create a sustainable feedback mechanism in participatory urban design processes, which will strengthen stakeholder participation, provide a better understanding of urban sustainability and enable participants to make more conscious, questioning and responsible design decisions.

In the second stage, a conceptual framework is created through a comprehensive literature review. This framework brings together participatory urban design and participation theories, gamification and serious game theories, sustainability principles and approaches, and data-based decision support mechanisms. These conceptual foundations provide an analytical ground for evaluating UrbanPlexity and addressing its contribution to participatory design processes from a comprehensive perspective.

The third phase focuses on the development of a gamified research model. This model includes the analysis of the spatial, social and political context of the Karaköy Perşembe Pazarı, the development of the UrbanPlexity scenario, the design of a digital serious game and the programming of analysis tools that ensure methodological rigor and data compatibility. Thus, conceptual insights are transformed into a functional and interactive simulation platform, supported by data analysis and visualization processes.

The fourth phase is the game implementation process, which involves testing UrbanPlexity with different stakeholder groups (citizens, municipality representatives, designers and NGO actors) in a structured environment. This phase includes preliminary interviews to understand the perceptions and expectations of the participants, practices that ensure recording of spatial and sustainability-focused decisions taken during the game, and interviews to understand the learning experiences and attitude changes of the participants after the game. The qualitative and quantitative data collected in this phase form a comprehensive basis for the final evaluation.

In the final stage, the findings are integrated, and the overall contributions of the thesis are critically evaluated. This evaluation includes summarizing the main insights, analyzing the contributions of UrbanPlexity to participatory design practice and sustainability-oriented planning, discussing the limitations of the study, and suggesting future research directions. Thus, the thesis not only develops a new participatory design tool but also provides a methodologically rigorous and holistic academic framework.

1.5. Novelty and Impacts

This thesis makes significant contributions to urban design and planning practice by proposing an innovative and game-based participatory approach. The integration of UrbanPlexity as a serious game tool demonstrates that interactive and data-driven platforms can create more inclusive and sustainable design processes. By transforming complex urban dynamics into accessible, scenario-based challenges, this study advances the role of participatory methods in creating more equitable and participatory design decisions.

In terms of academic contribution, this thesis enriches the literature in participatory urban design and gamification, merging these two previously separate research areas. It systematically brings together theoretical perspectives on participation, serious games, and data-driven decision-making through a detailed case study application. This dual focus not only advances theoretical discussions but also provides empirical evidence on the effectiveness of serious games in urban design, providing a replicable framework for future research.

In terms of decision-making processes, the thesis highlights how serious games can function as a decision support system that fosters dialogue, negotiation, and compromise among different stakeholders. By recording real-time data and participant interactions, UrbanPlexity provides a transparent and dynamic feedback loop that increases the legitimacy and inclusiveness of design decisions. This finding shows that serious games can complement and enhance traditional planning mechanisms.

The thesis also contributes to urban design and planning education by proposing a model based on role-playing and experiential learning. UrbanPlexity can be

adapted as an educational tool to help students and experts better understand the trade-offs and sustainability impacts of design decisions. The game experience includes participatory dynamics, sustainability metrics, and data-driven design, reinforces critical thinking and participatory problem-solving skills.

From a sustainability perspective, the thesis demonstrates how digital tools can support spatial decision-making processes that integrate environmental, social, and economic dimensions. By encouraging participants to consider the interconnected impacts of design choices, UrbanPlexity contributes to the formation of a holistic and sustainable urban development culture. The study also shows how serious games can contribute to the development of institutional and societal capacity for governance focused on sustainability.

This study also addresses the broad implications for local democracy and governance and provides a platform for implementing participatory decision-making processes. UrbanPlexity functions as a participatory tool that brings together different actors such as citizens, designers, municipal representatives and civil society organizations to contribute to a common decision-making process. This approach strengthens the principles of local democracy and good governance by increasing trust, transparency, and collective ownership of urban outcomes.

Additionally, the thesis expands the role of data-driven analysis in participatory processes. The integration of R-based analysis tools and spatial visualizations provides a deeper understanding of design trends, performance indicators, and stakeholder preferences. This data-centric approach increases the transparency and accountability of participatory outcomes and paves the way for evidence-based urban planning.

Finally, the thesis demonstrates how technological and contemporary approaches, such as gamification and data-driven analysis, can enrich the theoretical and practical frameworks of the urban design discipline. By combining these innovative methodologies with established participatory practices, UrbanPlexity offers a forward-looking model that aligns with professional and societal needs.

2
PARTICIPATORY URBAN DESIGN: PRINCIPLES AND METHODS

This section of the thesis examines the conceptual foundations, historical evolution, and methodological developments of participatory urban design. By drawing upon a wide body of interdisciplinary literature, it first introduces the theoretical basis of participatory design, tracing its emergence as a response to the limitations of technocratic and top-down planning practices. The discussion begins with foundational frameworks such as Arnstein's Ladder of Participation (Arnstein, 1969), Burke's participation strategies (Burke, 1968), and Habermas's theory of the public sphere (Habermas et al., 1964), establishing the intellectual backdrop against which participatory planning has evolved.

Following this, the section explores the relationship between public space and the public sphere, paying particular attention to how civic engagement is both enabled and constrained by physical and digital environments. The redefinition of participation in the context of data-driven and digitally mediated tools is critically examined, with reference to contemporary tools such as serious games, interactive systems, and participatory computing. These discussions highlight the shifting nature of collective authorship and the need for transparent, responsive infrastructures that enable inclusive decision-making in urban contexts.

The final part of the section is dedicated to a comparative review of conventional and contemporary participatory approaches. This approach aims to promote dialogue-oriented planning, mutual learning and the empowerment of the citizen agency by emphasizing newer, co-productive and technologically empowered frameworks, compared to older models of consultation that were often characterized by limited citizen influence and bureaucratic formality. Through this multi-layered examination, the chapter provides a comprehensive understanding of participatory urban design not as a singular methodology but as a dynamic and evolving field shaped by social, political, and technological transformations.

2.1. Participatory Urban Design Theory

The concept of participatory urban design emerged as a response to the limitations of top-down planning practices, particularly during the second half of the twentieth century. One of the earliest contributions, by Godschalk & Mills (1966), emphasized the importance of integrating communities not merely as beneficiaries but as active participants in shaping their built environment. Shortly thereafter, Burke (1968) proposed a multi-dimensional view of citizen participation, highlighting its potential as a stabilizing, educational, and transformative strategy within governance processes. Building upon these ideas, Arnstein (1969) developed the influential "Ladder of Citizen Participation," which introduced a critical framework for assessing degrees of public power, ranging from symbolic involvement to genuine citizen control. These foundational studies advocate a planning paradigm shift from centralized decision-making mechanisms to participatory processes where the balance of power is more fairly shared.

As these perspectives gained traction, new models of participation were developed. Callahan (2007), for instance, outlined representative participation frameworks in which elected officials and experts make decisions on behalf of constituents. In contrast, theorists like Stivers (1990) insisted that citizens are the rightful proprietors of governance, demanding direct involvement in decision-making processes. However, participation is not merely about formal inclusion. As Day (1997) noted, it entails negotiating power asymmetries, diverse interests, and entrenched social exclusions. These dynamics reveal the inherent complexity of participatory urban design and emphasize that procedural openness alone is insufficient without mechanisms to ensure meaningful influence and transparency.

Recent studies have re-evaluated these earlier paradigms in the context of growing digitalization, urban complexity, and participatory fatigue. For example, Ataman and Tuncer (2022) criticize the prevailing use of participation tools that prioritize data collection while offering limited transparency on how this data is later used in planning decisions. Similarly, Anthony (2023) identifies the difficulty of multi-stakeholder collaboration due to informational imbalances and the fragmentation of responsibilities. These barriers contribute to the inefficiency and superficiality of many participation processes, where inclusion may be simulated rather than substantive. Moreover, Dias et al. (2018) and Steiner an Markantoni, (2014) warn

of the “overload” and alienation that often result from traditional, hierarchical planning models that fail to accommodate the nuanced needs of diverse actors.

To address these challenges, scholars have emphasized the need for adaptive, inclusive, and knowledge-generating participation frameworks. Kahila-Tani et al. (2019) identify three critical areas: the development of effective participatory arrangements, the inclusion of broad demographic groups, and the production of versatile, high-quality knowledge. In line with this, Gutiérrez et al. (2017) propose reconceptualizing citizens, universities, and civil society actors as co-producers of urban services and innovations, rather than passive stakeholders. Participatory urban design thus represents a shift from procedural consultation to strategic partnership, grounded in shared authority, mutual trust, and collective responsibility. It is through this reorientation that more equitable, sustainable, and context-sensitive urban futures can be achieved.

2.2. Public Sphere and Participation

The public sphere, as conceptualized by Habermas (1964), represents a domain where individuals convene to engage in rational-critical discourse, thereby influencing societal norms and political decisions. Historically, this sphere was embodied in venues like salons and coffeehouses, serving as arenas for democratic deliberation. However, critiques have highlighted the exclusivity of this bourgeois public sphere, noting its limitations in encompassing diverse voices, particularly those of marginalized communities. In response, scholars such as Fraser (1990) have introduced the notion of "counter publics" advocating for multiple overlapping public spheres that accommodate varied social groups and perspectives.

In contemporary urban settings, public spaces function as tangible manifestations of the public sphere, facilitating interactions among diverse populations. These spaces are instrumental in promoting social cohesion by enabling everyday engagements, cultural exchanges, and communal activities. Recent studies have underscored the significance of well-designed public spaces in enhancing social bonds, with factors like accessibility, safety, and inclusivity playing crucial roles in fostering a sense of community among residents.

The advent of digital technologies has transformed the boundaries and practices of the traditional public sphere, enabling new configurations for civic interaction. Digital tools now serve as extended arenas for participation, particularly through virtual forums, augmented reality, and serious gaming environments. Bai et al. (2018a) demonstrate how interactive gaming systems can be employed to collect citizen preferences and generate adaptive spatial layouts through algorithmic processing, effectively embedding civic input into urban decision-making. Their research illustrates that, when supported by visual feedback and real-time interaction, such systems can lower the barrier for public involvement while enhancing deliberative quality. Moreover, the use of collective data structuring in their approach reflects the broader shift toward user-centered urban information systems, where each participant's decision contributes to a collectively optimized design outcome defining the digital public sphere as an interactive space of negotiation.

This redefinition of participation aligns with earlier theoretical work by Friedman and Negroponte on participatory computing and user-driven architecture. Friedman's "spatial dictionary" and Negroponte's "Soft Architecture Machines" (Vardouli, 2012) both proposed that user authorship, supported by computational frameworks, could generate more responsive built environments. The study by Bai et al. (2018b) revives and operationalizes these visions through contemporary digital tools, proving that design computation is now capable of integrating large-scale public preferences into spatial decision-making. Similarly, the "Urban Gallery" method developed at TU Berlin by Bouskela et al. (2016) combines physical and digital interfaces to facilitate negotiation among diverse stakeholders. These examples underscore that, to effectively bridge social gaps in urban settings, public space must be conceived not only as a physical common but also as a data-driven, digitally mediated space for collective authorship. Urban planners, therefore, must not only design for accessibility and inclusion in the physical realm but also invest in transparent, participatory digital infrastructures that allow citizens to meaningfully shape their urban futures.

2.3. Evolution of Participatory Framework

The evolution of participatory frameworks in urban planning reflects broader socio-political shifts, from centralized, expert-led planning to more inclusive, citizen-centered approaches. In the post-war era, planning practices were largely technocratic, rooted in rational-comprehensive models that positioned the planner as the primary decision-maker. However, the growing dissatisfaction with top-down urban interventions, especially in the 1960s and 1970s, paved the way for a re-evaluation of the role of the planner and the development of participatory mechanisms. Arnstein's (1969) study, The Ladder of Citizen Participation, provided a foundational framework for understanding participatory processes by introducing a typology of participation levels, ranging from tokenistic involvement to genuine citizen power. The study highlighted the symbolic nature of many participatory practices and reframed participation as fundamentally linked to the redistribution of power. This critical perspective has since informed and shaped the development of participatory paradigms in planning and governance.

During the late 20th century, new models of participatory planning began to emerge, aiming to institutionalize citizen engagement. The communicative turn in planning theory, championed by scholars like (Healey, 1992), emphasized dialogue, consensus-building, and shared understanding among stakeholders. Healey's advocacy for participatory planning marked a departure from merely inviting citizens into pre-structured decision processes, instead focusing on co-constructing knowledge and values. Similarly, (Innes & Booher, 2010) promoted the idea of "participatory rationality," where power is balanced through inclusive discourse and mutual learning. These frameworks recognized the diversity of public interests and sought to build legitimacy through inclusive deliberation, particularly in contexts where trust in institutions had eroded.

Despite these theoretical advancements, practical implementation of participatory frameworks often lagged. Participation remained limited in scope, frequently dominated by vocal minorities or reduced to consultation without influence. Moreover, structural barriers such as lack of access, institutional stagnation and socio-economic inequalities continued to hinder meaningful participation. Scholars like Fung & Kennedy (2006) responded by proposing adaptable models

such as the “Democracy Cube,” which categorized participation in terms of authority and inclusiveness, offering planners flexible design options for participatory processes. This pluralistic approach acknowledged that no single model fits all contexts and underscored the need for context-sensitive mechanisms that reflect local dynamics and capacities.

Recent studies have emphasized the increasing role of digital tools in shaping participatory frameworks, offering both opportunities and new challenges. As noted by De Siqueira et al. (2022), digital participation methods ranging from online mapping tools to gamified workshops have expanded the scope of participatory planning, reducing barriers to participation and offering the opportunity for simultaneous participation. Yet scholars such as (Kleinhans & Falco, 2023) caution that digital divides, lack of motivation, and unclear expectations still limit the effectiveness of these tools. As a result, today’s planning frameworks should be hybrid, combining face-to-face and digital participation, balancing expert and everyday knowledge, and maintaining transparency in decision-making processes. The trajectory of participatory frameworks thus reflects a continuous negotiation between ideals of inclusivity and the practical constraints of institutional and technological realities.

2.3.1 Conventional Approaches

The conventional approaches to participation in urban planning are rooted in institutionalized forms of engagement that emerged during the modernization of state governance in the mid-20th century. These methods typically operate within representative democratic frameworks, where citizen input is mediated through elected officials or technocratic bodies. Participation in this context is often procedural and limited to consultation phases, such as public hearings, interviews, or feedback sessions after major planning decisions have already been formulated (Thomas, 1995). As such, these mechanisms serve as legitimizing tools for existing decisions rather than tools for co-creation or power-sharing. In this sense, conventional participation reinforces top-down decision-making while offering limited influence on citizens, often leading to frustration and disengagement among the public.

Critics have pointed out that while these methods offer an appearance of inclusion, they frequently fail to address structural inequalities or power asymmetries in planning processes. As Arnstein (1969) sharply observed, "participation without redistribution of power is an empty and frustrating process for the powerless." Traditional participation frameworks fall into the lower levels of Arnstein's typology, namely "informing," "consultation," and "placation," and while they allow participants to contribute, they do not offer real authority in decision-making processes. These forms of participation tend to privilege already-empowered groups, marginalizing vulnerable populations whose voices are least heard yet most affected by planning decisions (Sandercock, 1998).

Despite their limitations, conventional methods were widely adopted in planning practice because of their administrative simplicity and alignment with legal and bureaucratic norms. They are typically embedded within institutional planning cycles, offering structured but rigid formats for engagement. As noted by Healey (2007), these approaches prioritize procedural regularity and accountability over responsiveness or creativity. For instance, public meetings often adhere to formal agendas, expert presentations, and limited question-and-answer periods, reducing the possibility of open dialogue or deliberate engagement. Moreover, such settings can be intimidating for non-experts, especially when dominated by technical language and institutional hierarchies (Kingston, 2002).

However, even within these conventional frameworks, important variations have emerged. Some municipalities have experimented with advisory boards, citizen juries, and neighborhood committees to extend participation beyond symbolic gestures (Lowndes et al., 2002). Yet these initiatives often remain consultative in nature and do not fundamentally challenge existing power structures. As recent literature suggests, while conventional approaches can still serve as starting points for engagement, they must evolve into more interactive and inclusive models if they are to meet the complexities of contemporary urban governance (Innes & Booher, 2010). This evolution is especially critical in an era characterized by social diversity, digital transformation, and a growing demand for transparency and accountability in public decision-making.

2.3.2 Contemporary Approaches

In response to the evident limitations of conventional, consultation-based participatory methods, contemporary approaches have sought to redefine how citizens engage in urban decision-making. The shift from formal, state-led procedures to more interactive, adaptive, and co-productive frameworks mark a significant turning point in participatory urban design. One of the major theoretical contributions in this realm is the communicative planning model proposed by Healey (1998), which positions dialogue and consensus among diverse stakeholders at the heart of planning processes. Innes and Booher (2010) further expanded this notion through their theory of "participatory rationality," which emphasizes inclusive dialogue, mutual learning, and deliberative negotiation in addressing complex urban issues. These frameworks recognize participation not as a one-time event but as an iterative, reflective process that accommodates uncertainty and conflict while pursuing collective outcomes.

The role of digital tools has become increasingly central in advancing these contemporary participatory models. Batty and Marshall (2012) describe urban design as a continuous "dialogue," which, particularly in the digital age, is enriched through the involvement of multiple actors communicating across different tools and modalities. Hou and Rios (2003) have similarly argued for the development of more flexible and responsive participation models, particularly considering the evolving needs of modern, diverse urban societies. Digital tools such as mapping tools, online voting systems, and participatory planning applications allow for the inclusion of wider audiences and the integration of real-time feedback into design processes (De Siqueira et al., 2022; Münster et al., 2017). These tools provide user-friendly interfaces, enabling data to be visualized and analyzed. They also facilitate monitoring and evaluation of participation results, contributing to a more inclusive and accountable participation.

Alongside digital innovation, gamified methods have emerged as an influential contemporary approach in participatory urban design. The growing use of serious games and gamification strategies in urban planning reflects the need for an intuitive and shared "language" among diverse actors. Games are increasingly used as tools to facilitate communication, simulate decision-making environments, and explore complex urban problems through participatory

experimentation (Fülop, 2013; King, 2022). The evolution of games from early examples such as “The Landlord’s Game” (developed in 1904) to digital simulation environments like SimCity (released in 1989) illustrates the growing sophistication and applicability of such tools (Stephens, 2016). As noted by Aguilar et al. (2021), recent applications of serious games are influenced by complexity theory and aim to reveal power dynamics, foster creative strategies for negotiation, and explore multi-actor governance scenarios in wicked planning problems.

Despite the enthusiasm surrounding these contemporary tools, researchers caution against assuming their universal effectiveness. Kleinhans and Falco (2023) identify key challenges that limit the potential of digital and gamified participation, including access inequality, low digital literacy, and the misalignment of digital processes with offline decision-making structures. Therefore, while contemporary approaches promise more equitable, engaging, and dynamic participatory environments, their success depends on careful contextual adaptation, inclusive design, and continuous evaluation. As urban challenges become more complex and societal demands more diverse, participatory frameworks must not only evolve but also remain critically reflective and socially responsive.

3
GAMIFICATION IN URBAN DESIGN

In this section of the thesis, the theoretical and practical foundations of gamification in urban design are comprehensively examined. The discussion begins with an introduction to gamification, which includes game elements such as scoring, challenges, and storytelling and aims to increase engagement, motivation, and learning outside of the game environment. This approach has gained relevance in urban planning, where traditional participation tools often fall short in facilitating meaningful dialogue or inclusive decision-making. Therefore, the first part of this chapter explores the theoretical principles of gamification and examines its role in reshaping participatory practices in urban environments, emphasizing how it enables structured yet creative forms of civic interaction.

Following this theoretical framing, the chapter moves on to analyze the various types of games that have been implemented in urban design, including serious games, simulations, role-playing frameworks, and co-creation models. By addressing these categories, the study demonstrates how different gamified formats serve unique purposes in participatory processes. These formats are used for different purposes such as increasing mental engagement, strengthening spatial awareness, contributing to participatory negotiations, and developing empathy. Additionally, this section draws attention to the relevance of analog formats such as board games, which offer accessible, low-barrier tools for inclusive participation. Board games are presented not merely as educational devices but as powerful instruments for hands-on spatial reasoning and community-based planning, especially in face-to-face settings where digital tools may be less effective.

The final part of the chapter introduces a series of case studies to illustrate how gamification is currently applied in participatory urban design practices. Ranging from speculative digital environments to location-based mobile tools, these examples demonstrate how serious games can facilitate both structured interaction and open-ended exploration of urban topics. Games like *The Mordor Shaper* (Olszewski & Turek, 2020), *Maslow's Palace* (Beattie et al., 2020), and *EquiCity (Nourian et al., 2023)* highlight the capacity of digital tools to engage diverse

stakeholders in multi-actor design challenges, allowing them to negotiate values, evaluate spatial trade-offs, and generate actionable insights. By analyzing such practices, this section not only underscores the transformative potential of gamified approaches in planning but also provides a critical foundation for understanding the design rationale behind UrbanPlexity tool developed in this thesis.

3.1. Gamification Theory and Principles

Gamification is a practice that aims to increase participation, motivation and problem-solving skills by using game design elements such as scoring, levels, storytelling or reward systems outside the game environment. While its conceptual foundations can be traced to earlier behavioral and motivational theories, gamification has gained traction in public policy, education, and urban planning since the early 2010s (Deterding & Khaled, 2011). In urban design, gamification is increasingly recognized not merely as a playful interface but as a methodological tool that fosters participation, encourages experiential learning, and facilitates interaction between experts and non-expert stakeholders (Türken, 2020). Its rise parallels the growing demand for more transparent, inclusive, and creative forms of public engagement.

Recent scholarships have emphasized the transformative capacity of gamified participatory processes in the urban context. Rather than relying solely on traditional participatory tools such as town hall meetings or interviews, gamification enables stakeholders to immerse themselves in scenario-based environments that simulate real-world challenges. Through such simulations, citizens are not only informed but also empowered to experiment with and evaluate alternative planning strategies. For instance, King (2022) frames games as powerful mediators for civic learning and negotiation, arguing that their structured flexibility allows for deep engagement without sacrificing creativity. These interactive environments allow participants to visualize spatial consequences, deliberate on trade-offs, and co-create urban futures in a cognitively accessible format.

The growing adoption of digital technologies has significantly accelerated the integration of gamified frameworks into urban design. Recent studies, such as De

Siqueira et al. (2022), underscore the capacity of digital gamified tools to accommodate asynchronous, large-scale participation while lowering technological entry barriers through intuitive interfaces. A study by Ampatzidou and Gugerell (2019a) further highlights how serious games rooted in complexity theory are being employed to navigate 'wicked problems' in urban planning, fostering participatory strategies in the face of conflicting interests and uncertainty. In such settings, gamification transcends its instrumental function and becomes a space for negotiating competing values, power dynamics, and adaptive decision-making.

Nonetheless, scholars warn that the effectiveness of gamified systems is highly contingent upon their contextual relevance and ethical design. Thibault (2019) and Sousa (2023) caution that if poorly implemented, gamification may lead to superficial engagement, instrumentalization of users, or disengagement due to perceived manipulation. Studies by Constantinescu et al. (2020), Duke (2022, Ng et al. (2023) reveal that gamification is most successful when it transcends the purpose of merely informing or entertaining and is embedded within a broader participatory ecosystem that aims to empower users and increase democratic accountability. Therefore, a critical challenge in urban gamification lies in balancing playfulness with rigor, engagement with inclusion, and innovation with equity.

3.2. Game Types

As gamification becomes increasingly relevant in urban design, various types of games have been adopted to suit different participatory goals. These game types range from educational simulations to immersive digital tools and participatory design interfaces. A common classification includes serious games, simulation games, role-playing games (RPGs), location-based games, and co-creation games. Each of these types serves specific purposes, varying in terms of interactivity, realism, and stakeholder engagement.

Serious games are primarily intended to convey knowledge, facilitate decision-making, or promote behavioral change. They are often employed to represent real-world urban problems in structured environments where players can experiment with alternative strategies. Recent research highlights their potential to support

long-term civic engagement and spatial understanding. For example, studies involving rural community building design demonstrated how serious games could help residents visualize design choices and feel more satisfied with outcomes when their input is meaningfully incorporated into the process (Di Mascio & Dalton, 2017; Johns et al., 2024; Kongeseri & Coley, 2019; Poplin, 2014) These games transform abstract urban problems into tangible experiences, fostering learning through direct interaction.

Closely related are simulation games, which replicate complex socio-spatial systems to offer players a sandbox for exploring planning concepts. Unlike serious games that may have specific behavioral objectives, simulation games often provide open-ended scenarios. Widely used games like Cities: Skylines have demonstrated how such environments can support urban planners in testing infrastructure, zoning, and transport decisions. More advanced forms of simulation are now being adapted into participatory planning processes, allowing citizens to evaluate planning outcomes in real time. Role-playing elements are sometimes embedded in simulations or presented separately in RPGs, which enable users to inhabit different stakeholder perspectives. For example, the "Energy Safari" serious game developed for participatory energy transition planning allowed participants to experience diverse roles such as citizens, policymakers, and private sector representatives, fostering empathy and enhancing dialogue across competing interests by Ampatzidou and Gugerell, (2019b).

In recent years, location-based and co-creation games have expanded the scope of participatory design into physical and hybrid environments. Location-based games, leveraging geolocation technologies, enable users to engage directly with urban spaces through site-specific tasks and explorations. For instance, a study demonstrated the effectiveness of such games in collecting spatially explicit preference data, which can inform decision-making processes in urban planning (Tóbiás & Boros, 2025). Co-creation games, on the other hand, emphasize participatory input by integrating participatory mechanisms into gameplay. A notable example is the utilization of a custom-designed digital game within a virtual reality environment to facilitate co-creation workshops, enhancing community engagement and knowledge sharing in urban design (Ng et al., 2024).

These game types not only foster spatial learning but also serve as experimental tools for participatory decision-making and inclusive urban transformation.

The diversity of game types employed in urban design reflects a broader shift toward multimodal, inclusive participation. Each game offers distinct advantages, from fostering empathy through role-playing scenarios to enabling real-time evaluation of planning outcomes via simulation games. The coming together of these approaches in the context of participatory planning creates a new paradigm that combines game-based experimentation, data-driven design, and community empowerment. The increasing accessibility of digital tools further reinforces this movement, allowing a broader range of users to engage with planning issues in novel, intuitive, and equitable ways. For example, the integration of gamification with Building Information Modeling (BIM) has been shown to enhance user participation and decision-making in design contexts (Özge Yalçın et al., 2024). Such innovations underscore the potential of gamified tools to transform citizen engagement from passive input to active co-production, ultimately contributing to more equitable and sustainable urban futures.

3.2.1 Board Games

Board games have increasingly been recognized as effective instruments within participatory urban planning processes, offering tangible and interactive tools that facilitate stakeholder engagement with complex spatial and social challenges. Distinct from digital simulations, board games create a shared physical setting that promotes face-to-face interaction, co-decision-making, and immediate feedback. Their tactile nature and rule-based structures encourage active learning and deliberation among diverse participants, making them particularly well-suited for use in workshops, educational initiatives, and community-based planning sessions (Lickiewicz et al., 2020).

One notable example of board games facilitating participatory urban planning is *Stadsbyggarna*, a game developed to introduce children to fundamental urban planning concepts. By translating abstract spatial principles into accessible scenarios, it enabled young participants to contribute meaningfully to the formulation of a 30-year urban development vision in a mid-sized Swedish city. The involvement of nineteen school classes in the process revealed that the game's

role-playing elements significantly fostered critical thinking and engagement in urban discourse (Bankler et al., 2020). A parallel example is *Blocks and Lots*, a board game created through a collaboration between Dr. Pop, Rosten Woo, and Esperanza Community Housing Corporation's game has been widely used in community workshops to discuss land use issues. Focusing on themes such as zoning, housing equity, and environmental justice, the game encourages residents to participate in realistic spatial decision-making processes, even if they have no prior expertise, through accessible mechanics and inclusive narratives. This approach allows participants to express local concerns and engages in deliberating on more equitable spatial futures. (Haas & Woo, 2011).

An additional example is *Co-gnito*, a hybrid board and physicalizing game aimed at eliciting participants' mental mappings and perceptions of urban identity. Through the placement of symbolic objects and narrative prompts onto a shared board, players participatorily construct representations of spatial belonging and marginalization. This process not only improves mutual understanding, but also reveals hidden socio-spatial inequalities, especially in participatory design sessions involving underrepresented communities (Panagiotidou et al., 2022).

Taken together, board games constitute a versatile and inclusive medium within the participatory urban design toolkit. Their ability to translate technical planning language into embodied, dialogic experiences enhances civic learning, fosters empathetic collaboration, and democratizes access to urban decision-making. As cities increasingly adopt multimodal participation strategies, analog game-based methods offer a compelling complement to digital tools by prioritizing accessibility, interaction, and narrative richness in shaping equitable and sustainable urban futures.

3.2.2 Serious Games

Serious games have emerged as pivotal tools in urban planning, offering immersive environments where stakeholders can engage with complex urban challenges. These games transcend traditional entertainment, serving as tools for education, collaboration, and decision-making. By simulating contextually grounded urban scenarios, they enable participants to explore the consequences of various planning decisions in a risk-free setting. For instance, the development of

a serious game focused on the 15-minute neighborhood concept has demonstrated potential in facilitating discussions around sustainable urban living, allowing users to visualize and interact with compact, accessible community designs (Garritsen et al., 2025).

The integration of advanced technologies has further enhanced the efficacy of serious games in urban design. Immersive serious games, incorporating elements like virtual reality and augmented reality, have been shown to modify public participation by fostering deeper emotional connections and more diverse discussions among participants (Ng et al., 2024). These technologies provide a more tangible understanding of urban spaces, enabling users to experience proposed changes firsthand and offer more informed feedback.

Additionally, serious games are proving effective when addressing complex urban problems that do not have a clear solution. By facilitating role-playing and scenario-based simulations, these games allow stakeholders to navigate the intricacies of urban transformation, balancing competing interests and exploring innovative solutions. A notable example is the EquiCity game, which employs mathematical simulations to help decision-makers reach equitable spatial designs through iterative trade-offs (Nourian et al., 2023).

In summary, serious games represent a transformative approach in urban planning, bridging the gap between theoretical concepts and practical application. Their ability to engage diverse stakeholders, simulate complex scenarios, and incorporate cutting-edge technologies positions them as invaluable tools in the pursuit of sustainable and inclusive urban development.

3.2.3 Digital Games

Digital games have emerged as powerful tools in participatory urban planning, offering immersive environments for simulating spatial dynamics and participatorily exploring urban scenarios. Unlike traditional planning methods, these tools allow users to engage experientially with complex urban systems, revealing the trade-offs and spatial implications of design decisions. Pueyo-Ros et al. (2023) emphasize that serious digital games function as participatory environments where participants can actively engage in proposing and testing spatial interventions, supporting participatory experimentation in real time. Their

visual interfaces and interactive design enable deeper cognitive engagement, broadening access to urban decision-making for diverse groups, including youth, non-experts, and marginalized communities.

One compelling example is the Edible City Game (ECG), which was developed to support the participatory design of urban agriculture systems. The ECG allows players to participatorily plan and manages edible landscapes, encouraging awareness of food sustainability while enhancing spatial learning and cooperation among stakeholders (Pueyo-Ros et al., 2023). Similarly, serious games have been applied in tourism, sustainability, and green infrastructure planning, as shown in the work of Koens et al. (2020), where local communities actively contributed to scenario-based decision-making. These games serve not only as educational tools but also as mediators of dialogue and tools for balancing stakeholder power in planning processes.

Beyond games explicitly designed for participation, commercial city-building simulations such as Cities: Skylines have found relevance in planning education and professional practice. Although initially intended for entertainment, these simulations enable users to visualize zoning decisions, transportation systems, and infrastructure trade-offs, helping them understand complex cause-and-effect relationships in urban development (Ashtari & de Lange, 2019; Johns et al., 2024). Similarly, sandbox games like Minecraft have been effectively repurposed for participatory urban design processes (Delaney, 2022). By providing an accessible, flexible, and intuitive environment, Minecraft enables a wide range of participants, including those with limited technical expertise to participatorily model urban spaces, experiment with design alternatives, and contribute to planning dialogues in a more inclusive and engaging manner. These examples illustrate how entertainment-oriented digital tools can transcend their original purposes to become powerful tools for fostering civic engagement, spatial literacy, and co-creation in contemporary urban planning practices.

Despite their many benefits, digital games in participatory planning also present challenges. As emphasized by Kleinhans and Falco (2023), issues of digital access and literacy can limit inclusivity, especially among underrepresented populations. Furthermore, poorly designed games may oversimplify urban complexities or fail to align with practical planning objectives, resulting in user disengagement. To

address these limitations, games must be context-sensitive, co-designed with stakeholders, and critically evaluated for effectiveness. When thoughtfully integrated, digital games can transform participatory processes by making urban planning more tangible, inclusive, and responsive to the multifaceted realities of contemporary cities.

3.3. Potentials of Digital Serious Gamification in Participatory Urban Design

Digital serious gamification is increasingly recognized as a transformative tool in participatory urban design, offering citizens interactive environments to explore spatial dynamics and simulate context-specific planning challenges. For example, the Mobility Safari game, developed for the city of Vienna, demonstrated how experiential, game-based formats can provoke reflective discussions about mobility choices, sustainability, and urban governance. By encouraging participants to reconcile gameplay with their lived realities, the game created a bridge between abstract planning concepts and everyday urban experience (Gugerell et al., 2018).

Another innovative example is the Maslow's Palace workshops, which adopted a speculative gaming approach to engage marginalized landfill-based communities in imagining spatial futures. This model emphasized collective memory, community values, and future aspirations. By focusing on shared storytelling and scenario-building, the workshops helped uncover spatial injustices and stimulated long-term design interest, demonstrating how speculative gamification can enhance participatory equity and empowerment (Beattie et al., 2020).

Digital serious games have also been successfully integrated into higher education, serving as pedagogical tools for spatial planning. The Serious Urban Play tool, designed as a multi-touch interactive tabletop, enabled architecture and urbanism students to cooperatively negotiate complex planning scenarios. Participants could simultaneously simulate transport, economic, and social policies, learning to balance competing priorities through real-time co-design. The study highlights how game-based environments can improve spatial literacy and participatory reasoning in early professional training (N. J. Stevens et al., 2014).

Gamification's potential to reach broader audiences is exemplified in the “Aksiku.bdg” project in Bandung, Indonesia, which targeted young citizens in participatory urban mapping. Designed to address localized urban challenges like waste management and flood risks, the game promoted youth engagement in civic issues through playful participation. However, the study also pointed out that for digital games to be truly inclusive, designers must address digital literacy, cultural appropriateness, and long-term accessibility (Singgih et al., 2015).

3.4. Current Praxis on Serious Gamification in Urban Design

Recent implementations of serious games in participatory urban design illustrate diverse methodological frameworks, each emphasizing different aspects of engagement, decision-making, and spatial representation. Mordor Shaper employs a mobile, narrative-driven approach integrating geolocation data and symbolic roleplay to encourage behavioral change and spatial awareness among users (Olszewski & Turek, 2020). Similarly, Maslow’s Palace utilizes speculative, voxel-based environments to engage marginalized communities through low-cost, co-creative gameplay focused on envisioning alternative urban futures (Beattie et al., 2020). While both games excel in immersive storytelling and inclusive, Minecraft + Block by Block distinguishes itself through its user-friendly sandbox interface, allowing broad demographic engagement in participatory spatial prototyping (Delaney, 2022). Its accessibility and adaptability for practical application make it a particularly scalable model for youth-inclusive urban design. Across these three, a common strength lies in lowering technical barriers and promoting user-driven ideation through fictional framing or intuitive interfaces. However, challenges such as limited policy integration (Maslow’s Palace), symbolic oversimplification (Mordor Shaper), and resolution constraints (Minecraft) highlight the ongoing trade-offs between engagement, technical fidelity, and actionable outcomes.

Complementing these narrative and sandbox-based approaches, The Edible City Game (ECG) and EquiCity introduce structured simulation and decision-making methodologies rooted in quantitative frameworks. ECG leverages a tool-based model (Tygron), integrating urban indicators and scenario experimentation to facilitate multi-stakeholder learning around food-centered nature-based solutions

(Pueyo-Ros et al., 2023). EquiCity, by contrast, introduces a sophisticated blend of social-choice theory and parametric design tools to navigate equity in spatial configurations (Nourian et al., 2023). These games foreground data transparency and evidence-based consensus-building while preserving elements of interactivity and role-based learning. Despite their strengths in strategic clarity and evaluability, they also demand higher levels of digital literacy and impose cognitive complexity, limiting accessibility. These five examples demonstrate the multidimensional capacity of serious games as both a participatory tool and an analytical environment. While these environments undertake roles such as supporting co-production, raising awareness, and contributing to iterative design processes, they also clearly demonstrate the need to maintain the balance between accessibility, accuracy, and policy impact in game-based participatory planning.

3.4.1 The Mordor Shaper (2020)

One of the distinctive examples of gamified participation in urban planning is The Mordor Shaper, developed for the Warsaw office district colloquially known as "Mordor." Designed as a mobile and AR-supported serious game, its primary aim was to address urban congestion and car-dependency through a fictional narrative inspired by Tolkien's universe. Players are assigned to character groups such as Orcs, Elves, or Hobbits, each symbolizing contrasting spatial strategies (e.g., exploitation, preservation, moderation), thereby encouraging users to explore diverse urban priorities through gameplay. The game leverages geolocation data, overlays it with actual urban dynamics, and uses these to simulate user-based interventions on mobility, parking, and green space strategies (Figure 3.1).



Figure 3.1 The interface of The Mordor Shaper serious game visualizes player roles within the urban context of Warsaw's office district (Olszewski & Turek, 2020).

Through real-time interaction and spatial annotation, The Mordor Shaper exemplifies how narrative-driven, location-based serious games can serve as geo-participatory tools, fostering engagement particularly among younger demographics. One of the strengths of this game lies in its symbolic yet accessible interface and its integration of Volunteered Geographic Information (VGI) to inform municipal strategies. Moreover, by reflecting moral dilemmas via role-play, it introduces an ethical dimension to participatory planning rarely found in traditional consultation tools. However, its reliance on archetypal roles and predefined choices also poses limitations in terms of participant agency and multidimensional representation of stakeholder views. Nonetheless, the project reveals the dual function of serious games in urban design: as both engagement facilitators and data-generating systems with potential policy relevance (Olszewski & Turek, 2020).

3.4.2 Maslow's Palace (2020)

Maslow's Palace was developed within the Speculative Participatory Serious Urban Gamification (SPS-UG) framework and offers an innovative methodology to promote inclusive urban design through speculative, game-based engagement with marginalized communities. Integrating fictional and increasingly realistic digital environments, this game enables participants to express their implicit values, voice social needs, and co-imagine alternative futures without any external constraints. Based on participatory action research, this methodology involves iterative co-design through game play, scenario navigation, and collective negotiation. As shown in Figure 3.2 (Beattie et al., 2020), the game interface allows players to interact with a wide range of design tools in a voxel-based urban environment, encouraging creative idea generation and spatial experimentation.



Figure 3.2 Maslow's Palace outcome from workshop group 3 in Shanti Nagar (Beattie et al., 2020).

The game's key strengths include encouraging high levels of participation at low cost, providing a safe and informal space to address sensitive social issues, and acting as a "design premise" that fosters social capital and shared understanding. However, challenges remain, including digital literacy barriers, translating in-game decisions into actionable urban policies, and the sustainability of long-term impacts. Despite these limitations, Maslow's Palace succeeds in providing a powerful tool for inclusive dialogue, exposure of opposing perspectives, and the development of solidarity across differences in participatory urban contexts, by

shifting participatory design from problem solving to problem definition (Beattie et al., 2020).

3.4.3 Minecraft + Block by Block (2021)

The work by Delaney (2022) uses Minecraft as an innovative tool for participatory urban design and demonstrates how commercial digital games can effectively support inclusive planning processes. In the context of the Block-by-Block initiative and the UCLCraft workshop, Minecraft's accessible, sandbox-based, voxel-structured environment allows users to co-design public spaces by directly interacting with 3D models through their avatars (Delaney 2022). The game's intuitive interface, as illustrated in Figure 3.3, eliminates the technical barriers often associated with traditional CAD tools and enables non-expert participants, including young people who are often excluded from the process, to actively participate in urban design processes as well as experts. The methodology is based on immersive, first-person interactions in multiplayer servers, where participants propose, iterate, and visualize spatial ideas together in real time.

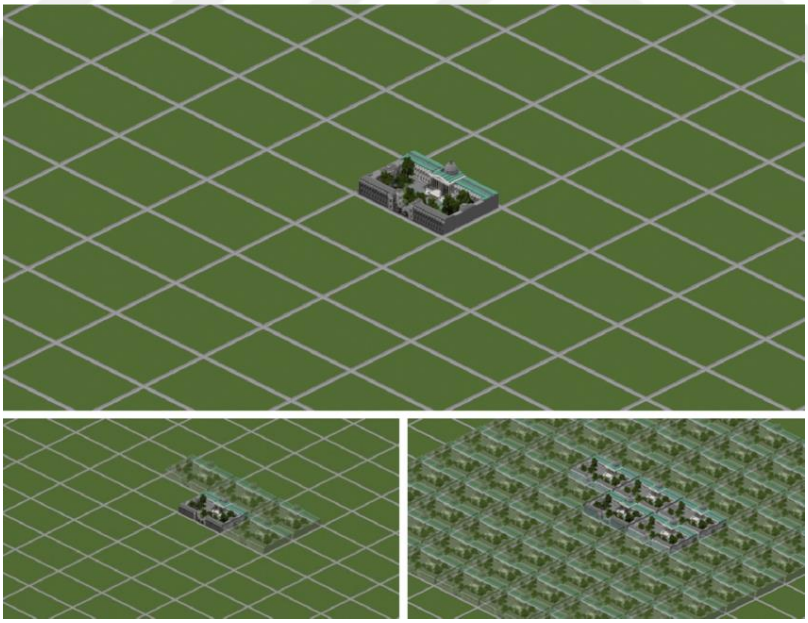

Figure 3.3 Voxel-based (blocky) aesthetic of the UCLCraft workshop server in Minecraft, illustrating the plots system where participants individually designed outdoor learning spaces within a 1:1 scale model of UCL's Main Quad (Delaney,2022).

The in-game visual demonstrates how a single architectural module can be replicated, scaled, and placed within a grid system in different spatial arrangements. This feature allows users to dynamically test density, pattern, and spatial relationships. This approach not only encourages creative experimentation but also provides valuable insights into collective spatial reasoning. However, Minecraft's limitations, such as its blocky resolution, lack of precision in technical detail, and potential gaps due to generational or digital literacy differences, should also be considered. Despite these limitations, Minecraft's strengths in encouraging participation, facilitating storytelling, and providing democratic access to design tools make it a powerful tool for expanding participatory practices in urban planning and design.

3.4.4 Edible City Game (2023)

The Edible City Game (ECG) developed by Pueyo-Ros et al. (2023) is a significant example of how serious games can be used as participatory tools in urban planning, particularly to support the integration of nature-based solutions (NBS) with food production capacities. Building on the Tygron tool, ECG allows players to participate in a gamified simulation where they assume stakeholder roles such as citizens, investors or planners, proposing, negotiating and implementing edible city interventions (Pueyo-Ros et al., 2023). As seen in Figure 3.4, there is a comprehensive interface such as a 3D "quasi-city" model that visualizes ongoing interventions, along with various indicators such as action menu, character roles, scenario status, participation, green justice and progress. As is evident in this interface, the methodological strength of ECG lies in its integration of a structured framework such as the Use Maturity Model Integration (CMMI-DEV) and the Mechanics-Dynamics-Aesthetics (MDA) model. These two models drive a cyclical process that includes scenario design, content development, and iterative evaluation based on user feedback.

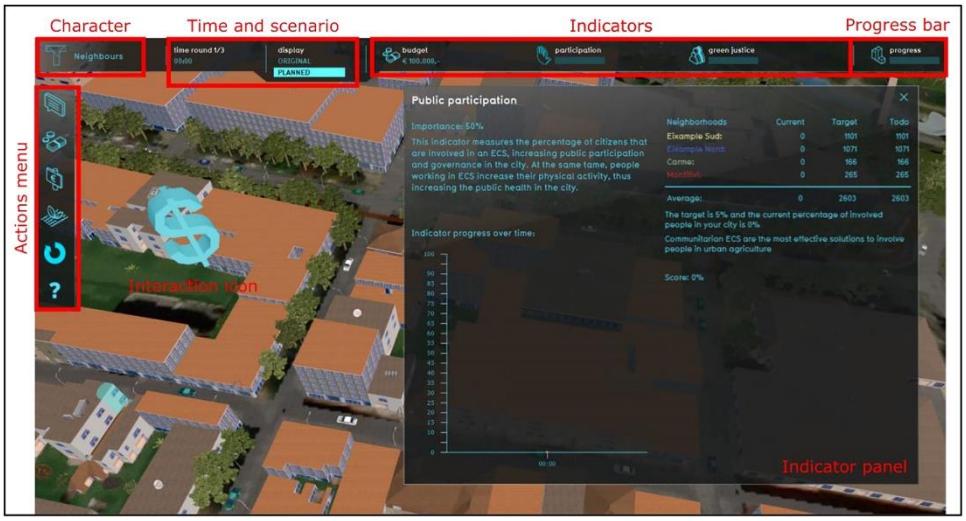

Figure 3.4 Interface of the Edible City game illustrating indicators, scenario status, interaction elements, and performance metrics (Pueyo-Ros et al., 2023).

One of the main advantages of ECG is its ability to dynamically visualize spatial outcomes in real time by using a 3D "half-city" model and overlaying layers with indicators such as participation rate, green justice or progress score (Pueyo-Ros et al., 2023). These visual components facilitate understanding and negotiation among users with different goals, strengthening learning through experimentation and discussion. However, ECG also has some limitations: it cannot easily integrate abstract social dynamics (e.g. policy dialogue, knowledge sharing), requires users to have digital literacy skills, and is limited to spatially measurable outcomes only. Despite these limitations, ECG offers a replicable and accessible model for engaging different stakeholders in sustainability planning and highlights the value of co-creation and experiential learning in participatory urban design.

3.4.5 EquiCity Game (2023)

The EquiCity game is a serious game designed to facilitate participatory urban design by integrating mathematical social preference mechanisms into a multi-actor decision-making framework (Nourian et al., 2023). It allows different stakeholder groups, such as citizens, designers, and municipal representatives, to engage with urban spatial arrangements in a structured and interactive way. The main advantage of the game is that it strengthens democratic participation, spatial justice awareness, and collective learning by making complex and data-driven

urban planning processes more accessible and transparent. Its methodology combines agent-based modeling, game theory, and spatial design principles, enabling real-time assessment of the equity impacts of design proposals on different stakeholder groups. One of the key strengths of the game is its structured role assignments that encourage empathy and understanding of different perspectives, and its iterative feedback loop that supports critical thinking and learning. A representative screenshot from the game interface Figure 3.5 shows how handwritten calculations, parametric decision tools, and spatial analytics are combined in a real urban context and support evidence-based deliberations.

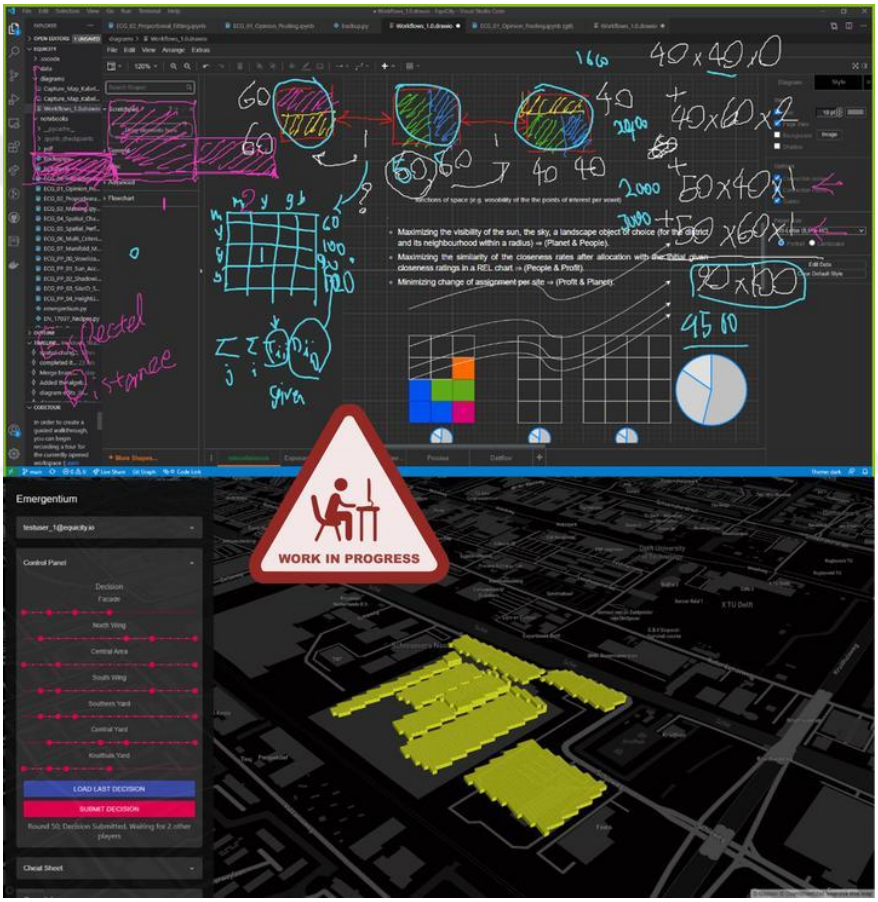

Figure 3.5 Screenshot from the EquiCity game interface, illustrating the decision-making environment combining parametric design inputs, spatial optimization, and social-choice theory mechanisms (Nourian et al., 2023).

At the same time, there are some limitations of the EquiCity game that should be considered. The main limitations faced by this game are the high cognitive load for inexperienced users, the complexity of the interface, and the limited scalability beyond controlled workshop environments. Despite all these limitations, EquiCity

manages to emphasize the role of fairness, transparency, and diversity in urban decision-making processes. It positions itself as both a participatory and pedagogical tool in the field of digital urban design and offers valuable insights to practitioners and researchers who want to integrate serious games into planning and governance. By combining complex spatial modeling with stakeholder-based deliberation processes, the EquiCity game contributes to more inclusive and data-driven urban design approaches.

4
A SERIOUS GAME FOR PARTICIPATORY URBAN DESIGN: URBANPLEXITY

This chapter presents the design, implementation, and empirical evaluation of the digital serious game UrbanPlexity, developed in this study as a participatory tool for urban design. It addresses how game-based environments can function as structured tools for inclusive decision-making, enabling non-experts to engage with complex urban issues through spatial experimentation. This chapter explains the conceptual development, digital infrastructure, game mechanics, and multi-actor engagement model of UrbanPlexity, emphasizing its grounding in participatory theory and gamification logic.

Structured across several interconnected stages, the study first outlines the overall research design that informs UrbanPlexity development process, followed by the formulation of the conceptual framework that translates participatory values into gameplay logic. It then details the game's design elements, including mechanics, feedback systems, and sustainability metrics, before turning to the multi-actor participatory model. Empirical data gathered from pre- and post-gameplay interviews are also analyzed to reveal shifts in stakeholder awareness, priorities, and urban design preferences.

This chapter, which examines the game in both theoretical and applied contexts, presents in detail the multi-phased research design of UrbanPlexity, progressing from its theoretical foundations to its digital game environment and empirical evaluation. Although a role-based interaction mechanic was not directly implemented in the gameplay, all participants played within the same scenario; however, the outcomes were later filtered and analyzed based on participant roles, allowing for role-based evaluations.

4.1. Research Design

This research adopts a multi-phased methodological structure that strategically integrates conceptual framing, digital game development, empirical testing, and analytical evaluation. As visualized in Figure 4.1, the process begins with the definition of a case study context, followed by the development of a serious game prototype that translates urban design principles into interactive decision-making scenarios. The overarching goal of this research design is to explore how digital gamified tools can enhance participatory urban design practices by integrating stakeholder input into simulated planning environments.

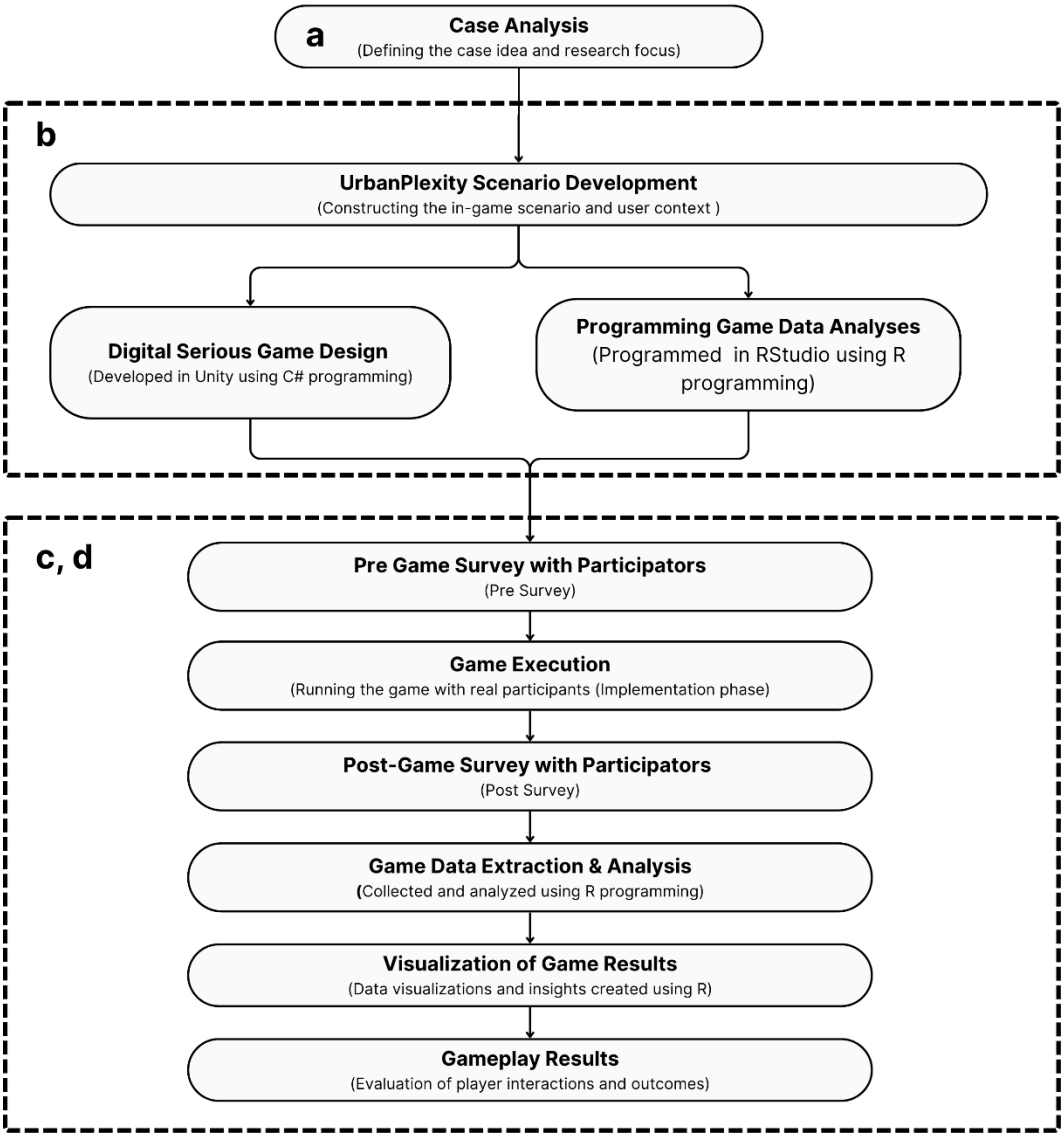

Figure 4.1 Detailed methodological workflow of the UrbanPlexity research process

The initial phase focuses on case analysis, in which the problem definition, research question, and urban context are articulated. This foundational step sets the conceptual framework for the rest of the study, establishing the relevance of participation, data-driven design, and digital interfaces in urban planning. Here, the notion of urban complexity is approached as a dynamic interplay between spatial, social, and ecological parameters, requiring participatory methods for meaningful decision-making. The selected case provides the geographical and thematic background for the UrbanPlexity scenario.

In the second stage, the UrbanPlexity scenario is developed through a dual-track process: the design of a digital serious game in Unity and the creation of a corresponding data analysis system in R. The Unity-based game platform simulates planning trade-offs using interactive urban elements and sustainability indicators. In parallel, the R programming environment is used to establish a backend for data capture, management, and visualization. These two components are designed to operate in tandem—user decisions in the game are automatically translated into data outputs, enabling real-time feedback and subsequent evaluation.

The third phase involves engaging real participants—municipal actors, designers, supportive organizations, and citizens—through structured gameplay sessions. Prior to the game, participants complete an interview to assess their expectations and prior knowledge. This is followed by the implementation of the game, in which participants make spatial decisions based on the simulated design scenario. After gameplay, a second interview captures their reflections, providing qualitative insights into user experience, perceived agency, and design behavior.

The final phase centers on data extraction, visualization, and interpretation. Gameplay data, including sustainability scores, spatial configurations, and interaction logs, are processed using R programming tools. Visual analytics—such as heatmaps, bar graphs, and score distributions—are employed to interpret participant strategies and outcomes. These visualizations are triangulated with interview responses to yield a comprehensive evaluation of how the serious game fosters participatory learning, spatial awareness, and participatory thinking in urban design processes.

4.1.1 Development of the Digital Tool

The development of UrbanPlexity was grounded in a comprehensive conceptual framework that integrates critical theories of participatory planning with the affordances of digital game-based systems. The initial phase of the research involved a detailed literature review that traced the evolution of public engagement models in urban design. Seminal frameworks such as Sherry Arnstein's "Ladder of Citizen Participation" (1969) offered a diagnostic perspective on the structural limitations and power asymmetries of traditional participation methods. Patsy Healey's "Planning Through Debate" (1997) introduced the notion of communicative rationality and deliberative processes, emphasizing the dialogical dimension of planning practice. In parallel, Innes and Booher's (2010) "Collaborative Rationality" model underscored the value of adaptive, inclusive, and networked interactions that move beyond consultation toward co-production. These theoretical contributions shaped the normative and procedural basis of UrbanPlexity as a platform designed to simulate and support authentic participatory design.

Parallel to these foundational theories, the study engaged with the growing body of research on serious games and digital participation tools. Conventional participation platforms have been criticized for reinforcing symbolic inclusion, privileging expert knowledge, and lacking real-time responsiveness. In contrast, serious games present a promising alternative that fosters agency, interaction, and reflection. Studies by Poplin (2012), Ampatzidou et al. (2018), and Pueyo-Ros et al. (2023) demonstrated how gamified systems can serve as experimental environments where non-experts and experts alike engage with complex spatial trade-offs. These systems enable participants to test strategies, observe simulated consequences, and iteratively adjust decisions, thereby enhancing both the inclusivity and effectiveness of participatory design processes.

Drawing on these precedents, UrbanPlexity was conceptualized as a methodological innovation that bridges theory and technology. Precedent cases such as the Edible City Game (Pueyo-Ros et al., 2023), Block by Block (Delaney, 2022), and The Mordor Shaper (Olszewski & Turek, 2020) informed the platform's structural logic and participatory mechanics. These tools illustrated the value of integrating visual simulation, intuitive interfaces, and structured game

rules for meaningful citizen engagement. UrbanPlexity expands on these foundations by incorporating performance indicators such as sustainability metrics into a unified system that enables comparative analysis of different actor groups' experiences. This approach fosters experiential learning and collective deliberation.

The conceptual model developed is based on three basic principles. First, the game-based experience approach allows participants to simulate design decisions within a structured system that reflects urban constraints encountered in planning processes and to receive instant feedback on the results of these decisions. Second, thanks to the data-driven interaction, all actions performed by the players are recorded and converted into numerical indicators that can be analyzed. Third, although each user plays by the same rules in the game, participation in the process is provided with different professional and social identities. As a result of this common experience, users are evaluated under groups such as municipality representatives, designers, citizens or civil society actors and how spatial preferences are shaped by different perspectives is examined. These three basic principles determine the general structure of the game, interface layout, rule system and data infrastructure, and ensure that the research objectives are embedded in all technical components of the tool.

The implementation of this conceptual framework materialized in a digital system architecture composed of six interlinked components, as shown in Figure 4.2. These components include a centralized data pool (comprising spatial datasets, GDPR-compliant ethical protocols, and user-generated content), the game development environment (using Unity and Blender), a real-time Firebase database, the gameplay interface, and two data analysis modules—one for quantitative computation using R, and another for visual output generation. These interconnected systems allow for seamless data exchange between player inputs and researcher outputs, reinforcing the participatory and analytical integrity of the game tool.

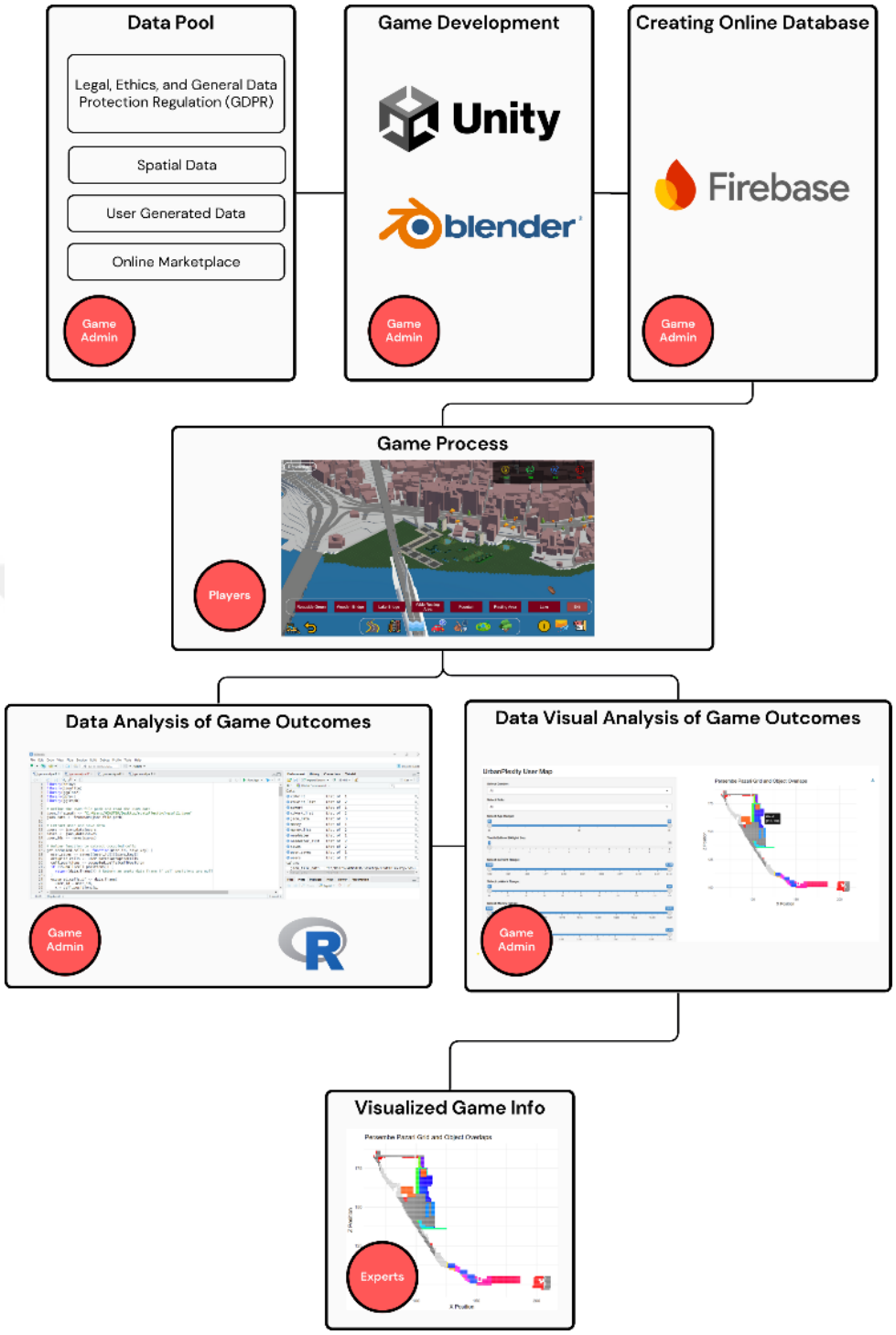

Figure 4.2 UrbanPlexity system architecture for participatory urban design

Ultimately, the development of the digital tool is not only a product of technical assembly but a result of integrating theoretical critique with empirical requirements. By aligning participatory planning theory with digital infrastructure and interactive logic, UrbanPlexity emerges as a hybrid mechanism, both a planning tool and a research instrument. It enables citizens and experts to co-produce knowledge within a gamified, feedback-driven urban environment, thus advancing new possibilities for equitable, sustainable, and data-informed design.

4.1.2 Participatory Interface Structuring

The participatory interface of UrbanPlexity was designed as a key component to enable structured and inclusive engagement in urban decision-making. It considers the diverse backgrounds and competencies of potential users, from professional planners and designers to citizens with no formal training. The interface was developed to balance ease of use with accuracy in urban design. It functions not only as a tool for interaction but also as a pedagogical and deliberative space where users engage in reflective design thinking.

To ensure intuitive interaction, the interface incorporates a visually guided layout that includes an icon-based vertical toolbar and a real-time metric dashboard. The toolbar allows users to select various spatial objects—such as green infrastructure, buildings, roads, and mobility elements, while the top dashboard continuously displays systemic outcomes of user decisions via key indicators: CoPoint, NeedWater, MoneyValue, and Happiness. These dynamic feedback systems reinforce learning and help users understand how individual interventions affect broader urban sustainability outcomes.

At the center of the interface lies a grid-based canvas, designed to simulate urban space through modular logic. Each grid unit represents a 6x6 meter segment of physical space, enabling fine-grained yet scalable interaction. This grid structure ensures spatial accountability for every decision made and allows for the post-game analysis of user behavior, preferences, and priorities. The modular system also enables consistent comparative evaluation across different actor groups and sessions.

To illustrate this structure, a representative visualization has been generated to reflect the underlying principles of the interface design Figure 4.3. While this image was not captured directly from the UrbanPlexity prototype, it was constructed to visually communicate the architectural logic of the participatory interface. The sample screenshot showcases the grid-based spatial field, a simplified object selection menu, and the real-time system indicators, helping to contextualize how the game facilitates urban design exploration within spatial, ecological, and economic constraints.



Figure 4.3 Illustrative representation of the UrbanPlexity grid-based interface

Ultimately, the participatory interface serves as a mediating space between the abstract goals of inclusive design and the concrete constraints of urban systems. It enables users to learn by doing, to experiment without risk, and to express preferences within a bounded yet open-ended environment. The UrbanPlexity interface is thus not only a surface for interaction, but a structured field for co-production, evaluation, and knowledge generation in participatory urbanism.

4.1.3 Multi-Actor Gameplay and Stakeholder Structuring

UrbanPlexity was conceptualized as a participatory simulation tool designed to reflect the complex nature of urban decision-making environments. While the gameplay itself was not customized according to specific roles, four primary

participant categories were established—Municipality Representatives, Designers, Citizens, and Supportive Actors (further divided into NGO and Private Sector Representatives)—for the purpose of post-game analysis. These categories were used to collect and evaluate participant feedback and game data based on different perspectives, responsibilities, and priorities typically found in urban development processes, as illustrated in Figure 4.4.

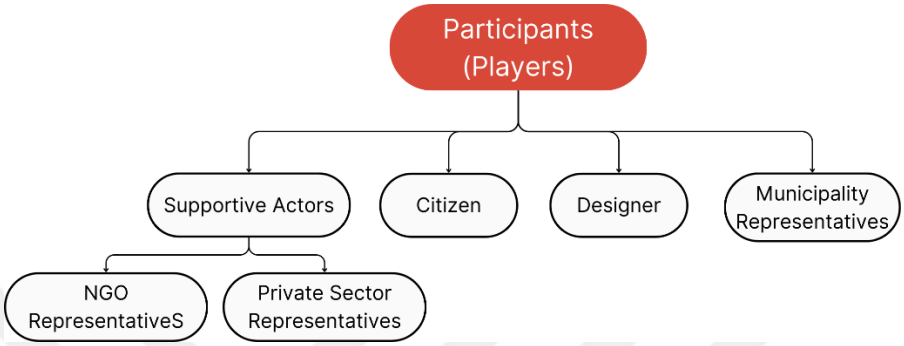

Figure 4.4 Stakeholder-based structuring of game participants

This post-game categorization allowed for a more structured interpretation of how participants with different professional backgrounds or civic identities engaged with spatial challenges, prioritized interventions, and responded to sustainability indicators. By mapping user decisions to these actor identities, the analysis revealed both overlapping and divergent strategies across groups, offering insights into the relationship between real-world roles and in-game spatial behavior. This approach helped uncover implicit value systems, such as a citizen's preference for green areas or a designer's sensitivity to spatial composition, without constraining user agency during gameplay.

This multi-actor framework was not implemented through role-specific gameplay mechanics but was instead employed as a methodological lens to structure the post-game analysis. Its primary function was to conceptually simulate the layered and potentially conflicting interests inherent in urban design processes. By categorizing participants into predefined actor groups, the framework enabled a structured interpretation of diverse perspectives within a shared design environment. Rather than influencing in-game actions, this classification facilitated the examination of how urban planning decisions might vary across institutional roles, thereby offering insights into participatory dynamics and multi-stakeholder interactions in theoretical terms.

To maintain analytic rigor, game sessions were designed to include participants from each predefined actor category in a balanced manner. While the gameplay itself did not incorporate actor-specific limitations or affordances, all user-generated data were retrospectively tagged according to the assigned actor identity. This post-hoc structuring enabled a comparative analysis of decision-making patterns, spatial strategies, and performance metrics across actor types. The actor framework thus served primarily as a methodological tool for interpretation, rather than a gameplay mechanism embedded within the system.

4.1.4 Post-Gameplay Data Collection and Evaluation

The final stage of the research design focuses on data collection, analysis, and the interpretation of design outcomes. Once participants complete their gameplay sessions, their spatial inputs, object selections, and indicator outcomes are automatically stored in a cloud-based database using Firebase. This infrastructure allows for scalable data capture, facilitating both individual and comparative analyses across actor types and gameplay sessions.

Quantitative metrics (e.g., number of placed objects, cumulative carbon emissions, budget utilization) and qualitative parameters (e.g., stakeholder happiness scores, design diversity) are extracted and visualized through spatial mapping and statistical tools. These datasets are then analyzed to understand behavioral trends, stakeholder preferences, and recurring spatial logics. For example, clustering analysis of grid-based placement patterns enables the identification of popular design strategies or contested zones within the urban context.

Additionally, pre- and post-game interviews were conducted with selected participants from each stakeholder group to triangulate the gameplay data with subjective experiences and reflections. These interviews help assess how the game influenced participants' understanding of urban planning principles, sustainability considerations, and the roles of others in the design process. The combination of interactive gameplay and reflective inquiry ensures that UrbanPlexity functions not only as a serious game but also as a participatory research tool.

4.2. UrbanPlexity Process Conceptual Design

This section elaborates the conceptual foundation that guided the development of UrbanPlexity as a serious game for participatory urban design. UrbanPlexity was conceived as a hybrid decision-making tool that integrates digital gameplay with spatially grounded design processes, enabling multiple stakeholders to contribute to the shaping of urban spaces. The conceptual design process was informed by an interdisciplinary synthesis of theories on participatory planning, gamification, and sustainable urban development. Drawing from Arnstein's ladder of citizen participation, the project repositions participants from passive recipients of information to co-creators of spatial interventions. Rather than replacing expert knowledge, UrbanPlexity aims to bridge lay and professional domains through a data-driven interface that balances playability and planning logic.

At the core of UrbanPlexity conceptual model lies the simulation of spatial constraints and stakeholder perspectives within a simplified but structured digital environment. The tool organizes spatial decision-making within a grid-based system, where players represent different urban actors (e.g., citizens, designers, mayors, NGOs) and respond to defined planning challenges. Each actor's decision influences shared indicators of sustainability—environmental (CO Point, NeedWater), economic (MoneyValue), and social (Happiness)—reflecting real trade-offs in urban planning. This role-based interaction paradigm is key to embedding diverse values, competing interests, and systemic complexity into a streamlined participatory framework. Unlike open-ended sandbox tools, UrbanPlexity guides players through a set of constraints that mirror the real urban design process, such as limited budgets, land use policies, and functional requirements.

Furthermore, the conceptual framework of UrbanPlexity emphasizes both the process and the product of participation. In terms of process, it fosters dialogic engagement across actors, facilitates iterative trial-and-error decision-making, and allows users to visualize the impact of their interventions through real-time feedback mechanisms. In terms of product, the system records design patterns, prioritization strategies, and stakeholder preferences in a spatial database, transforming gameplay into a repository of participatory data. This dual emphasis supports UrbanPlexity overarching goal: to serve as a transparent, scalable, and

replicable model for integrating participatory input into the early stages of urban design. The modularity of the system allows it to be adapted to various urban contexts, stakeholder constellations, and planning scales, reinforcing its versatility as both a research tool and a civic technology tool.

4.3. UrbanPlexity Game Design Process

The design of UrbanPlexity was shaped by a research-oriented and user-centered methodology that integrates theoretical principles from participatory urbanism with digital simulation techniques. The game is conceived as a serious digital platform that enables diverse stakeholder groups, including non-expert participants, designers, municipal representatives, and supportive actors—to engage with the complexities of urban design within a guided yet open-ended environment. By simulating planning constraints and enabling actor-specific decision-making, UrbanPlexity facilitates participatory experimentation and allows for the structured capture of stakeholder preferences across multiple dimensions of urban sustainability.

As illustrated in Figure 4.5, the design logic of the game is supported by a multilayered data pool, comprising three main sources: spatial data, user-generated data, and external assets from online marketplaces. Spatial data includes regional planning notes, zoning regulations, and CAD drawings of the designated pilot area. These inputs were use14d to construct a scaled 3D base model and translate the built environment setting into a modular 6x6 meter grid system, ensuring that gameplay decisions correspond to tangible spatial implications. This translation ensures that gameplay decisions correspond to measurable, real-world spatial implications. CAD files were adapted to the game engine through 3D modeling software and scaled according to standardized design units.

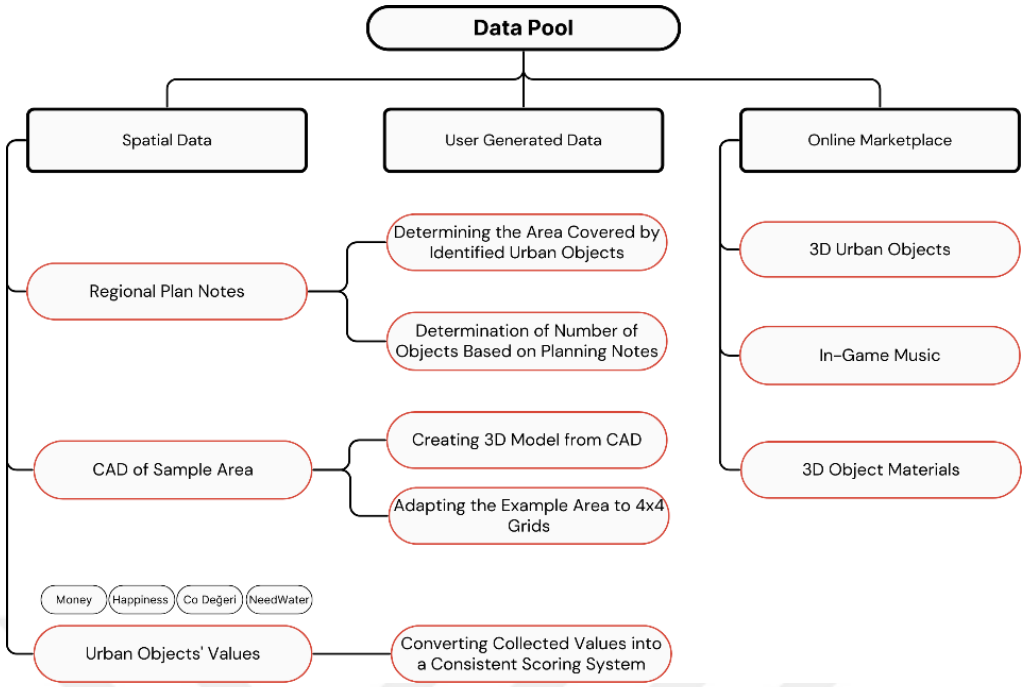

Figure 4.5 Data pool structure and flow of UrbanPlexity game components

User-generated data, on the other hand, is produced directly through gameplay. Participants place urban objects onto the grid-based map—such as trees, buildings, pedestrian infrastructure, or transportation elements—thereby shaping both form and function within the virtual landscape. Each spatial allocation is tied to key sustainability indicators: MoneyValue, Happiness, CoPoint, and NeedWater. These values are derived from previously calibrated metrics and converted into a standardized scoring system, enabling comparative analysis across sessions, users, and actor types. The gameplay interface, while intuitive, is also algorithmically structured to log each design action into the central data repository.

The third input stream—external content from online marketplaces—completes the digital environment with a diverse range of 3D object models, textural materials, and in-game music. These aesthetic and functional elements enrich the immersive quality of the simulation while maintaining technical compatibility with the Unity-based architecture. The game's backend systematically merges these inputs into a unified Data Pool, which serves as both a design source and an evaluation archive. Through this architecture, the platform enables not only engagement but also post-game analysis for planning insights and policy feedback.

Gameplay mechanics themselves reflect principles from established urban planning practices. Players operate within a constrained scenario where budget limits, zoning laws, and ecological thresholds guide and restrict their spatial choices. These constraints are not arbitrary but are designed to mimic authentic urban planning trade-offs, requiring players to balance competing priorities and stakeholder interests. Each category (e.g., citizen, municipality, designer, NGO) operates under specific decision logics and toolsets, further simulating institutional hierarchies and participatory tensions found in multi-actor governance environments.

UrbanPlexity transforms the abstract goals of participatory planning into a tangible, interactive process. The game functions not only as a design environment but also as a data collection tool, capturing detailed information about user preferences, negotiation strategies, and sustainability trade-offs. This information feeds back into the research, allowing for the development of actor-specific planning typologies and the evaluation of participatory tools within urban complexity.

4.3.1 Game Mechanics

UrbanPlexity is structured as a rule-based serious game that emulates selected dimensions of urban planning decision-making. Rather than directly generating urban design proposals, it aims to function as a decision-support environment that collects and structures stakeholder preferences for further analysis. Its mechanics are designed to simulate certain complexities of urban systems within a simplified, user-friendly digital interface. The core of the gameplay revolves around three major pillars: a spatial logic embedded in the grid-based placement system, a feedback mechanism that evaluates user decisions, and a set of guiding constraints that align gameplay with sustainable and context-sensitive considerations.

The spatial organization in UrbanPlexity is facilitated through a grid-based system, where each cell corresponds to a 6x6 meter real-world space. This standardization provides a referential framework for consistent and comparable user actions. Urban elements such as roads, water features, green spaces, and built structures are inserted into the grid based on general planning logic. The available

spatial categories, including transportation, green spaces, and built environments, are presented to users via the interface icons illustrated in Image (a) of Figure 4.6, offering an intuitive access point for selecting and placing objects. While the game reflects certain real-world considerations such as spacing rules and non-overlapping uses, these rules are not comprehensive representations of national or municipal planning regulations. Rather, they are selectively defined by the game designer to create a structured yet accessible simulation. This highlights an inherent limitation: the predefined set of objects and rules can shape participant behavior and indirectly steer design preferences. Such constraints should be seen as necessary simplifications, not replacements for regulatory planning instruments.

Evaluation of player decisions occurs through a real-time feedback panel displaying four performance indicators: economic cost (MoneyValue), stakeholder satisfaction (Happiness), carbon emissions (CoPoint), and water consumption (NeedWater). These indicators, mapped to the pillars of sustainability, dynamically respond to gameplay actions and aim to promote learning through trial and reflection. For example, the cost metric reflects a simplified municipal budget model, while stakeholder satisfaction draws from predefined preference weights assigned to four actor groups: citizens, designers, municipal representatives, and NGOs. While these models help simulate real-world complexity, they are abstractions that should not be interpreted as definitive representations of actual planning dynamics. Therefore, the game outcomes should be considered as inputs that inform, not determine, urban design processes.

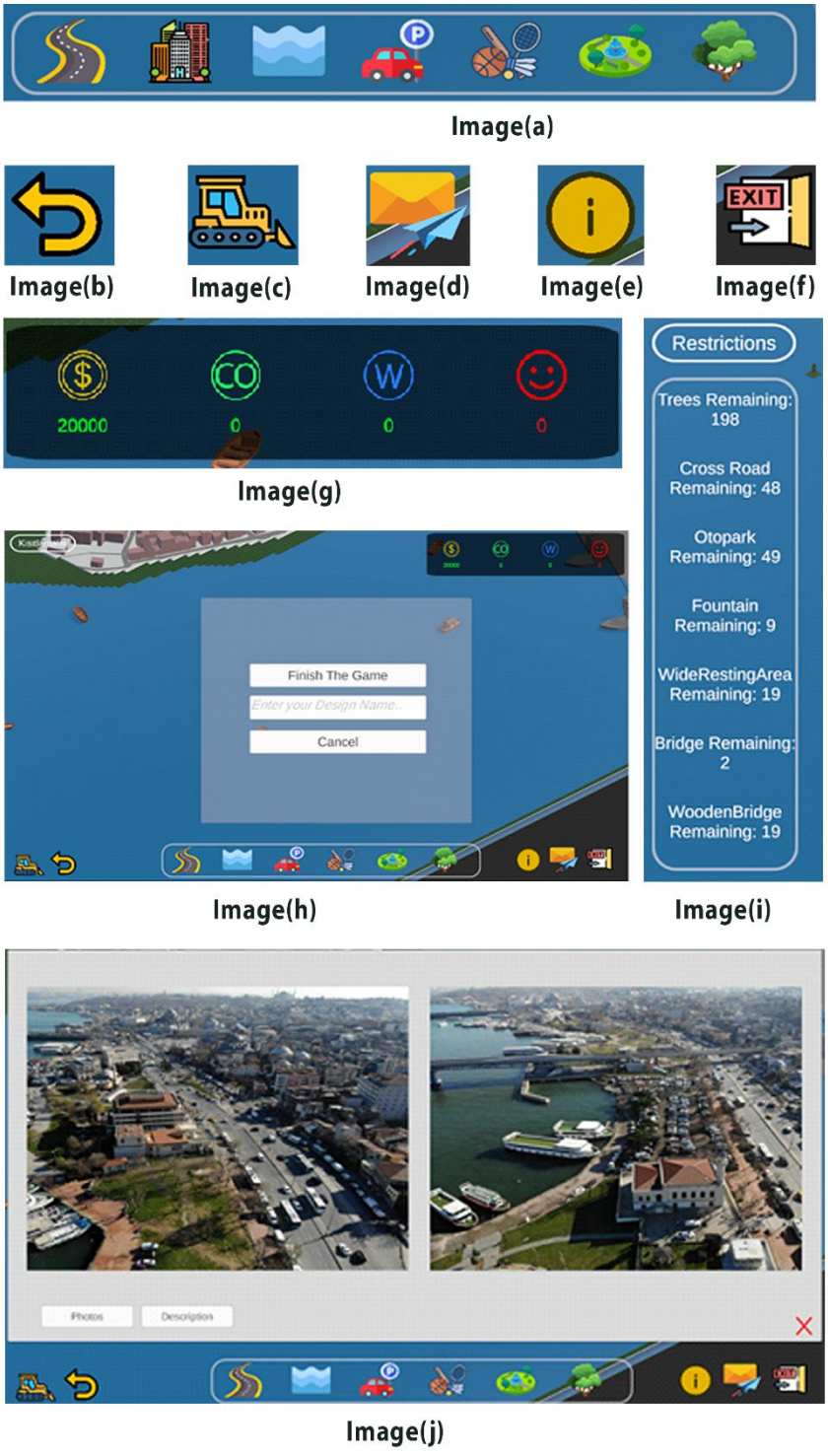

Figure 4.6 User interface components and gameplay icons from the UrbanPlexity game

To support functional decision-making, a set of auxiliary tools is integrated into the interface. These include the undo button (Image b), bulldozer tool for deleting elements (Image c), the feedback mail icon for submitting final designs (Image d),

the information icon that reveals contextual site details (Image e), and the exit icon (Image f) for quitting the game without saving. The information icon further links to a panel, shown in Image (j), which provides aerial photos and descriptive data about the actual Perşembe Pazarı site, grounding player decisions in geographic and historical context.

Design constraints are another critical mechanic embedded within UrbanPlexity. These are illustrated in Image (i), which shows limitations on item availability such as the number of trees, bridges, and recreational elements. These quantitative restrictions emulate regulatory planning constraints and vary depending on the scenario. Additionally, the submit-design popup window illustrated in Image (h), asks players to finalize their layouts with a unique name, storing submissions into a Firebase database for later analysis. The use of this structured workflow encourages users to reflect on their design rationale before finalizing.

The interface design culminates in a coherent and interactive environment—consolidated visually in Figure 4.6 that unites functionality, spatial logic, real-time feedback, and constraint-based decision-making. By situating players within an environment that blends rule-based mechanics with participatory logic, UrbanPlexity transforms abstract urban planning challenges into an accessible and reflective gameplay experience.

To ensure that game interactions remain both realistic and pedagogically valuable, a robust set of design constraints has been systematically embedded into the UrbanPlexity system. These constraints emulate the technical and procedural norms commonly encountered in professional urban planning. First, budgetary constraints restrict the number and type of design elements that can be deployed, compelling users to operate within a predefined fiscal boundary. These economic limits are scenario-dependent, reflecting context-specific municipal conditions. Second, land-use constraints define an editable intervention zone, distinguishing it from surrounding areas that include immutable residential blocks, road networks, and open spaces. This spatial limitation mirrors zoning ordinances, and administrative boundaries present in contemporary urban settings. Third, object quantity constraints prevent excessive or unbalanced development by imposing maximum thresholds for certain spatial elements, based on proportional site coverage. Finally, object-type constraints prohibit the placement of contextually

incompatible or environmentally detrimental objects in ecologically sensitive or functionally incompatible locations. Collectively, these layered constraints cultivate realism while promoting strategic, resource-conscious decision-making among players.

Beyond formal constraints, the game introduces design-oriented challenges intended to stimulate critical thinking and experimentation. One principal challenge is the need to navigate competing objectives, maximizing stakeholder satisfaction, minimizing ecological impact, and adhering to budgetary limitations. This triadic tension emulates negotiation and compromise integral to participatory design processes. Additionally, the game incorporates a temporal dimension, where decisions must be made in a sequenced and cumulative manner. Early interventions influence subsequent design opportunities, compelling players to anticipate long-term effects and refine strategies iteratively. Such mechanics encourage systems thinking and foster an appreciation of urban complexity within a simulated but consequential environment.

In contrast to the embedded constraints and structured challenges, technical and methodological limitations of UrbanPlexity emerge from the necessary simplifications required for digital implementation. The grid-based layout, while beneficial for maintaining spatial clarity, introduces an abstraction that limits the representation of organic or irregular morphologies. Likewise, certain planning variables have been generalized to ensure compatibility with the Unity game engine. Moreover, stakeholder satisfaction metrics are derived from fixed models informed by literature and interviews, rather than adaptive learning algorithms. This introduces an epistemological limitation in capturing the full range of dynamic user needs and behaviors. While these constraints do not compromise the overall functionality of the game, they must be acknowledged in evaluating gameplay outcomes and in extrapolating findings to broader urban contexts.

In summary, UrbanPlexity game mechanics weaves together spatial logic, strategic complexity, and multi-actor interaction within a pedagogically structured digital environment. The interplay between constraints, challenges, and systemic limitations offers a multidimensional platform that is not only effective as a learning tool but also capable of generating valuable empirical insights into participatory urban design behaviors.

4.3.2 Game Elements

The design elements available in UrbanPlexity constitute the fundamental building blocks through which players construct urban scenarios. These components were not arbitrarily selected; rather, their inclusion reflects a comprehensive review of urban design literature, spatial planning regulations, and participatory simulation requirements. Each object in the game library is designed to be contextually relevant and spatially accurate, adhering to a standardized 6x6 meter modular grid. This calibration ensures that gameplay decisions translate into realistic urban configurations, allowing the platform to operate not only as a participatory tool but also as a speculative design simulator. A visual representation of the complete game object library is provided in Figure 4.7 illustrating the diversity of spatial typologies incorporated into the game.

One of the most essential categories within the game is the set of roads and pathways, which are subdivided into main roads, side roads, bike paths, and pedestrian pavements. Main roads are represented through a variety of geometric configurations—including straight segments, corners, and multi-directional intersections—allowing players to construct transportation networks that simulate vehicular circulation patterns. Side roads, although narrower in dimension, serve the dual function of enabling localized access and facilitating fine-grain urban design. Bike paths follow a similar modular logic, underscoring the game's attention to sustainable mobility solutions. In addition, multiple pavement types are included—such as stone, brick, gravel, and wood textures, each offering a different visual and symbolic character. These components encourage the creation of walkable environments and the incorporation of tactile diversity in urban ground treatment.

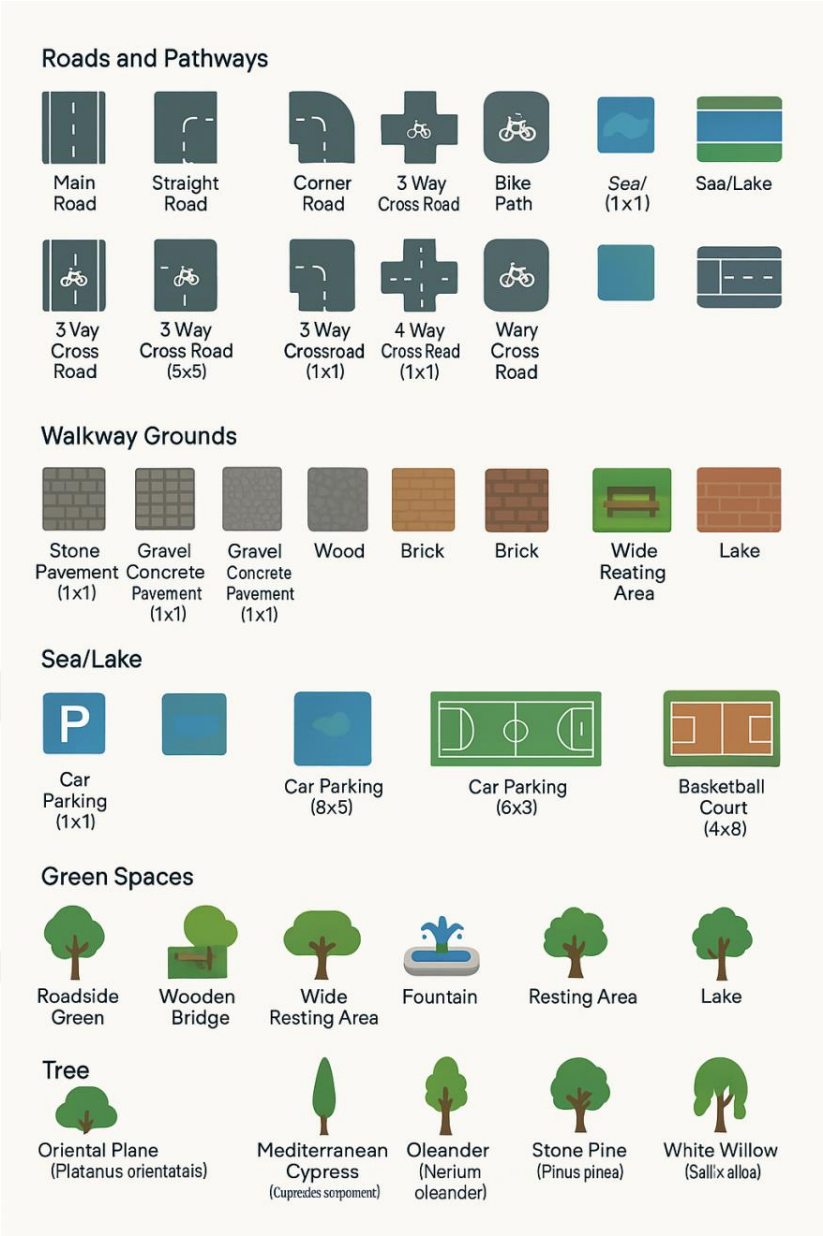

Figure 4.7 Comprehensive visual inventory of all design elements used in the UrbanPlexity game

Water elements such as sea or lake tiles are also integrated into the object library. Although limited in typology, their inclusion is critical to simulating natural features and enabling the placement of adjacent landscape interventions. These tiles can be used to define waterfronts, retention basins, or urban blue infrastructure. The game allows these water bodies to be used solely for defining limited spatial zones; interactions such as constructing bridges or platforms are not supported. These elements serve as a contextual base for adjacent landscape design and contribute to the representation of natural environments.

Parking facilities are represented through both small (1x1) and large (8x5) scale modules. These design elements reflect contemporary urban necessities and simulate the spatial burden of automobile infrastructure. Their strategic placement requires consideration of accessibility, visual impact, and land-use efficiency, thereby encouraging players to reflect on the cost–benefit balance of car dependency within cities. By simulating these aspects, the game integrates mobility planning with land consumption awareness.

Recreational and sports spaces offer opportunities for enhancing public life and user satisfaction within the game. Objects such as football fields, tennis courts, and basketball courts are scaled to match standard dimensions and serve as anchors for social engagement. Their inclusion not only diversifies the functional mix of the urban environment but also introduces trade-offs related to budget and resource consumption, such as irrigation and maintenance costs. These facilities are programmed to increase the game's happiness index, encouraging their thoughtful integration within broader design strategies.

Green infrastructure is further enriched through the availability of diverse public space elements including resting areas, fountains, wooden or lake bridges, and wide seating zones. These components support human-scale design and promote urban livability. Additionally, larger elements such as artificial lakes and landscaped open spaces are introduced to simulate multifunctional ecological nodes. Players are encouraged to place these elements strategically to improve air quality, reduce urban heat islands, and foster communal identity.

Finally, a curated selection of tree species is embedded in the object library. These include the Oriental Plane (Platanus orientalist), Mediterranean Cypress (Cupressus sempervirens), Field Maple (Acer campestre), Oleander (Nerium oleander), Stone Pine (Pinus pinea), and White Willow (Salix alba). Each tree is modeled not only for visual distinction but also for its associated ecological parameters, such as carbon sequestration capacity, water consumption, and biodiversity support. By incorporating empirical botanical data, the game prompts players to consider the environmental implications of their planting decisions, simulating a climate-sensitive urban forestry strategy.

What distinguishes the game elements in UrbanPlexity from conventional visual assets is their integration with data-driven sustainability metrics. Each object includes embedded attributes—such as cost, environmental impact, and social utility—which directly influence the game's performance indicators. For instance, placing a fountain may enhance citizen satisfaction but increase water demand; conversely, planting drought-resistant trees may improve ecological resilience with minimal maintenance. These interactions transform basic object placement into a cognitively engaging activity that mirrors the constraints, trade-offs, and systemic interdependencies of urban development. By incorporating spatial, environmental, and socio-economic data into each object, UrbanPlexity redefines game elements as interactive tools of participatory design inquiry rather than static components of a virtual environment.

4.3.3 Game Interfaces

The user interface (UI) of UrbanPlexity was developed to support intuitive engagement without sacrificing informational depth. Upon entering the game, players are offered a brief tutorial that outlines core mechanics, available tools, and sustainability indicators. This optional introductory guide is especially beneficial for first-time users and ensures that players with varying levels of digital literacy can access the full potential of the game. The UI layout is minimalist but functional, with a central design grid flanked by operational panels and real-time metric displays.

Crucial interaction tools embedded within the UI include the undo function, the bulldozer tool for removing elements, and a rotation feature that allows players to adjust the orientation of design components. Informational overlays provide details on each object's cost, ecological footprint, and its contribution to stakeholder well-being. A dynamic evaluation bar, situated in the upper-right corner, offers real-time visualization of the player's performance across four sustainability dimensions, thereby encouraging adaptive thinking and reflective decision-making. Additional elements, such as an information icon, deliver contextual insights about the design site, including aerial views and planning documentation. Once the design is finalized, users can submit their layouts through a dedicated interface that facilitates data storage in Firebase, enabling

further analytical review. A session can also be exited without saving progress, offering flexibility to the player.

This comprehensive yet user-friendly interface structure is illustrated in Figure 4.8, which captures the key functional zones and evaluation tools embedded within the gameplay environment. By aligning interaction logic with educational and participatory goals, the UI ensures a balanced experience that merges usability with substantive design exploration.



Figure 4.8 User interface of the UrbanPlexity environment, illustrating the central design grid, tool panels, sustainability indicators, and dynamic evaluation bar

4.3.4 Sustainability Targets

Sustainability is a fundamental principle in UrbanPlexity, ensuring that urban planning decisions within the game correspond to environmental, social, and economic priorities observed in practice. Each object in the game is assigned sustainability parameters that influence urban development outcomes. These parameters include CO Point, which represents the carbon footprint of objects and encourages eco-friendly choices; NeedWater, which quantifies water consumption and promotes resource efficiency; economic value, which enforces budget-conscious planning; and Happiness, a dynamic metric derived from player preferences that highlights the social impact of urban design. Together, these factors create a comprehensive framework that guides players in making sustainable decisions while balancing environmental responsibility, financial feasibility, and social well-being.

By integrating these sustainability targets, UrbanPlexity provides an interactive tool for exploring the complexities of sustainable urban development. The game challenges players to make informed choices that mitigate environmental degradation, optimize resource allocation, and enhance community satisfaction. Through its simulation-based approach, UrbanPlexity fosters a deeper understanding of sustainability challenges in urban planning, empowering players to consider the long-term implications of their decisions on both the environment and society.

Social sustainability is a multidimensional concept that encompasses not only individual happiness and social well-being, but also participation, accessibility, cultural sustainability, and safety. UrbanPlexity integrates these elements into its game mechanics, allowing players to evaluate the impacts of their urban design decisions and actively engage in the planning process. By enabling individuals to participate regardless of physical location, the game brings together perspectives from participants with diverse socio-economic and cultural backgrounds. This creates a more inclusive and democratic city planning experience, encouraging a more transparent and pluralistic approach to urban governance through direct citizen involvement in decision-making.

UrbanPlexity supports sustainable urban development by combining individual design experiences with collective learning and social interaction. The game allows the ideas and decisions made by players to be directly communicated to urban designers, making it easier for public opinions to be incorporated into urban design processes. Moreover, the ability for all participants to view each other's results and compare them using variables based on core principles of sustainability helps establish a shared language for evaluation. This interaction strengthens mutual understanding among different communities and promotes more informed and inclusive decision-making in urban planning processes.

Economic sustainability plays a critical role in ensuring the long-term financial stability of urban development, promoting the efficient use of resources, and minimizing economic inequalities. UrbanPlexity integrates these aspects into its game mechanics, enabling players to engage with concepts such as budget management, cost-benefit analysis, and economic planning. Each object in the game is assigned a cost parameter proportional to its actual economic value,

requiring players to manage urban development within a financially realistic framework. Additionally, a maximum placement limit is set for each object based on the needs of the designated area. This mechanism prevents overdevelopment, promotes realistic planning approaches, and ensures that players use resources in a balanced and thoughtful manner. Gathering input from all stakeholders not only enhances the inclusiveness of the process but also helps anticipate future demands, allowing for the proactive management of unforeseen issues in later stages.

UrbanPlexity goes beyond simple cost control by offering a system that considers the economic diversity and accessibility of urban spaces. Players are encouraged to make decisions that account for economic variables and address the needs of different socio-economic groups, contributing to the creation of a more balanced economic structure within the city. Moreover, the visualization of game outcomes based on economic indicators enables players to compare different strategies and make informed planning decisions in line with the principles of sustainable economic development. This approach supports an inclusive development model that prioritizes not only economic growth, but also financial resilience and societal well-being. The active participation of all stakeholders enhances the understanding of current needs and expectations, while also enabling the early identification of potential future challenges and the development of strategic responses.

Environmental sustainability focuses on minimizing the ecological footprint of urban development by promoting responsible resource use, reducing pollution, and preserving natural ecosystems. UrbanPlexity incorporates environmental sustainability into its core gameplay by encouraging players to consider the ecological consequences of their design decisions throughout the planning process. Two key environmental indicators—carbon emission (CO Point) and water consumption (NeedWater)—serve as the primary metrics for evaluating a design's environmental performance. Each placed object affects these values differently: for example, green spaces may reduce carbon emissions, while industrial elements may increase them. Similarly, certain infrastructures demand higher water consumption, challenging players to make more resource-efficient choices.

As players make changes to their designs, environmental indicators are updated in real-time, helping them visualize the immediate impact of their decisions. This dynamic feedback loop not only raises awareness of environmental issues but also supports the development of eco-conscious urban strategies. Additionally, built-in spatial regulations—such as minimum distances between roads and green areas—further promote sustainable land use and urban resilience. By simulating ecological constraints and environmental challenges, UrbanPlexity cultivates a learning environment that encourages players to prioritize long-term sustainability over short-term gains. It supports ecological literacy by making sustainability both measurable and actionable within the game context, and it empowers players to take an active role in envisioning climate-resilient and environmentally responsible urban futures.

4.4. Multi-actor Participant Engagement and Pre-Post Gameplay Experiences

This section elaborates on the engagement process with participants from diverse urban stakeholder groups involved in UrbanPlexity game. The study categorizes participants into four distinct groups—municipality representatives, designers, citizens, and supportive actors, each representing a unique perspective in urban planning. By embedding these actors within the serious game structure, the research aimed to capture a wide spectrum of expectations, design tendencies, and post-game reflections to analyze the participatory potential of UrbanPlexity.

The research process was grounded in a comparative methodology, integrating both pre- and post-gameplay in-depth interviews. These interviews were structured to elicit qualitative insights into participants' perceptions of participatory design processes, their initial hesitations or motivations for involvement, and how their perspectives evolved through gameplay. This approach was instrumental in revealing the cognitive and behavioral shifts experienced by participants as they engaged with design constraints and decision-making responsibilities.

Moreover, the post-game feedback served to evaluate UrbanPlexity not only as a gamified design tool but also as a medium for stakeholder education, critical reflection, and participatory learning. The comparative data analysis between

stakeholder groups highlighted both shared themes and divergent evaluations, reflecting the nuanced interplay between professional expertise, civic identity, and participatory practice in a digital simulation environment.

4.4.1 Pre-Gameplay Evaluations: Expectations

Prior to the UrbanPlexity gameplay sessions, a structured evaluation process was conducted to assess participants' baseline perceptions, motivations, and potential anxieties regarding participatory urban design. The purpose of this pre-game assessment was twofold: first, to capture the participants' understanding of multi-actor planning processes and sustainability dimensions; second, to identify existing barriers to effective engagement, including perceived knowledge gaps, institutional distrust, or design-related anxiety. This phase functioned as an essential control condition for comparing post-game shifts in perspective and capacity.

A total of 6 pre-game question categories were addressed through structured interviews, covering themes such as perceived importance of public participation, individual roles in urban planning, familiarity with sustainability principles, and previous experience with participatory planning processes. Participants were also asked to reflect on whether they believed urban design should be the exclusive domain of experts or whether broader stakeholder engagement, including citizens and NGOs—could yield more equitable and informed outcomes. These questions were designed to critically examine existing biases and hierarchies in the planning imagination.

Particular attention was given to the motivational and psychological conditions under which participation takes place. Participants were asked to rate their level of interest in the case area (Karaköy Perşembe Pazarı), their confidence in navigating spatial tools such as maps and plans, and their emotional response to potentially being excluded or misunderstood in a participatory setting. These insights are vital to understanding participation not as a static right, but as an emotionally contingent act shaped by familiarity, legitimacy, and perceived inclusion.

From a methodological standpoint, this pre-game evaluation served as a baseline diagnostic, enabling researchers to map not only expectations but also structural inequalities in participatory readiness. By identifying whether participants had

previous experience with inclusive planning models, and how they self-evaluated their capacity to contribute meaningfully, the pre-game stage helped to contextualize gameplay results and distinguish between temporary behaviors and structurally ingrained participation patterns.

Lastly, several items explored participants' expectations of game-based methods themselves. Participants were asked whether they believed gamification could support more inclusive urban planning, and if so, in what ways. These questions allowed the research to pre-assess the legitimacy of UrbanPlexity as a participatory medium before participants engaged with it directly.

4.4.2 Post-Gameplay Evaluations: Feedback

Following the completion of the UrbanPlexity game session, a post-game evaluation was conducted to measure how participants' views, motivations, and capacities evolved because of the experience. This evaluation was structured around both qualitative interviews and quantitative interview responses. The goal was to assess the perceived impact of the game on participants' understanding of participatory design, their role awareness, and their willingness to engage in future participatory planning processes.

The post-game evaluation revisited many of the same themes addressed in the pre-game assessment—such as actor-based collaboration, stakeholder influence, and the legitimacy of non-expert contributions—in order to allow for direct before/after comparisons. In addition, new items were introduced to assess the perceived usability, inclusivity, and sustainability orientation of the game platform. Participants reflected on whether the game increased their awareness of environmental, economic, and social trade-offs, and how clearly the consequences of their spatial decisions were communicated within the simulation.

Several questions also examined the emotional and cognitive impact of the game. Participants reported whether their anxiety about contributing to design discussions had diminished, whether the game had enhanced their spatial literacy and imagination, and whether they felt their ideas were respected and reflected in the system. The ease of use, the clarity of feedback mechanisms, and the flexibility of design choices were all evaluated as indicators of interface effectiveness.

Additionally, the post-game evaluation assessed motivational transformations, asking participants whether they were now more likely to engage in urban design initiatives, especially those facilitated through digital or gamified tools. Items also explored whether the game experience altered participants' views on the centrality of expert-led planning, prompting greater openness to multi-actor co-production models.

From a methodological perspective, the post-game analysis functions as both an impact assessment and a validity check for the research instrument. By comparing pre- and post-game responses, the study can quantify the shift in participant perceptions while also identifying areas where the tool may require refinement—such as improving clarity of sustainability metrics, enhancing communication channels, or increasing the diversity of spatial options.

4.4.3 Post-Gameplay Design-Based Data Analysis

Following gameplay sessions, a customized data analysis framework was established to extract, process, and visualize participant-generated outputs. This workflow was built using the R programming language in the RStudio environment, designed to parse complex JSON structures exported from the Unity-based UrbanPlexity platform. These files contained detailed records of each user's spatial interventions—such as the coordinates of placed objects and associated sustainability values (CoPoint, NeedWater, MoneyValue, Happiness). As shown in Figure 4.9, a dedicated R script was implemented to automate the parsing, cleaning, and transformation of these records into structured data frames suitable for statistical analysis and visual interpretation.

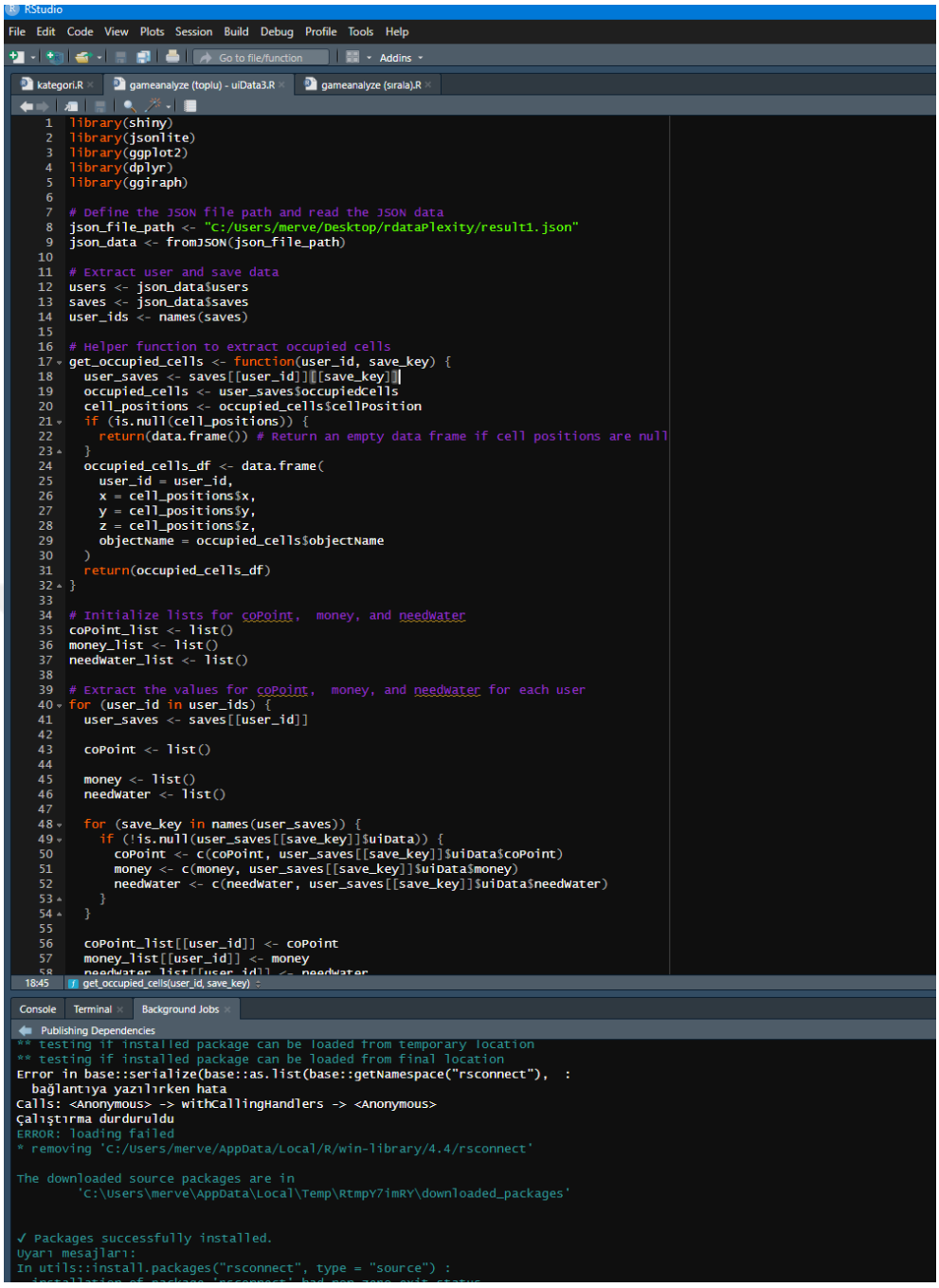

Figure 4.9 Real-time spatial data analysis and visualization interface built in RStudio for UrbanPlexity

Each spatial decision made by participants was geolocated within a grid corresponding to a 6x6-meter modular unit, enabling accurate measurement of total occupied area, object frequencies, and sustainability trade-offs. To verify the spatial fidelity of this structure, grid-based game outputs were mapped directly onto the satellite image of the study site—Karaköy Perşembe Pazarı. As depicted in Figure 4.10 the game-generated grid layout and the actual urban environment

were compared side-by-side to assess coherence. This visual juxtaposition helped verify that participants' decisions aligned spatially with the designed boundaries and the morphological characteristics of the project site.

To deepen the spatial evaluation, a layered composite overlay was created by superimposing the game's grid output onto the satellite map of the area. As shown in 4.10, this hybrid visualization illustrates the precise location of design interventions within the real urban fabric. Color-coded blocks represent the type and density of urban elements placed by different participants, making it possible to interpret spatial concentrations, overlaps, and actor-specific priorities. This mapping technique bridged the virtual and physical dimensions of participatory design, allowing planners to trace simulated decisions back to real geographic zones.

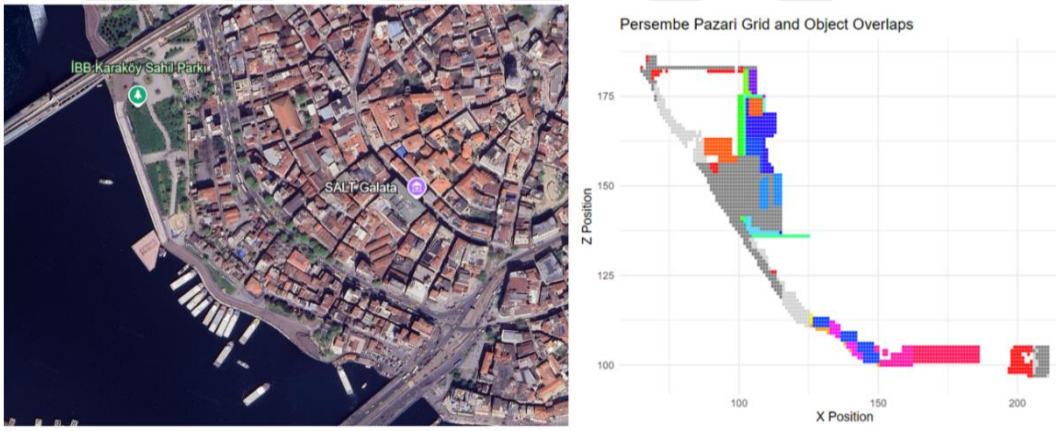

Figure 4.10 Comparison of satellite imagery and grid-based gameplay output

The entire data handling and visualization system was supported by a scripted analytic pipeline, shown in Figure 4.11, which demonstrates the RStudio environment where the JSON files were processed. Custom functions were developed using packages such as jsonlite, dplyr, and ggplot2 to extract occupied cell positions, assign sustainability values, and prepare data structures for comparative visualization. This process ensured reproducibility, transparency, and scalability in how gameplay outcomes were translated into meaningful planning insights.



Figure 4.11 Composite overlay of game output on urban satellite map

To facilitate interactive exploration of the results, a Shiny-based user interface was integrated into the visualization system. As seen in Figure 4.12, the UrbanPlexity User Map allows researchers to filter results based on multiple parameters including participant role, age group, coPoint range, water consumption, and money usage. This functionality enables dynamic cross-comparison of participant behavior, revealing for instance which demographic segments favored low-cost ecological interventions, or which actor categories prioritized infrastructural coherence over public space. This tool added a powerful layer of interactivity, allowing real-time investigation of stakeholder-specific tendencies in participatory urban design.

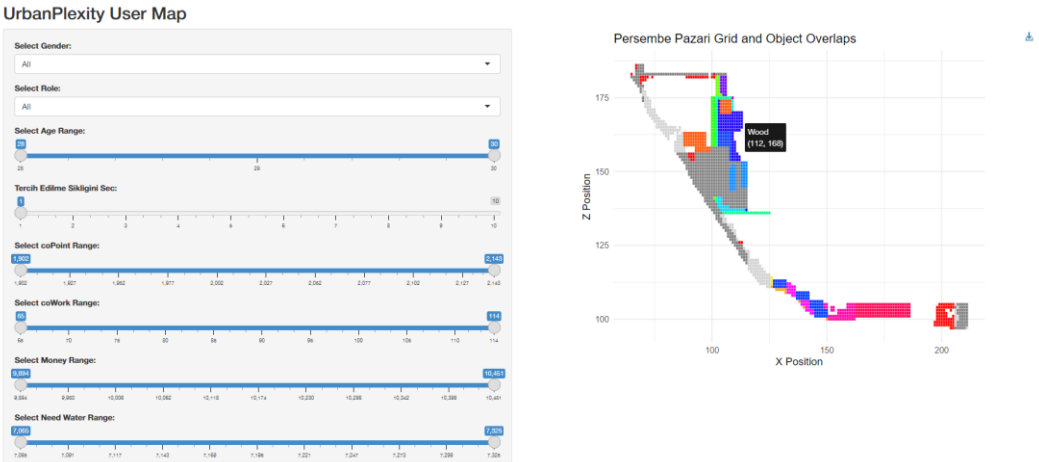

Figure 4.12 UrbanPlexity user map – interactive filtering interface

Ultimately, the post-game data analysis validated the UrbanPlexity system's capacity to capture nuanced design logics reflective of each stakeholder group.

Citizens have aimed to increase the quality of public life by focusing on green areas, recreational areas, afforestation and recreational facilities. Designers have made more balanced choices between social facilities, transportation infrastructure and landscape elements, thus observing spatial integrity. Municipality representatives have tried to establish a balance between functionality and environmental integrity by prioritizing green and recreational areas along with infrastructure elements such as vehicle roads and parking areas. NGO representatives and supporting actors have contributed to the production of fair spaces in line with the principles of accessibility and social inclusiveness by preferring elements such as recreational areas, walkable pedestrian paths, sports areas and common recreational spaces.

5
EMPIRICAL STUDY: URBANPLEXITY EXPERIENCE IN KARAKÖY, PERŞEMBE PAZARI

This chapter presents the empirical implementation of UrbanPlexity serious game within the urban context of Perşembe Pazarı, a historically significant and dynamically transforming neighborhood in Istanbul's Karaköy district. The study explores how diverse stakeholders engage with participatory urban design when mediated by a digital game environment. Drawing on spatial outputs and in-depth interview responses, this section examines the capacity of UrbanPlexity to elicit meaningful input from citizens, designers, municipal representatives, and supportive actors, while also analyzing how the game experience influences participants' understanding of sustainability, inclusion, and planning complexity.

The research integrates spatial data collected during gameplay with qualitative insights gathered before and after the game sessions. Through this mixed-methods approach, the empirical study reveals patterns of design behavior, role-based tendencies, and attitudinal changes toward participatory planning. Each stakeholder group is evaluated in terms of their gameplay decisions, sustainability prioritization, and feedback on the tool's usability and impact. By situating this implementation in an empirical case study, the study provides a grounded examination of how serious games can function not only as participatory tools but also as evaluative frameworks for urban design education and policy exploration.

The chapter is structured around five main components: the historical and planning context of the Perşembe Pazarı area; the technical adaptations made to tailor UrbanPlexity to the site; the resulting urban design proposals generated by each actor category; an analysis of pre- and post-game interviews; and concluding reflections on the game's utility in revealing user preferences and advancing participatory planning agendas. Each section aims to deepen the understanding of how digital gamification can bridge knowledge gaps and foster collective intelligence in urban design.

5.1. Urban Development Process of Perşembe Pazarı

Located along the southern shore of the Golden Horn, Perşembe Pazarı is a historically layered urban fabric that has played a pivotal role in Istanbul's economic and spatial development. Functioning as a prominent trade and production center since the Byzantine and Ottoman periods, the area has been characterized by its dense concentration of commercial structures, artisanal workshops, and a network of narrow, irregular streets. Its geographic position at the threshold between land and sea has historically allowed it to operate as a liminal zone—serving both maritime logistics and inland commerce. In this context, Perşembe Pazarı has evolved as a hybrid zone where spatial, social, and economic flows converge, rendering it a particularly dynamic urban fragment within the city's core (Figure 5.1)



Figure 5.1 Perşembe Pazarı location along the Golden Horn waterfront, highlighting its proximity to central urban axes and infrastructural corridors

Despite its enduring urban significance, Perşembe Pazarı has faced intense pressure from top-down renewal projects, particularly since the 1980s. This was notably accelerated by large-scale clearance policies and speculative development strategies, such as the Dalan-era demolitions, which disrupted the historic morphology of the area. The area is presented as a prime example of how historical commercial hubs lose functionality and physical integrity due to

misaligned planning priorities (Dermicioğlu, 2012). Such transformations have progressively undermined its identity as a site of production and exchange, transforming it into a contested zone of urban speculation and partial obsolescence.

In recent years, the Perşembe Pazarı area has reemerged as a focal point for alternative urban regeneration strategies through several participatory and design-driven initiatives. A prominent example is the Golden Horn Waterfront Design Competition (İstanbul Senin), held in 2020 by the Istanbul Metropolitan Municipality, which strategically divided the Golden Horn shoreline into seven distinct zones for comprehensive redesign and ecological revitalization. The 7th region, encompassing the stretch between the Galata and Unkapanı bridges, was awarded to the design team Adapt Architects. Their proposal, titled Lebeke, introduces a conceptually rich pedestrian axis that reinterprets the historic coastline through the metaphor of a woven fabric—connecting fragmented heritage sites, Ceneviz gate traces, historic squares, and urban memory fragments along the water's edge. The design promotes a low-intervention approach that restores the area's spatial continuity while foregrounding ecological, cultural, and social values. Crucially, the proposal aligns with the guiding principles of UrbanPlexity game—namely, spatial equity, participatory planning, and the sustainable integration of heritage and contemporary use. Elements such as pedestrianization, the removal of vehicular traffic and surface parking, the reconstitution of the Azapkapı Arastası, and the reinterpretation of lost urban spaces parallel the game's emphasis on historical continuity, experiential learning, and inclusive spatial negotiations.

Parallel academic studies have also conceptualized Perşembe Pazarı as a spatial and cultural "threshold" within Istanbul's urban structure. Güngen and Akpınar's (2018) analysis of Karaköy as an "eşik mekanı" emphasizes how the area negotiates between historical legacies and contemporary spatial practices. In their reading, the "han" structures, interstitial passages, and fragmented street networks of Perşembe Pazarı operate as sites of spatial memory and socio-economic transition. This theoretical framing offers a valuable foundation for UrbanPlexity use of the site as a case study: the game, in its design and evaluation mechanisms,

simulates the interaction of conflicting spatial claims and design values across a transitional urban landscape.

Furthermore, initiatives such as the Open-Source Perşembe Pazarı Design Workshop (2019) and the YTONG Architectural Ideas Competition (2023) have contributed new conceptual layers to the site by promoting participatory production and design cultures. These projects have proposed spatial scenarios that celebrate local craft, propose hybrid “han” typologies, and advocate for the co-existence of heritage and contemporary production landscapes. Importantly, these engagements mirror UrbanPlexity gamified framework, which foregrounds diverse actor participation, strategic decision-making, and adaptive reuse scenarios as critical components of future-oriented urban design.

In this context, the selection of Perşembe Pazarı as a case study within UrbanPlexity research is both methodologically and thematically strategic. As emphasized in municipal heritage documentation Istanbul Metropolitan Municipality's Architectural Heritage Study (2016) and sociological research on spatial segregation (Bahçekapılı, 2020), the area embodies the entanglement of historical continuity, socio-spatial polarization, and redevelopment pressures. It represents an ideal testing ground for serious games that aim to evaluate participatory design, explore the dynamics of co-existence between diverse stakeholders, and negotiate between preservation and transformation. By leveraging these interdisciplinary insights and embedding them into its interface and scenario mechanics, UrbanPlexity not only simulates but actively participates in the broader discourse surrounding the future of contested urban thresholds like Perşembe Pazarı.

5.2. Case-Specific Technical Settings in UrbanPlexity Case Area

Located along the northern shoreline of the Golden Horn within Istanbul’s Beyoğlu district, the Perşembe Pazarı planning area encompasses approximately 9.02 hectares and is bounded by the Galata and Atatürk (Unkapanı) bridges. It occupies a strategic position between the historical port infrastructure and the commercial heart of the city. This location makes it a unique zone where waterfront, urban memory, and intense commercial activity intersect. As visualized in the aerial overview provided by the Istanbul Metropolitan

Municipality (İBB), the area is framed by dense urban texture and historical landmarks, establishing its dual identity as both a transportation corridor and cultural threshold (Figure 5.2).



Figure 5.2 Aerial view of the Perşembe Pazarı planning area showing its location along the northern shoreline of the Golden Horn. Adapted from *Perşembe Pazarı*, by Istanbul Metropolitan Municipality, n.d., retrieved from https://sehirplanlama.ibb.istanbul/ibb-persembe-pazari/

Functionally, the site predominantly hosts commercial activities interwoven with historical structures and artisanal workshops. A functional distribution map

(Figure 5.3) reveals a zoning configuration concentrated around trade, logistics, and crafts-based production, especially along the shorefront and inner streets. The existing urban form is shaped by narrow alleys, fragmented plots, and dense building stock. This configuration introduces spatial constraints that UrbanPlexity models through editable grid cells, object limitations, and gameplay rules rooted in land-use intensity and stakeholder roles.



Figure 5.3 Functional land-use diagram showing commercial zoning and workshop density

Kürkçü Gate, Yağ Gate, Balık Pazarı Gate and Karaköy Gate, located in Figure 5.4, have been identified as the entrance gates that historically regulated access to the Karaköy coastline and surrounding commercial areas. Although these gates no longer function as physical structures, their spatial and historical significance remains embedded in the urban fabric. Within the UrbanPlexity platform, these points were utilized as key reference markers in delineating the boundaries of the project area. In this respect, the game's simulation environment was deliberately limited to the central commercial axis, excluding legally protected monuments and non-intervention zones to preserve historical sensitivity.



Figure 5.4 Map of the project area showing historical entrance gates along the Karaköy waterfront,

By excluding the historical structures themselves and focusing instead on the functional corridors between them, the game environment respects the regulatory constraints applicable to heritage areas, including those defined by the Turkish Conservation Law and local planning guidelines. In this way, UrbanPlexity does

not simulate interventions in historically sensitive parcels but uses their proximity to inform the context of user decisions.

This context-specific configuration was instrumental in defining the design constraints and gameplay logic within UrbanPlexity. The narrow alleyways and heterogeneous parcel sizes found in the area imposed structural limitations that were translated into the game as restricted placement zones, height limits, and object density rules. Additionally, the historical complexity and multifunctional land-use patterns observed in the Perşembe Pazarı district informed the calibration of urban elements within the game. Players were required to reconcile these limitations with scenario-specific objectives, such as improving livability, preserving heritage, and optimizing infrastructure. Through this spatial filtering, the game supports place-based analysis without encouraging direct transformation of protected zones.

By grounding gameplay in the spatial realities and heritage dynamics of the Perşembe Pazarı site, UrbanPlexity transcends abstract simulation and serves as a pedagogical tool that encourages site-sensitive design thinking. As seen across Figure 5.3, Figure 5.4 and Figure 5.5 the integration of aerial mapping, land-use classification, and historical access points creates a multidimensional framework for participatory design. Importantly, the game does not treat the project area as a tabula rasa; rather, it preserves the integrity of key urban artifacts while enabling scenario-based experimentation in adaptable areas. In doing so, the game aligns with contemporary principles of contextual urbanism, reinforcing the value of place-based knowledge, inclusive decision-making, and adaptive planning in shaping sustainable cities.

5.3. Urban Design Alternatives Developed by Participants

Within UrbanPlexity digital participatory tool, diverse user groups contributed varied urban design proposals shaped by their institutional affiliations, professional backgrounds, and personal values. By engaging with a shared urban grid and scenario, participants from the municipality, design experts, supportive institutions, and citizen groups articulated a broad spectrum of urban imaginaries. Each group's output reflects distinct planning rationales and spatial strategies, making visible the complex negotiations that underpin participatory urbanism.

This section synthesizes the commonalities and contrasts among the user groups across five analytical dimensions: planning approach, spatial configuration, sustainability metrics, infrastructural emphasis, and social impact.

Municipality representatives prioritized infrastructural feasibility and long-term policy alignment in their design decisions. G.O. adopted a utilitarian and recreation-focused model with sports courts and centralized parking, generating moderate CoPoint and user satisfaction scores. In contrast, E.O. pursued an ecologically continuous design with integrated green-blue infrastructure, resulting in higher happiness and sustainability indicators. Their contrasting strategies reflect internal variations within municipal planning paradigms, oscillating between technical functionality and social-environmental responsiveness. This demonstrates how institutional planning roles accommodate differing interpretations of sustainability and public interest, even within similar regulatory boundaries.

Design representatives M.G. and M.I. clearly reflected the influence of their professional backgrounds in their spatial configurations. M.G.'s shoreline-oriented layout emphasized pedestrian accessibility, ecological continuity, and visual permeability, aligning with landscape urbanism approaches. In contrast, M.I. structured the coastal area with green spaces, walking paths, and sports facilities, adopting a more interaction-oriented strategy inspired by gamification logic. The divergence between M.G.'s low-infrastructure, nature-based layout and M.I.'s denser, engagement-driven design reveals the potential for interdisciplinary and multi-layered responses to sustainability challenges. Notably, both designs achieved high happiness scores, demonstrating that user satisfaction can be attained not through a singular design methodology, but through the thoughtful application of diverse approaches.

Supportive actors, coming from NGO and private consultancy backgrounds, displayed a clear divergence shaped by their institutional perspectives. M.A. (NGO) proposed a green and inclusive design model that prioritized carbon efficiency and user happiness, avoiding hard infrastructure while emphasizing accessible rest areas and pedestrian pathways. In contrast, D.C. (private sector) adopted a more functional and user-oriented approach by incorporating bicycle lanes, sports facilities, and structured recreational spaces. These differing spatial

outputs reveal how the same design challenge can be approached through varying institutional lenses. Within this context, the supportive actor group highlights the diversity between civic environmental tendencies and practice-driven design strategies in participatory environments.

Citizen representatives S.G. and Ö.G. contributed non-expert yet strategically sound spatial proposals, underscoring the accessibility of participatory tools like UrbanPlexity. S.G. emphasized ecological preservation with minimal intervention, favoring linear green spaces and pedestrian zones. Ö.G. created a balanced layout combining natural and functional features, such as sports areas and structured paths. Their differing approaches produced comparable sustainability scores, affirming the potential of citizens to engage productively with complex urban issues. The visual and metric outputs underscore the value of grassroots perspectives in enriching the planning discourse with alternative priorities and emotional geographies.

Collectively, the UrbanPlexity experiment illustrates that serious game-based tools can surface a rich array of urban design logics, each reflective of participant roles, knowledge bases, and value systems. From municipal pragmatism and professional formalism to institutional positioning and lay intuition, these outputs reveal the democratic and pedagogical potential of digital participation. By enabling comparative visualization and quantification of spatial decisions, UrbanPlexity provides a scaffold for inclusive dialogue, mutual learning, and multi-actor collaboration in urban development processes.

5.3.1 Municipality Representative

The participatory digital design environment of UrbanPlexity provided municipal representatives, G.O. and E.O., with an interactive and gamified platform to engage with urban planning processes. Both participants, acting on behalf of public administration, approached the design task with a mindset shaped by institutional responsibility, constrained resources, and long-term impact. Their efforts to balance technical infrastructure, public accessibility, and ecological sensitivity reflect the multilayered structure of municipal planning.

G.O.'s urban layout (see Figure 5.5) followed an approach that prioritizes active recreation and technical accessibility. Key elements of the design include parking

areas, basketball and tennis courts, and linearly placed trees. This configuration is concentrated in the western part of the Perşembe Pazarı grid and represents a planning rationale focused more on infrastructure. The spatial strategy shows limited landscape diversity and places more emphasis on circulation efficiency rather than visual or environmental richness. While G.O.'s total CoPoint and water usage remains moderate compared to other participants, the happiness score indicates lower user satisfaction, despite the functionality of the layout.



Figure 5.5 UrbanPlexity gameplay output by G.O. (municipality representative).

In contrast, E.O. pursued a more ecologically integrated and socially responsive design. The spatial arrangement (Figure 5.6) demonstrates a compact yet diverse application of green and blue infrastructure along the eastern shoreline. E.O. created a continuous public realm through the integration of small lakes, tree-lined corridors, and pedestrian-oriented resting areas. Sports facilities were also incorporated but organized in a compact cluster to avoid spatial fragmentation. This planning approach, grounded in ecological continuity and user-oriented design, resulted in significantly higher values for happiness, CoPoint, and water consumption, indicating a more socially and environmentally sensitive framework.



Figure 5.6 UrbanPlexity gameplay output by E.O. (municipality representative).

A spatial distribution analysis (Figure 5.7) highlights how both representatives targeted overlapping zones between grid coordinates X:125–130 and Z:130–140. However, the objects used, and the frequency of placement diverge considerably. E.O. appears to have saturated these shared areas with diverse functions trees, green strips, and resting nodes while G.O. primarily focused on technical facilities such as courts and parking. This spatial divergence, despite nominal overlap, reveals differing urban imaginaries shaped by individual planning priorities within a shared policy environment.

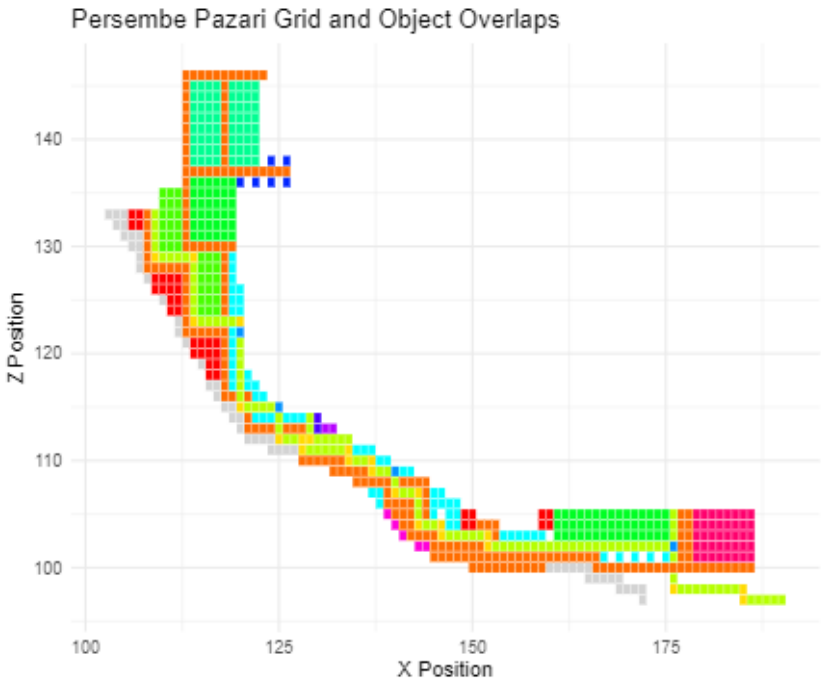

Figure 5.7 Spatial overlap and distribution of municipal actor decisions on Perşembe Pazarı grid (from UrbanPlexity backend analysis).

These contrasting strategies are further substantiated by the numerical data and performance indicators recorded during gameplay (Table 5.1). While G.O.'s model represents a pragmatic, infrastructure-first approach reflective of transportation planning and recreational zoning, E.O.'s design illustrates a more holistic urban vision that integrates environmental sensitivity, social cohesion, and spatial legibility. Their differing CoPoint and water usage values provide further insight into how municipal actors operationalize sustainability: either as an infrastructural requirement or as a qualitative layer embedded within the urban experience.

Table 5.1 Comparative preferences of municipality representative participants in UrbanPlexity

Criterion	E.O. (Municipality)	G.O. (Municipality)
Planning approach	Green infrastructure and social balance	Recreation-oriented, sports + parking emphasis
Sports facilities	Clustered on east, integrated	Distributed across west, technical
Ecological elements	Diverse, shoreline continuity	Sparse, linear trees
Parking areas	Minimal, pedestrian-priority	Centralized, functional necessity
CoPoint	2314	1630
Water need	7992	3997
Happiness	19047	13086

Ultimately, this comparative analysis illustrates how a game-based participatory design tool like UrbanPlexity can successfully reveal the spectrum of municipal planning behaviors. The structured environment allows users to express their professional insights and design preferences while engaging with constraints such as limited budgets, carbon targets, and stakeholder satisfaction. The visualization of these divergent strategies through spatial overlays and metric dashboards reinforces the value of serious games in participatory governance, not only as engagement tools but also as tools for comparative evaluation and planning pedagogy.

5.3.2 Designer Representative

Within UrbanPlexity game environment, two participants representing the designer category—both experts from architecture and urban planning—engaged in spatial decision-making through the lens of their disciplinary expertise. These participants, anonymized as M.G. and M.I., approached the design task with distinct priorities and methodological frameworks. While both participants worked within the same urban context, their divergent strategies provide insight into how professional background, technical training, and user-centered design philosophies influence urban form generation in a digital participatory tool.

M.G.'s urban design proposal exhibited a linear and integrated approach, concentrating along the eastern shoreline of the Perşembe Pazarı game area. The spatial configuration included a balanced placement of pedestrian pathways, small water features, resting zones, and continuous green infrastructure such as tree alignments and green corridors. M.G.'s design avoided rigid zoning and instead prioritized spatial continuity and walkability, which resulted in higher happiness scores and low water consumption. This layout strategy can be interpreted as a reflection of M.G.'s commitment to ecological integrity and human-scale urbanism, emphasizing the affordances of the site for public life and recreational use (Figure 5.8).



Figure 5.8 End-of-game urban design by designer 1 (M.G.) in UrbanPlexity

In contrast, M.I. approached the design task with a modular and infrastructure-supported planning logic, placing emphasis on high-density usage and functional zoning. M.I.'s design centered around a western-axis composition, integrating elements such as football fields, basketball courts, dual parking systems, and systematically arranged green islands. The grid-based modulation of M.I.'s spatial decisions suggests an analytical and parametric mindset, aimed at maximizing utility and spatial efficiency. This method yielded the highest happiness score among the designer group, albeit with greater water usage, indicating an intensively programmed landscape that favors structured leisure and vehicular access (Figure 5.9).



Figure 5.9 End-of-game urban Design by designer 2 (M.I.) in UrbanPlexity

When visually analyzed through the spatial distribution grid (Figure 5.10), it becomes evident that both designers utilized complementary yet distinct strategies. M.G.'s placements clustered along the eastern band (X: 160–190), where soft landscaping and water-based features dominated. The spatial language here is more permeable and organically arranged, underscoring user comfort and environmental responsiveness. Conversely, M.I.'s interventions were concentrated in the western-central grid (X: 90–115), characterized by dense object repetition and formal order, likely aiming to optimize land use and infrastructure capacity. This clear contrast highlights the methodological variance in how architects and planners interpret the same spatial problems under participatory conditions.

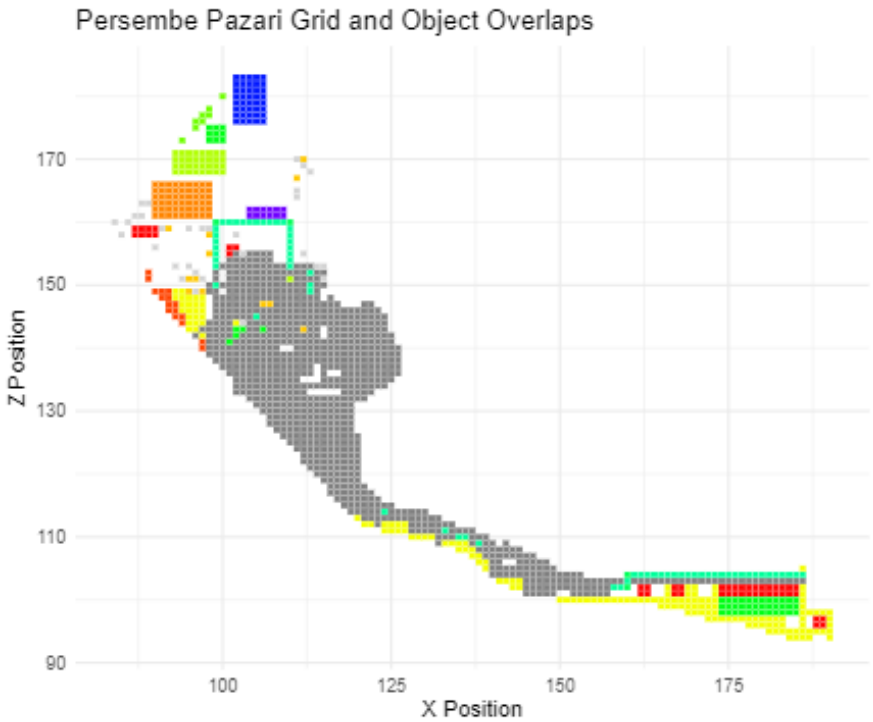

Figure 5.10 Spatial distribution and overlaps of placed urban objects in the Perşembe Pazarı area by designers

A comparative review of their placement metrics (Table 5.2) further illustrates these contrasts. M.I. recorded the highest coPoint score, likely as a result of incorporating sustainable infrastructure elements such as compacted green areas and minimizing transport-related emissions. Meanwhile, M.G., although scoring lower environmental impact, achieved a better balance between ecological harmony and social usability, especially by omitting motorized infrastructure. Interestingly, both designs avoided over-reliance on hard infrastructure like extensive road networks or large-scale buildings, suggesting a shared disciplinary awareness of soft urbanism principles and sustainable landscape design.

Table 5.2 Comparative preferences of designer participants in UrbanPlexity game

Criterion	M.G. (Designer 1)	M.I. (Designer 2)
Planning approach	Linear and integrated shoreline	Modular, functional park layout
Sports facilities	Low to medium density	High-density, diversified
Ecological elements	Lakeside + tree alignments	Lake + dense green island modules
Parking areas	Not included	Dual-system parking areas
CoPoint	1327	2936
Water need	7987	9492
Happiness	18118	21405

These distinctions between M.G. and M.I. reflect the interpretive flexibility offered by UrbanPlexity design tool, which allows experts to test planning scenarios based on their own priorities while being constrained by sustainability metrics and budgetary frameworks. The differences in object types, densities, and spatial distributions affirm that the tool not only captures preference diversity but also serves as a pedagogical medium for exploring divergent planning approaches. Areas of intersection further demonstrate the value of UrbanPlexity in identifying points of spatial consensus among experts with different perspectives.

Building on these dynamics, the designer category's outputs within UrbanPlexity illustrate how the game can capture professional nuance and theoretical orientation through in-game decisions. While M.G. emphasized continuity, accessibility, and ecological integration, M.I. delivered a compact, function-oriented design grounded in spatial economy. Both participants contributed meaningfully to the game environment, demonstrating that digital participatory tools can successfully host and distinguish between varying professional

interpretations of sustainable urban design. These findings reinforce the significance of incorporating diverse expert perspectives in game-based participatory planning tools.

5.3.3 Supportive Actor Representative

In the UrbanPlexity game environment, participants representing supportive actors specifically from the NGO sector and private consultancy demonstrated distinct spatial strategies that reflect their institutional orientations and priorities. The participants, anonymized as M.A. (NGO) and D.C. (private sector), were assigned the same design scenario but approached the urban intervention task with noticeably different emphases, which can be interpreted through their respective placements and sustainability metrics. These differences are visually documented in Figure 5.11 and Figure 5.12, which display the post-game urban design layouts of each participant.

Figure 5.11 illustrates M.A.'s (NGO) spatial strategy, which prioritizes ecological and public space development. The design includes a high frequency of soft landscape elements such as roadside green units, tree-lined pedestrian paths, water features, and open rest areas. These selections not only maximize carbon reduction but also reflect a user-centric planning approach, evidenced by a high happiness score. Notably, M.A. avoided large-scale sports or parking facilities, maintaining a focus on inclusivity and walkability. M.A.'s design clusters around the southeast quadrant of the grid, reinforcing edge connectivity and spatial permeability toward the waterfront.



Figure 5.11 End-of-game urban design by NGO representative (M.A.)

In contrast, D.C. (private sector), as shown in Figure 5.12, implemented a more functionally driven zoning strategy. The layout emphasizes infrastructural efficiency and multi-use recreational areas. Key elements include designated parking zones, multiple sports courts such as tennis and basketball, and linear green islands positioned around the lake. This approach reflects an investment-oriented rationale typical of development consultancy perspectives, with a focus on maximizing utility and land value. As a result, although the coPoint and happiness scores are lower compared to the counterpart's, the design demonstrates stronger performance in water usage and monetary efficiency, indicating a clear prioritization of constrained resource management.



Figure 5.12 End-of-game urban design by private sector representative (D.C.)

The comparative spatial distribution and overlap of design elements between the two participants are presented in Figure 5.13. This visual analysis reveals not only the density of individual placements but also the grid zones where design strategies intersect. Notably, shared interventions are concentrated in bands X:110–130 and X:175–185, where both actors identified critical zones for pedestrian access and open space development. However, their object selections within these zones differ significantly—M.A. favored natural features and green infrastructure, while D.C. deployed sports facilities and vehicle-oriented functions.

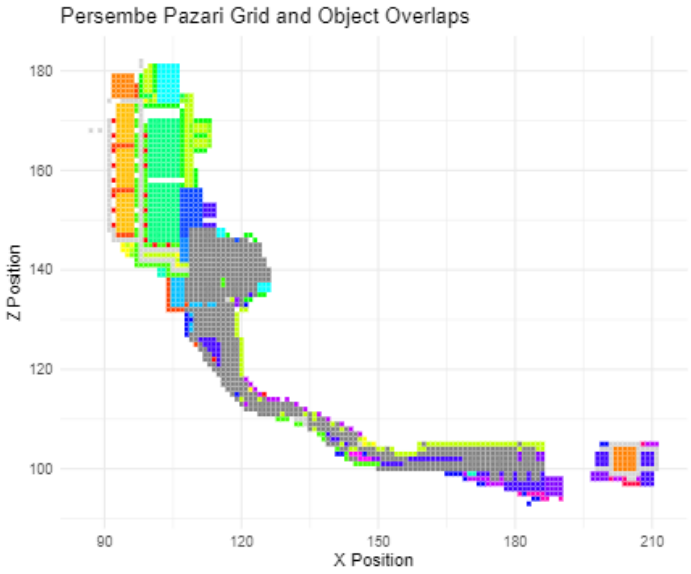

Figure 5.13 Spatial distribution and overlaps of placed urban objects in the Perşembe Pazarı area by supportive representatives

These differences in spatial logic are further clarified in Table 5.3, which outlines the participants' thematic focus areas, ecological sensitivity, and resource investments. M.A. exhibits a more environmentally and socially integrated planning approach, with low economic prioritization. D.C., on the other hand, reflects a technocratic and economically rational orientation, favoring structured recreational typologies and budget-conscious land use. This comparison confirms the game's capacity to model planning dilemmas grounded in institutional frameworks and professional roles.

Table 5.3 Comparative preferences of supportive actor representatives in UrbanPlexity

Criterion	M.A. (NGO)	D.C. (Private Sector)
Planning approach	Green infrastructure and public space emphasis	Infrastructure and investment-oriented
Sports facilities	Pedestrian paths, tree lines, water elements, rest areas	Sports courts, parking zones, lakeside edges
Ecological elements	Lakeside + tree alignments	Lake + dense green island modules
Parking areas	Not included	Dual-system parking areas
CoPoint	3232	1546
Water need	7973	4460
Happiness	23317	9914

Overall, this segment of UrbanPlexity experiment highlights the divergent rationalities between non-governmental and private actors in shaping urban space. While M.A.'s design aligns with civic environmentalism and participatory planning ideals, D.C.'s approach resonates with professional consultancy-driven outcomes emphasizing infrastructure and investment. The visual and numerical outputs provide not only a diagnostic of user strategies but also a template for understanding institutional diversity in urban decision-making.

5.3.4 Citizen Representative

UrbanPlexity gameplay experience revealed that even individuals without formal design or planning education can engage with urban space through meaningful and strategic decisions. In this context, two citizen participants, S.G. and Ö.G., contributed distinct spatial strategies that demonstrate how environmental

awareness, personal preferences, and aesthetic sensibilities can shape non-expert urban design practices. Despite lacking institutional affiliation or technical expertise, their decisions addressed crucial aspects of sustainability and social well-being.

S.G.'s design strategy placed strong emphasis on natural continuity and environmental preservation. Spatial interventions were concentrated along the eastern shoreline of the map, with a preference for linear green infrastructure and object placements that aligned with ecological sensitivity. As depicted in Figure 5.14, S.G. avoided heavy infrastructure interventions, instead of employing tree alignments, green corridors, lakeside elements, and resting areas. This resulted in a spatial composition that prioritized ecological sensitivity and calm, pedestrian-oriented experiences. S.G.'s final scores, particularly in the "Happiness" metric, demonstrate that this environmentally grounded approach still resonated with the simulated user satisfaction model.



Figure 5.14 End-of-game urban design by citizen representative (S.G.)

By contrast, Ö.G.'s placement pattern reflected a more systematic and hybridized approach. Ö.G.'s spatial arrangement included structured green alignments, walkways, and sports infrastructure, striking a balance between natural and technical components. Ö.G.'s design, shown in Figure 5.15 reflects a rational prioritization strategy that attempted to incorporate functionality and recreation into a cohesive whole. Ö.G.'s final scores also underscore the success of this

approach. The happiness score, along with environmental and economic indicators, showed a balanced and proportional distribution across all four metrics. These scores suggest a successful attempt to maximize multi-criteria performance without over-relying on any single factor.



Figure 5.15 End-of-game urban design by citizen representative (Ö.G.)

Figure 5.16 visually presents how S.G. and Ö.G. distributed their design elements across the grid. The color-coded areas show their individual placements, while the gray cells indicate overlapping positions. Notably, the X: 125–135 and Z: 130–140 grid bands emerged as shared hotspots where both participants assigned spatial value. However, while S.G. placed natural elements in these areas, Ö.G. chose more functional, amenity-based objects. This divergence reveals the multiplicity of possible design narratives even within a shared site and supports the use of serious games for participatory urban planning.

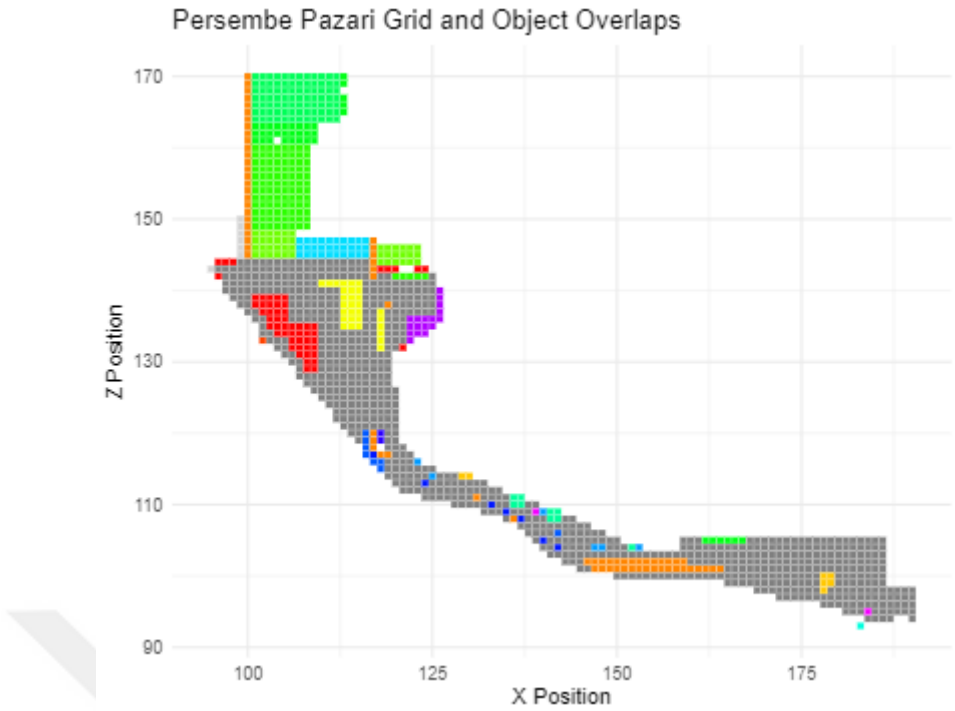

Figure 5.16 Spatial distribution and overlaps of placed urban objects in the Perşembe Pazarı area by citizen representatives

Moreover, this comparison highlights that S.G. adopted a more ecological, preservation-driven strategy, while Ö.G. opted for a balanced approach integrating green infrastructure with social facilities. Despite these differences, both participants contributed to the game environment's design diversity, aligning with UrbanPlexity goal of visualizing heterogeneous urban imaginaries. This insight is crucial for future participatory processes, as it suggests that inclusive design tools can successfully harness the voices of non-experts in productive ways.

These differences in spatial logic are further clarified in Table 5.4, which compares participants' design intentions, ecological emphasis, and engagement with infrastructure. S.G.'s intervention illustrates a preservationist attitude centered on environmental harmony, low intervention, and the prioritization of user comfort through soft landscape typologies. In contrast, Ö.G.'s layout is marked by a pragmatic balance of natural and functional elements, introducing structured recreation and access systems while maintaining a prominent level of ecological sensitivity. Their distinct strategies reflect divergent individual value systems and interpretations of urban livability, despite their shared non-professional background.

Table 5.4 Comparative preferences of citizen participants in UrbanPlexity

Criterion	S.G.(Citizen1)	Ö.G.(Citizen2)
Planning approach	Preservation of natural structure	Balanced – technical + natural
Sports facilities	Pedestrian paths, tree lines	Sports courts, parking zones, lakeside edges
Ecological elements	Lakeside + tree alignments	Lake + dense green island modules
Parking areas	Not included	Dual-system parking areas
coPoint	2,194	2,398
Water Need	7,975	7,993
Happiness	15,909	18,771

Overall, this portion of UrbanPlexity experiment underscores the versatility of non-expert stakeholders in contributing to urban planning dialogues. S.G.'s minimalistic and eco-conscious design channels grassroots environmentalism and a restorative vision of public space, whereas Ö.G.'s layout evokes a user-focused pragmatism with moderate infrastructure integration. The visual mappings and performance indicators collectively demonstrate that serious games such as UrbanPlexity can serve as tools not only for participatory input but also for revealing the nuanced preferences of ordinary citizens. These contributions, while distinct from those of institutional actors, offer critical insights into the democratic potential of urban design processes.

5.4. Pre-Post Gameplay Experiences: Expectations and Feedback

UrbanPlexity game was designed not only as a spatial decision-making environment but also as an experiential tool to investigate how various stakeholders ranging from institutional actors to everyday citizens interpret, engage with, and evaluate participatory urban design processes. This section synthesizes the pre- and post-game reflections of four actor groups (municipality representatives, designers, supportive actors, and citizens), highlighting how initial expectations evolved through interaction with the game. These reflections offer critical insights into the transformative capacity of gamified tools in urban governance, especially in contexts where participatory processes are often criticized for being tokenistic or procedurally limited.

Prior to gameplay, participants from all groups demonstrated a shared skepticism regarding the efficacy of conventional participation methods. Municipal actors expressed doubts about the operationalization of citizen input, designers raised concerns about the dilution of professional authority, supportive actors questioned the symbolic nature of participation, and citizens showed uncertainty about their technical adequacy. Despite these reservations, all actor groups acknowledged a theoretical interest in inclusive decision-making and hoped that UrbanPlexity would serve as a more structured, visual, and feedback-driven alternative to existing participation mechanisms. These expectations formed the evaluative lens through which participants later assessed their gameplay experiences.

Following the game sessions, participant responses revealed a broad re-evaluation of participatory potential. Municipality and supportive actors noted how the game enabled structured scenario testing within defined constraints, while designers emphasized the value of transparent trade-off modeling and feedback loops. Citizens, in turn, experienced a shift in self-perception—from passive observers to active co-creators, indicating that digital tools can bridge knowledge gaps and support civic learning. Across all categories, the tool's ability to visualize sustainability metrics and simulate actor interdependence was frequently cited as its most impactful feature. These findings suggest that serious games can

recalibrate participation from a procedural obligation to reflective and generative practice.

In summary, the pre- and post-game reflections gathered from each stakeholder category underscore the relevance of UrbanPlexity as both a diagnostic and pedagogical tool. The game environment facilitated not only spatial experimentation but also meta-cognitive learning regarding governance, design, and agency. While each group maintained some of their initial reservations such as concerns about policy integration or interface abstraction, the shared recognition of the game's analytical rigor and educational potential affirms its utility within broader participatory frameworks. This section therefore provides empirical grounding for the claim that serious games like UrbanPlexity can reframe how diverse urban actors engage with one another and with the built environment.

5.4.1 Municipality Representative

Prior to engaging with UrbanPlexity tool, the municipal representatives, G.Ö. and E.K., both conveyed a nuanced yet critical perspective regarding the limitations of participatory mechanisms in urban design practices. A municipal representative (G.Ö.), drawing on administrative experience at the Istanbul Metropolitan Municipality, emphasized that citizen participation is frequently limited by the general public's lack of technical fluency. G.Ö. noted that although public engagement is legally embedded in planning procedures, it often manifests as symbolic inclusion rather than substantive involvement. Likewise, E.K. acknowledged that participation in smaller municipalities tends to be uneven and mediated by political or personal proximity to decision-makers, leading to a skewed representation that undermines the democratic ethos of urban governance.

Both representatives strongly advocated multi-actor decision-making frameworks, underscoring that inclusive design processes enhance the legitimacy and applicability of urban interventions. However, they also shared concerns about the absence of effective tools and structured models for translating public input into actionable strategies. According to them, current methods of participation, such as public meetings or interviews, fail to engage citizens in a meaningful or sustainable way. Instead, they expressed optimism about digital and gamified

tools like UrbanPlexity, which they believed could fill this methodological gap by offering visual, interactive, and feedback-based tools that improve both citizen comprehension and institutional responsiveness.

Following their gameplay experience, both participants reported a perceptible shift in their understanding of how participatory tools could be operationalized in municipal contexts. E.K. highlighted the game's ability to simplify complex urban systems and make sustainability-oriented thinking more accessible. E.K. appreciated the way UrbanPlexity allowed users to experiment with spatial configurations while receiving real-time feedback on their decisions, thereby reinforcing informed judgment. G.Ö., on the other hand, focused more on the potential institutional applications of the game. G.Ö. found value in how the tool encouraged structured decision-making under constraints such as budget, space, and environmental indicators, arguing that such simulations could be integrated into municipal workshops and scenario planning exercises.

One significant area of convergence between the two municipal actors was their appreciation for UrbanPlexity capacity to simulate participatory decision-making in a measurable and reproducible way. Both recognized that, by facilitating a transparent feedback loop, the game allowed municipalities to evaluate the effectiveness of public suggestions without relinquishing technical control. Furthermore, the tool's adaptability to different spatial scales and demographic profiles was seen as a critical advantage in planning environments characterized by complexity and diversity.

Nonetheless, their post-game reflections also revealed some divergences. E.K. emphasized the role of UrbanPlexity as an educational tool that could empower citizens through digital literacy and experiential learning. The focus of E.K. was on democratizing access to planning tools. In contrast, G.Ö. was more concerned with how such tools could be integrated into formal governance workflows. G.Ö. advocated for expanded multiplayer functionalities and suggested that the tool be used not just as a public outreach mechanism but also as a policy simulation environment within municipal teams.

Consequently, the reflections of these municipal representatives illustrate the transformative potential of participatory game environments like UrbanPlexity.

While both entered the study with a critical view of existing participation models, their experience with the tool led them to endorse its capacity to act as both an inclusive engagement tool and a strategic planning instrument. These complementary perspectives, one based on citizen empowerment and the other on institutional integration, highlight the need for hybrid methods to bridge the gap between top-down governance and bottom-up participation.

5.4.2 Designer Representative

Before using the UrbanPlexity tool, design participants M.G. (architect) and M.I. (urban planner) expressed cautious optimism and professional skepticism about the feasibility of participatory design mechanisms. M.G. emphasized that, although participation is often valued in theory, its practical application tends to be limited, especially in contexts where professional expertise is seen as dominant. M.G. questioned the quality of input received from lay citizens and raised concerns about the fragmentation of responsibility in participatory planning efforts. M.I., however, offered a more pragmatic stance: while acknowledging the constraints of conventional participatory tools, M.I. argued that they could be productive if structured properly and aligned with professional processes. For both participants, gamification was initially viewed as a curious but underexplored modality in urban design.

In discussing expectations for UrbanPlexity tool, both participants highlighted the need for tools that could simplify technical constraints without trivializing the design process. M.G. voiced a desire for the tool to provide spatial feedback loops that would allow participants to experiment with different arrangements while considering environmental and social indicators. M.I. emphasized the importance of seeing how individual decisions aggregate at a larger scale and affect system-wide outcomes. Both designers expressed interest in whether the game could accommodate the complexities of urban planning such as density thresholds, circulation flows, and spatial hierarchies within a navigable digital platform.

After completing UrbanPlexity gameplay, both M.G. and M.I. reflected positively on the structured constraints and real-time feedback mechanisms integrated into the tool. M.G. appreciated how the game subtly embedded professional planning logic—such as spatial layering and infrastructure connectivity—into its decision-

making framework without requiring high-level technical knowledge. M.I. praised the way the game enabled modular planning strategies, which aligned with an understanding of phased and flexible urbanism. M.I. especially highlighted the dashboard elements that reflected sustainability outcomes, suggesting that these were key for communicating the value of professional trade-offs to a wider public.

Despite these convergences, their post-game reflections diverged on the question of public integration. M.G. maintained a degree of skepticism, noting that while the game successfully simulated spatial planning dynamics, it might still be too abstract or constrained for citizens unfamiliar with design literacy. M.G. recommended the development of layered interfaces tailored to different user types. M.I., by contrast, believed that the tool's simplified logic was an asset that enabled non-experts to meaningfully engage in complex decision-making. M.G. saw UrbanPlexity as a potential educational tool in participatory workshops, capable of nurturing spatial awareness among community members.

Nevertheless, both participants agreed that the game's capacity to render trade-offs transparent was its most significant contribution. They noted that the embedded indicators for carbon footprint, water consumption, and stakeholder happiness allowed for a multidimensional evaluation of urban design strategies, effectively bridging qualitative intuition with quantitative outcomes. They also expressed that this alignment with sustainability goals reflected contemporary paradigms in design education and practice.

In summary, the feedback from the designer representatives reveals a dual validation of UrbanPlexity: as a professional planning simulator and as a participatory interface. Their differing views on its accessibility to non-experts underscore the challenge of designing universally intuitive tools, but their shared recognition of the game's methodological rigor and sustainability metrics confirms its relevance. Together, their responses underscore the potential of serious games to foster more reflective, transparent, and pedagogically grounded approaches in participatory urban design.

5.4.3 Supportive Actor Representative

Before the gameplay, the supportive actor participants, M.A., a representative from a non-governmental organization, and D.C., a private sector consultant specializing in sustainable cities, articulated distinct expectations grounded in their professional orientations. M.A. emphasized the need for participatory tools that democratize decision-making and reflect the values of social inclusion, ecological justice, and inter-institutional dialogue. M.A.'s primary concern was whether the game could move beyond symbolic participation and offer a structured environment in which data gathered from participants could inform actual urban policies. In contrast, D.C. approached UrbanPlexity game from a pragmatic and outcome-oriented perspective, focusing on whether it could serve as a planning support system that facilitates efficient stakeholder coordination, resource allocation, and long-term strategy development.

In terms of expectations, both participants expressed interest in whether the game would be capable of visualizing trade-offs between ecological, economic, and social parameters. M.A. was particularly curious about how the interface might allow non-experts users to express their values meaningfully while staying within the bounds of technical feasibility. M.A. also highlighted the importance of simulating conflicting stakeholder priorities in a way that encourages mutual understanding. D.C., on the other hand, was more concerned with the tool's capacity for real-time evaluation and strategic scenario modeling. D.C. expected the game to include mechanisms for negotiation, compromise, and performance measurement, particularly in terms of quantifiable sustainability indicators.

Following the gameplay, M.A. expressed satisfaction with the game's capacity to facilitate layered decision-making without overwhelming users. M.A. appreciated the presence of tangible sustainability metrics and valued the opportunity to observe how decisions impacted broader urban systems in real time. M.A. particularly highlighted the user-friendly interface, which allowed for nuanced spatial strategies that aligned with M.A.'s organization's advocacy for ecological preservation and inclusive public spaces. D.C., meanwhile, praised the structured format of the game, noting that the grid-based placement system and feedback metrics supported clear evaluation and adaptation. D.C. also emphasized the

usefulness of role-specific parameters and limitations in simulating participatory urban planning dynamics.

Despite this overall satisfaction, their reflections diverged in terms of usability and scalability. M.A. remained cautious about the degree to which the game could influence institutional decision-making beyond the simulation itself. M.A. emphasized that digital tools must be accompanied by strong governance frameworks to translate participatory outcomes into actual policy shifts. D.C. criticized the limited granularity of cost modeling and called for greater integration of economic forecasting tools. Both participants, however, agreed that the game provided a rare opportunity to examine spatial proposals within a system that demands trade-offs, accountability, and empathy toward other actors' perspectives.

A point of convergence emerged around the idea that UrbanPlexity could serve as a pedagogical and institutional intermediary. M.A. viewed it as a potential civic education tool for local communities, while D.C. saw it as a strategic planning prototype to be used in stakeholder workshops. They both highlighted the benefit of a shared visual and numerical framework that made institutional dialogues more productive and transparent. The balance between intuitive design and structured simulation was identified as a key strength that enabled diverse actors to engage without prior expertise.

Consequently, the perspectives of the supportive actor participants affirm UrbanPlexity capacity to engage stakeholders with different institutional logics. While M.A. brought a normative, advocacy-driven approach centered on social and environmental ethics, D.C. introduced a strategic, efficiency-oriented lens. Their responses illustrate how serious games like UrbanPlexity can bridge ideological divides and create a common tool for data-informed negotiation, scenario building, and reflective planning in participatory urban design.

5.4.4 Citizen Representative

Prior to gameplay, the citizen participants, S.G. and Ö.G., approached UrbanPlexity experience with markedly diverse levels of confidence and familiarity with urban design processes. S.G. openly expressed limited knowledge of planning principles and highlighted uncertainty about whether any

contributions could carry meaningful weight. Expectations were modest and focused on gaining awareness of how urban spaces are shaped, as well as exploring whether intuitive values such as the need for green spaces or pedestrian comfort could be expressed within a digital design environment. Ö.G., by contrast, had previously engaged with participatory projects at a surface level, such as online voting for public space competitions, and was curious to see if this game would allow for more active, creative, and structured input. Ö.G.'s expectations focused on whether the game would simulate the tensions between distinctive design priorities and allow ordinary users to understand the constraints faced by experts.

During pre-game interviews, both participants revealed a desire to feel empowered in their decision-making despite their non-expert backgrounds. S.G. emphasized the importance of a safe and accessible tool that would allow S.G.'s to learn by doing, especially through visual cues and simple cause-effect relationships. S.G. hoped the game would enhance environmental awareness and provide clarity on the relationship between design choices and urban livability. Ö.G., on the other hand, anticipated that the game would replicate the tensions found in planning, such as balancing economic viability, environmental integrity, and public satisfaction, while preserving creative flexibility. Ö.G. hoped the game would offer metrics or feedback systems to validate decisions and enable comparison with other design approaches.

After gameplay, both participants reflected positively on their experience. S.G. noted a significant increase in confidence, stating that the visual design of the interface supported a clearer understanding of key urban design principles. S.G. appreciated the ability to see the real-time impacts of decisions on metrics such as water consumption and public happiness, and felt that the resulting design reflected core values, particularly ecological sensitivity and social well-being. The intuitive placement system and the emotional satisfaction of creating a space that could be imagined as inhabitable were especially valued. Ö.G. also described the gameplay as engaging and insightful. The strategic thinking it required and the way the feedback system encouraged consideration of trade-offs were particularly appreciated. It was noted that the game increased awareness of the challenges

involved in accommodating diverse needs and actors, which would inform future perspectives on urban transformation.

Their reflections revealed both alignment and divergence. Both participants agreed that the game served as a useful awareness-raising tool, especially in terms of understanding how individual actions relate to broader urban systems. They also appreciated the way the game emphasized sustainability not just as an abstract ideal, but as something embedded in tangible, measurable decisions. However, their interpretations of space differed. S.G. maintained a more emotional and aesthetic connection to green and blue infrastructure, whereas Ö.G. demonstrated a more functional approach, integrating recreational and infrastructural elements more systematically. These differences highlight the diversity of citizen perspectives and the capacity of UrbanPlexity to accommodate a range of experiential backgrounds and values.

A notable point of convergence was their shared recognition of the game as a form of democratic expression. Both participants felt that UrbanPlexity allowed them to make informed, reflective, and individually meaningful decisions within a system that also encouraged consideration of public good. They also emphasized the importance of feedback in validating their contributions, noting that real-time changes in environmental and social indicators helped them understand the complexities of planning without needing professional knowledge. This suggests the tool's potential for not only data collection but also civic learning and capacity building.

Reflecting this context, the citizen participants' experiences demonstrate that serious games like UrbanPlexity can significantly enhance non-expert engagement in urban design. While their prior knowledge and design logic varied, both S.G. and Ö.G. were able to translate personal values into spatial strategies and reflect critically on the outcomes. The game functioned as both a pedagogical and participatory tool, providing users with a sense of agency while also reinforcing the interconnectedness of environmental, social, and economic dimensions in urban development. Their participation affirms the potential of gamified tools to democratize complex design processes and broaden the epistemic community of urban planning.

5.5. Comparative Stakeholder Insights

This section presents a systematic comparison of the spatial strategies, decision-making logics, and sustainability priorities of four stakeholder groups participating in the UrbanPlexity game. By analyzing how each group acts in unique yet interconnected ways in the participatory game environment, this comparative synthesis reveals how institutional contexts, professional expertise, and personal values shape urban design processes. The following paragraphs elaborate on these contributions, highlighting the potential of serious games to reveal nuanced design logics in participatory urban planning processes and to foster inclusive, data-driven dialogues.

Municipality representatives viewed UrbanPlexity as an opportunity to simulate planning scenarios within a structured decision-making environment. The internal diversity of municipal planning paradigms is reflected in one's focus on functional, infrastructure-first designs, while the other includes ecological and social dimensions. Despite sharing a common policy framework, the differences in the spatial strategies of the two participants illustrate how municipal actors balance technical requirements with broader sustainability goals. The game results show how serious games contribute to revealing these internal differences and critically assessing the complexity of municipal planning practices.

The designers, as representatives of the architecture and urban design ex, transformed their expert perspectives into strikingly different spatial arrangements. One participant preferred a linear and ecologically integrated approach that prioritized pedestrian access and environmental sensitivity, while the other adopted a modular, functional layout that emphasized density and infrastructural efficiency. These differences demonstrate the diversity of expert approaches to urban design issues, despite using the same participatory tool. Despite their differences, both designs achieved high user satisfaction scores, demonstrating that professional expertise, when applied carefully, can accommodate multiple interpretations of sustainability and habitability.

The supporting actors, representatives of a civil society organization and a private sector consultant specializing in sustainable cities, clearly demonstrated how institutional missions shaped participatory urban interventions. The civil society representative adopted a design approach focused on green infrastructure, prioritizing environmental justice and social accessibility, emphasizing carbon efficiency and the quality of public space. In contrast, the private sector consultant developed a settlement model that includes elements such as multifunctional sports fields, structured parking lots, and green islands around the lake, and aims to optimize spatial value through usage efficiency. This approach reflects the logic of investment and spatial value production, which is often seen in urban consultancy perspectives. The participatory game environment makes it possible to evaluate the effects of institutional perspectives on spatial priorities and sustainability criteria from a comparative perspective by revealing these differences.

Citizen participants with non-expert training or institutional affiliation developed creative and balanced spatial proposals that included both ecological and functional elements. While one participant presented a design approach that enriched pedestrian paths, preserved natural structures, and required low intervention, the other proposed a more balanced model that integrated green infrastructure with regular walkways and social facilities. These differences demonstrate how personal values and daily experiences are reflected in participatory design processes, revealing the inclusiveness and accessibility of digital tools such as UrbanPlexity. The ability of citizen participants to make feasible and sustainable spatial decisions without having expert knowledge strengthens the democratic potential of game-based participation in urban planning.

Taken together, these observations suggest both commonalities and differences across stakeholder groups. While all groups embraced sustainability as a core design criterion and valued UrbanPlexity feedback-oriented, interactive environment, their spatial strategies and priorities differed significantly. While the municipality and supporting actors emphasized policy alignment and structured processes, designers and citizens explored the more fluid, experiential dimensions of urban space. This comparative synthesis suggests that serious games can bring

together professional, institutional, and everyday perspectives to support not only participatory contributions but also mutual understanding, critical thinking, and fairer decision-making processes.

6
CONCLUSION

This thesis investigates the potential of the digital serious game UrbanPlexity as a participatory support tool in complex and contested urban design contexts. It focuses on how a structured and rule-based tool environment can foster user engagement, promote awareness of sustainability considerations, and encourage non-expert stakeholders to explore spatial decision-making processes. Grounded in participatory design theory, gamification literature and urban sustainability frameworks, the study does not claim to offer definitive design solutions. Instead, it presents UrbanPlexity as a simplified yet experientially rich platform that produces indicative data to support the early stages of urban planning. The game does not replace expert authority or formal planning mechanisms; rather, it functions as a supplementary medium that helps visualize trade-offs, reveal stakeholder tendencies, and create a participatory base for further design development.

The findings of the empirical study conducted in the Perşembe Pazarı district of Istanbul suggest that serious games may provide meaningful support in participatory urban design by enabling individual stakeholders to engage with complex planning scenarios. Based on gameplay sessions involving participants from four actor categories including municipality representatives, designers, supportive actors and citizens, UrbanPlexity appeared effective in encouraging user engagement, enhancing awareness of diverse perspectives, and integrating sustainability-focused considerations into design thinking. Although the spatial outcomes and post-game reflections indicated that participants became more aware of ecological, economic and social trade-offs in urban planning, these insights should be regarded as preliminary and indicative rather than prescriptive. The tool allowed participants to explore preferences and strategies within a defined system; however, the limited object set and rule-based structure inevitably influenced player behavior and possible solutions. Therefore, the results produced through gameplay should be seen as informed input for reflection rather than finalized urban planning outcomes.

In direct response to the research questions, several conclusions can be outlined. First, serious games such as UrbanPlexity have the potential to offer more engaging and accessible participatory experience compared to conventional methods. This is particularly evident in the increased motivation and confidence reported by citizen participants and the expressed interest of municipal representatives in exploring new tools for public engagement. Second, the use of real-time feedback indicators such as CoPoint, NeedWater, MoneyValue and Happiness enabled participants to observe the immediate consequences of their design actions. Although these metrics are simplified representations, they contributed to more reflective behavior and introduced sustainability-related thinking into the gameplay process. Third, the structured and rule-based nature of the game supported the simulation of constrained planning decisions. It allowed participants to engage in competing priorities in a controlled environment. However, these tools should be understood not as definitive design solutions but as supportive frameworks that inform decision-making. UrbanPlexity does not aim to produce final spatial outcomes; rather, it offers a structured environment that enables participants to engage with the complexities of urban design. In doing so, it addresses a critical gap in participatory planning by creating a bridge between stakeholder perspectives and design processes. The tool functions as a preparatory layer that helps generate context-sensitive input, which can ultimately contribute to more informed and inclusive planning outcomes.

Most importantly, the game revealed the coexistence of multiple planning rationalities, including ecological, technical, user-centered and institutional approaches. While each actor group engaged with the design tasks through distinct priorities and levels of expertise, all participants were able to interact meaningfully with the system. This indicates that UrbanPlexity can accommodate diverse knowledge bases, roles, and participation intentions. However, the game's capacity to support inclusive engagement also introduces questions of control and governance. Since the design logic, feedback mechanisms, and object libraries are predefined by the developer, the system reflects the assumptions and choices of its creator. This raises concerns about potential bias, selective framing, or manipulation, especially if the tool is used beyond its intended scope. Therefore, clarifying who manages the rules, updates the content, and regulates the use of the

platform is essential. These governance aspects must be addressed transparently to ensure that the tool remains accountable, adaptable, and ethically grounded within participatory planning practices. UrbanPlexity should be considered not only as a methodological innovation, but also as a framework whose legitimacy depends on clear operational responsibilities and institutional oversight.

In conclusion, this study suggests that serious digital games such as UrbanPlexity have the potential to enrich participatory urban design processes by offering structured environments that support learning, experimentation, and data-informed engagement. Rather than claiming to solve complex urban challenges or replace expert-driven planning, the tool contributes by revealing how different user groups interpret spatial scenarios, navigate trade-offs, and prioritize sustainability considerations. Its greatest value lies in generating indicative input that can inform early-stage planning discussions, especially in settings where diverse stakeholder perspectives must be integrated. While the game does not resolve the deeper institutional and regulatory complexities of urban governance, it proposes a supplementary framework that may help bridge the gap between participatory aspirations and operational constraints. For this potential to be realized, clear articulation of the tool's governance, limitations, and use cases remains essential. UrbanPlexity should be seen as a preliminary step toward more inclusive urban planning models, with its contributions framed as exploratory and supportive, rather than prescriptive or definitive.

6.1. Limitations of the Study

This study explores the potential of serious gaming as a participatory and sustainability-oriented tool in urban design, using UrbanPlexity tool as both a methodological and empirical framework. The research focuses specifically on the Perşembe Pazarı area in Istanbul—a historically layered and strategically located urban site undergoing redevelopment pressures. Through the lens of game-based experimentation, the study addresses how different actor groups—namely municipal officials, designers, supportive actors, and citizens—approach decision-making in constrained urban scenarios. By integrating quantitative metrics (coPoint, NeedWater, Happiness) with spatial design outputs and qualitative

interviews, the study presents a holistic framework for analyzing user participation in complex planning environments.

While the study provides rich insights into participatory decision-making and actor-based spatial strategies, it is necessarily limited in its geographic and demographic scope. The case area of Perşembe Pazarı offers a historically and culturally significant urban setting, but its specific morphology, regulatory conditions, and socio-political context may not be generalizable to all cities. Similarly, the sample size—restricted to eight participants across four actor categories—limits the extent to which broader conclusions can be drawn about collective behavior. The study does not claim to be statistically representative; rather, it offers a qualitative and exploratory model of engagement that can be tested further through scaled-up implementations.

Another limitation pertains to the simplified nature of the simulation model. While UrbanPlexity incorporates practical constraints such as budget management, environmental impact, and stakeholder preferences, it does not reflect the full regulatory complexity of real-world planning. Critical legal instruments such as the Coastal Law, Zoning Law, or municipal development regulations are not comprehensively embedded into the game mechanics. Instead, simplified rules and design constraints are selectively defined to support a pedagogical and exploratory environment. Although this abstraction enables accessibility and structured experimentation, it also introduces the risk of misinterpretation if the tool is used outside its intended scope. In such cases, the simulation outputs might be perceived as normative or prescriptive, which could lead to oversimplified or manipulated representations of urban planning realities. However, this thesis does not make such claims; rather, it positions the game as a conceptual and educational aid, not as a regulatory or policy-making instrument.

Finally, while the study adopts a triangulated methodology combining interviews, gameplay observations, and spatial data analysis, its findings remain partially shaped by the interpretive role of the researcher. The thematic coding of responses and the evaluation of spatial outputs inevitably involve subjective decisions that may reflect personal biases. Additionally, the one-time gameplay structure limited the participants' ability to develop evolving strategies or reflect on their decisions across multiple sessions. This constraint may have affected the depth of learning

and strategic adaptation. Moreover, the absence of comparative case studies or alternative planning contexts limits the generalizability of the findings. Future research should prioritize iterative gameplay formats, incorporate a broader range of participants and planning conditions, and further refine evaluation tools in order to deepen the empirical robustness and contextual relevance of such game-based participatory models.

6.2. Ethical Considerations on UrbanPlexity

The integration of digital tools such as UrbanPlexity into participatory urban design processes brings with it a series of ethical considerations that must be carefully evaluated. While the platform aims to democratize participation and facilitate informed decision-making, it also carries inherent risks related to manipulation, regulatory ambiguity, and ownership of planning outcomes.

One of the most critical concerns relates to the potential for manipulative outcomes stemming from the structure of game mechanics. The values attributed to elements such as benches, trees, buildings, or mobility infrastructure are assigned by the developer or facilitator, and while these appear neutral, they can influence participant behavior by implicitly favoring certain spatial strategies. For example, if trees are assigned higher environmental scores than bike lanes, participants may be more likely to choose green infrastructure regardless of contextual suitability. Additionally, the range of selectable objects presented to users defines the design boundaries and constrains creativity. When these options are limited or curated in a particular direction, the scope of participatory input may become restricted. In such cases, the process may shift from being exploratory to suggestive, leading users toward predetermined outcomes rather than encouraging diverse and context-sensitive solutions.

Another ethical dimension relates to the legal and regulatory frameworks embedded in the platform. UrbanPlexity simulates real-world constraints such as the Coastal Law (Kıyı Kanunu), Zoning Law (İmar Kanunu), and Municipal Building Regulations (İmar Yönetmeliği), translating them into in-game rules and limitations. While this allows users to understand the impact of legal boundaries on design, it also introduces interpretive flexibility. Depending on how these constraints are encoded into the game, different versions of the same law can yield

varying outcomes. Therefore, transparency in how legal rules are implemented within the tool is essential to maintain legitimacy and avoid oversimplification or misrepresentation of planning laws. If left unchecked, these legal translations could become tools of soft manipulation, where the interface appears neutral but subtly enforces specific political or administrative agendas.

Despite these ethical risks, it is important to emphasize that this thesis does not seek to validate or utilize the game as a tool of manipulation or replacement of planning institutions. On the contrary, the aim is to explore its potential as a supplementary platform that can enhance transparency, foster inclusive engagement, and simulate planning scenarios within clear ethical and legal boundaries. The critical evaluation of these ethical issues is not intended to undermine the tool's value but to strengthen its foundation by promoting responsible design, transparent governance, and inclusive authorship.

In addition to the conceptual risks discussed above, the implementation of UrbanPlexity was governed by a formal ethical framework approved by the Yıldız Technical University Scientific Research and Publication Ethics Board (Report No: 20250605579, Verification Code: 14789). All participants were informed of the study's objectives, their roles, and their rights, including withdrawal and data privacy. Informed consent was obtained, and data was stored securely with full anonymization. Importantly, the game was designed to ensure equal access to information and spatial constraints across all actor groups, mitigating real-world power imbalances. While ethical safeguards were maintained throughout, the study also emphasized that meaningful participation depends not only on design neutrality but also on institutional willingness to incorporate citizen input into actual planning processes.

In conclusion, the ethical deployment of UrbanPlexity depends not only on the technical structure of the tool but also on institutional intent, facilitator integrity, and user awareness. Future applications must establish clear guidelines regarding data use, decision ownership, and regulatory fidelity to ensure that the tool remains a participatory aid rather than a mechanism of hidden control.

6.3. Potentials of UrbanPlexity

UrbanPlexity represents a promising contribution to the ongoing search for more inclusive, comprehensible, and data-informed approaches to participatory urban design. Rather than attempting to replace established planning mechanisms, the platform positions itself as a complementary tool that facilitates stakeholder engagement through structured simulation. By offering a simplified, rule-based environment, it allows non-expert users to experiment with spatial scenarios, visualize trade-offs, and understand the basic implications of their decisions. This capacity to provide experiential understanding makes it particularly valuable in the early stages of urban design processes, where broad input and preliminary exploration are critical.

One of the core potentials of UrbanPlexity lies in its ability to translate abstract sustainability goals into concrete and observable feedback. Through real-time indicators such as carbon emissions, water consumption, cost, and stakeholder satisfaction, participants are encouraged to reflect on the ecological, economic, and social dimensions of their decisions. This feedback loop helps build awareness without requiring deep technical knowledge, supporting both individual learning and group deliberation. Moreover, the platform's modular structure enables adaptation to different urban contexts and actor configurations, offering flexibility for future applications.

Another important dimension is the game's potential to uncover patterns of thinking, preference, and conflict among different participant groups. By structuring interaction around predefined constraints and options, UrbanPlexity can help identify common ground and divergent priorities across stakeholder categories. This diagnostic function is particularly relevant in contested or multi-actor planning environments, where aligning interests and values is a fundamental challenge. The platform thus serves not only as a medium for expression, but also as a reflective instrument that can guide institutional actors in understanding public tendencies and expectations.

However, the tool's potential is not unlimited. UrbanPlexity should not be perceived as a solution, but as an experimental framework that provides indicative input for planning experts. Its simplified mechanics, curated content, and

designer-defined rules mean that the outcomes are mediated and shaped by the system's internal logic. Therefore, the game is best utilized as a preparatory and communicative layer within broader participatory processes. When framed and governed transparently, it has the capacity to foster dialogue, democratize access to design tools, and strengthen the epistemic foundations of participatory urban governance.

UrbanPlexity potential lies in its ability to serve as a structured and accessible interface for exploring early-stage urban design ideas. While this thesis focuses on a single case study, the tool's flexible structure allows for adaptation to other participatory contexts, including academic, municipal, or civil society-led initiatives. Its strength does not stem from offering finalized solutions but from enabling users to experiment with spatial configurations, observe simplified feedback, and reflect on potential trade-offs. Rather than resolving the broader challenges of participatory planning, UrbanPlexity helps highlight the types of questions, values, and tensions that emerge when diverse actors engage with urban space. In this sense, the game does not replace expert-driven processes but may serve as a preparatory and complementary step, especially in contexts where inclusive input and shared understanding are needed.

6.3.1 As a Tool for Sustainable Urban Design

UrbanPlexity introduces a structured environment in which sustainability-oriented decision-making can be explored through simplified but interconnected indicators. By integrating metrics such as carbon emissions (CoPoint), water consumption (NeedWater), economic cost (MoneyValue), and stakeholder satisfaction (Happiness), the tool creates a feedback system that helps participants understand the potential environmental, economic, and social consequences of their spatial decisions. Although these indicators are abstract representations, they offer a starting point for reflecting on the trade-offs embedded in urban planning.

Rather than prescribing sustainable solutions, UrbanPlexity enables users to test scenarios where sustainability is one of multiple objectives to be balanced. This interactive structure helps surface tensions between ecological goals and other priorities such as functionality, accessibility, or cost. In this regard, the tool may foster a broader awareness of sustainability challenges among both expert and

non-expert users. However, the simplifications required for gameplay must be acknowledged. The indicators used do not capture the full complexity of environmental systems or long-term impacts, and thus the tool's role is best understood as illustrative rather than predictive.

By making sustainability considerations more visible and relatable within a participatory setting, UrbanPlexity contributes to early-stage conversations about responsible urban development. Its potential lies not in replacing technical assessments, but in initiating reflection and dialogue about sustainability within broader urban governance frameworks.

6.3.2 As a Tool for Participatory Urban Design

UrbanPlexity functions as a structured yet adaptable platform that supports broader participation in urban design processes. By allowing users from different backgrounds such as citizens, designers, municipal representatives, and actors from non-governmental organizations to operate within a shared game environment, the tool enables individual engagement through a common interface. Its visual layout, rule-based mechanics, and real-time feedback indicators lower the threshold for non-experts to understand and act upon spatial challenges. In this way, it addresses enduring barriers in participatory planning including limited accessibility, technical complexity, and abstract communication formats.

Rather than positioning users as passive observers, UrbanPlexity offers a guided framework in which they can act as independent decision-makers. Although it does not replicate the full legal and administrative complexity of real-world governance, it provides a simplified simulation in which negotiation, compromise, and strategic reasoning can be individually explored. By translating planning concepts into visible spatial consequences, the tool allows participants to grasp urban design as both a technical and value-driven process.

However, the participatory value of UrbanPlexity is shaped by how the tool is implemented and framed. The selection of design objects, the weighting of feedback metrics, and the definition of objectives are determined by the developer or facilitator. These design choices define the parameters of the experience and can influence user behavior, intentionally or unintentionally. UrbanPlexity, although designed as a digital tool to support participatory processes, inherently

reflects the assumptions of its developers through its object values, feedback systems, and game rules. Therefore, it should not be assumed to be a completely neutral platform; rather, it must be evaluated within the context of ethical and governance principles.

UrbanPlexity brings forward a new generation of digital participation tools that seek to bridge the gap between institutional planning frameworks and bottom-up civic engagement. By transforming complex planning processes into interactive, data-informed, and user-friendly experiences, the tool broadens the base of participation and democratizes access to decision-making. It puts into practice the principle of designing not for the public but with the public, capturing and responding to the diverse voices that shape contemporary cities.

Furthermore, UrbanPlexity adaptability across different geographic contexts and intervention scales enhances its participatory relevance. The tool can be localized to reflect specific urban challenges, such as coastal redevelopment or neighborhood revitalization, thereby enabling hyper-contextualized engagement. This flexibility makes it a promising instrument for embedding inclusive design thinking into varied spatial and socio-political environments.

6.4. Recommendations for the Integration into Urban Design Practices

To ensure meaningful and responsible integration of UrbanPlexity into urban design practices, several recommendations can be proposed based on the findings and limitations discussed in this thesis.

First, UrbanPlexity should be positioned as a complementary support tool rather than a standalone planning instrument. While the game offers a structured and engaging environment for exploring spatial decisions, it does not replace legal, political, or institutional processes that govern urban planning. Therefore, the tool should be integrated into existing participatory frameworks such as visioning workshops, pre-design consultations, or educational design studios, where it can serve to generate context-sensitive input and foster stakeholder reflection.

Second, the implementation of UrbanPlexity should be accompanied by transparent communication regarding the logic, limits, and intended use of the

tool. This includes clarifying how feedback indicators are defined, how object values are weighted, and what aspects of urban planning are simulated versus abstracted. Facilitators must make users aware of the tool's scope to avoid misinterpretation or overreliance on simplified outputs. Such clarity is essential to maintain ethical standards and avoid turning the game into a manipulative or prescriptive mechanism.

Third, participatory sessions using UrbanPlexity should be designed with inclusivity in mind. Ensuring the involvement of diverse stakeholder groups, including marginalized or underrepresented communities, can help expand the participatory reach of planning efforts. Additionally, accessibility features such as language support, clear visual communication, and facilitator training should be developed to accommodate different levels of experience and knowledge among participants.

Fourth, the institutional integration of the tool requires defined governance structures. This involves determining who manages the updates, calibrates the object values, and regulates its use in official planning processes. Municipalities or planning authorities adopting the tool should consider establishing interdisciplinary oversight committees or collaborative partnerships with academic institutions to ensure that UrbanPlexity remains responsive, adaptable, and ethically grounded over time.

Fifth, the tool's future development should explore ways to enable real-time collaboration among multiple participants. While UrbanPlexity currently supports individual interaction with the simulation, the absence of direct participant-to-participant engagement limits its potential as a dialogic planning platform. By incorporating multi-user functionality, shared design spaces, or integrated discussion interfaces, the tool could better reflect real-world planning dynamics that involve negotiation, compromise, and collective decision-making. These additions would not only enhance the depth of interaction but also help users experience the complexity of aligning diverse stakeholder interests.

Sixth, bridging the divide between gamified environments and expert planning tools represents a critical step toward operationalizing participatory input. Currently, UrbanPlexity functions as a standalone environment, and while it

generates valuable spatial suggestions, the outputs remain disconnected from professional urban design workflows. Future iterations of the tool could support exporting user-generated layouts into standard formats used in planning practice, such as CAD or GIS-compatible files. This would enable municipalities and designers to integrate participatory data into formal design processes more effectively, strengthening the feedback loop between public engagement and tangible urban interventions.

Finally, further research and iterative testing are essential for refining the tool's functionality and evaluating its long-term impacts. Pilot programs across varied geographic, cultural, and socio-economic contexts can help assess how different users interact with the system, how results are interpreted, and how the tool influences design outcomes. These learnings should be systematically documented to inform future development and guide best practices for serious game integration in urban design.

6.5. Further Research Motivations

Based on the insights, limitations, and reflections derived from this study, several recommendations can be made to guide the responsible and effective integration of UrbanPlexity into urban design practices. These proposals address both the practical use of the tool and future directions for its development.

First, UrbanPlexity should be positioned as a complementary support tool within broader participatory frameworks rather than as a substitute for expert planning processes. Its primary contribution lies in offering an accessible, structured environment for early-stage exploration, where diverse stakeholders can experiment with spatial decisions and reflect on trade-offs. The tool may be most effectively applied in contexts such as municipal visioning workshops, community engagement programs, or academic design studios, where the goal is to foster dialogue, gather insights, and introduce sustainability-oriented thinking.

Second, clear communication of the tool's purpose, structure, and limitations is essential. Users should be informed about the simplified nature of the simulation, how object values and feedback indicators are assigned, and what aspects of real-world planning are abstracted or excluded. This transparency is critical to avoid

misinterpretation and to ensure ethical use. Participants must understand that the outcomes are not definitive solutions, but rather exploratory reflections shaped by predefined parameters.

Third, inclusive implementation practices are needed to ensure that diverse voices are represented. This includes proactively involving marginalized communities and actors often excluded from planning processes. To support broader accessibility, the tool's interface and facilitation strategies should be adapted for participants with varying levels of experience and technical literacy. This may involve translation, visual simplification, or training modules for facilitators.

Fourth, UrbanPlexity integration into institutional contexts should be accompanied by clear governance mechanisms. Since the game mechanics, content libraries, and value systems are shaped by design choices, responsibility for updates, calibration, and ethical oversight must be clearly defined. Municipal authorities or planning institutions considering the use of the tool are encouraged to establish interdisciplinary advisory groups or partnerships with academic institutions to ensure accountability, responsiveness, and long-term viability.

Fifth, expanding UrbanPlexity functionality to support real-time collaboration between multiple users would increase its relevance for participatory scenarios involving negotiation and group decision-making. Integrating virtual co-design spaces or shared simulation sessions could replicate dynamics often encountered in stakeholder meetings and participatory planning workshops.

Sixth, there is potential for further development through the integration of immersive technologies. Future iterations of UrbanPlexity could explore Virtual Reality (VR) or Augmented Reality (AR) adaptations that allow users to experience spatial proposals in three dimensions. These technologies may enhance spatial comprehension and emotional engagement, particularly for users unfamiliar with reading plans or navigating abstract maps.

Seventh, the applicability of UrbanPlexity in large-scale urban transformation and renewal projects deserves further investigation. The tool's adaptability to various urban contexts, including those undergoing regeneration, could support early-stage consultations, alternative scenario testing, and local stakeholder involvement. Conducting pilot studies in these settings could help evaluate the

tool’s effectiveness in more complex and politically sensitive planning environments.

Finally, continued research through longitudinal case studies and cross-regional comparisons would help assess how different user groups interact with UrbanPlexity and how outcomes are interpreted and used. These studies would contribute to a more robust understanding of the role serious games can play in shaping participatory planning practices.

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A
ETHICS COMMITTEE APPROVAL LETTER

YILDIZ TEKNİK ÜNİVERSİTESİ
Sosyal ve Beşeri Bilimler Araştırmaları Etik Kurulu

Toplantı Tarihi: 01.06.2025 **Toplantı No: 2025.06**

SOSYAL VE BEŞERİ BİLİMLER ARAŞTIRMALARI ETİK KURULU TOPLANTI KARARI

Yürütücülüğünü Üniversitemiz Fen Bilimleri Enstitüsü öğretim üyelerinden Dr. Öğr. Üyesi Deniz ERDEM OKUMUŞ danışmanlığında lisansüstü öğrencisi FATİH MEHMET GULER tarafından yapılacak olan "Katılımcı Bir Süreçte Kamusal Alan Konfigürasyonu İçin Dijital Oyun Tasarımı İstanbul Karaköy Perşembe Pazarı Örneği" adlı çalışma ve bu çalışmada kullanılacak veri toplama araçları ve yöntemlerine ilişkin bilgilerde etiğe aykırı herhangi bir bulguya rastlanmamıştır.

Etik Kurul Üyeleri

DocuSigned by: Murat Donduran 07F20CD75AD8430...
Prof. Dr. Murat DONDURAN
Başkan

DocuSigned by: 9D5616D3F2674C8...
Prof. Dr. Fatih GÜLGEN
Üye

DocuSigned by: Yiğit Evren D6CAA832588B413...
Prof. Dr. Yiğit EVREN
Üye

DocuSigned by: Begüm Satıcı 95126DCBD72243B...
Doç. Dr. Begüm SATICI
Üye

DocuSigned by: 11BD69611D0B462...
Doç. Dr. Nur CEMELELİOĞLU
Üye

DocuSigned by: Gülbin Özkan AEDFCC489DA74F0...
Doç. Dr. Gülbin ÖZKAN
Üye

DocuSigned by: Hasan Ağan karaduman 7FF802A54D7049F...
Dr. Öğr. Üyesi H. Ağan KARADUMAN
Üye

Taş Bina A-2013 Oda Davutpaşa Kampüsü Esenler/İstanbul Tel: (0212) 383 31 18
E-posta: sbemdr@yildiz.edu.tr - Web: sbe.yildiz.edu.tr
Rapor Doğrulama Adresi: "etik.yildiz.edu.tr/dogrula" Rapor No: 20250605579 Doğrulama Kodu: 14789

B
INTERVIEW QUESTIONS

URBANPLEXITY PRE-GAME ENGAGEMENT IN-DEPTH INTERVIEW

Section 1: Importance of Participatory/Multiple Actor Processes in Urban Design

1. Are the views of the public, Supportive Actors, the municipality, and designers adequately considered in urban design projects? Do you think participation is genuinely achieved in these projects?
2. How do you assess the importance of participatory/multiple actor processes in urban design?
3. How do you evaluate your role in urban design processes? How effective do you think you are in these processes, and what support or tools would you need to enhance your contribution?
4. Do you believe that urban design decisions should be made solely by experts? What are your thoughts on this?
5. To what extent do different actors participate in urban design processes? Which actors do you think have the highest participation?
6. Do you think gamification methods can make urban design processes more participatory, or will these methods remain ineffective or limited? Why?
7. To what extent do you agree that gamification methods can contribute to urban design processes?
8. How do you think gamification methods contribute to urban design processes with different participants? If they do not contribute, can you explain why? If they do contribute, what might those contributions be?
9. Have you previously participated in urban design projects in a participatory/multiple actor way? (For example, projects where different actors like municipalities, citizens, Supportive Actors, and designers come together)

Section 2: Participation Level Evaluation

10. At what level(s) did you participate in the urban design processes you have been involved in before?

Section 3: Evaluation of the Game in Terms of Sustainability

11. In the urban design projects, you have participated in before, did you receive any information about environmental, social, or economic impacts? If so, what topics did you receive information on?
12. How do you assess the evaluation of environmental impacts (such as air, water, soil pollution, carbon footprint, ecosystem effects, etc.) in urban design processes?

13. How knowledgeable do you think you are about protecting the environment and using natural resources sustainably?
14. Do you think economic sustainability (efficient use of budget, long-term economic benefits, prevention of resource waste) should be a priority in urban planning and design?
15. How aware are you of efficient budget use, preventing waste of natural resources, and achieving long-term economic benefits in urban planning and design?
16. Do you think that meeting the needs of the community, creating accessible and safe public spaces for everyone, and ensuring social equality should be prioritized in urban planning and design?
17. How aware are you of ensuring social equality, creating accessible public spaces for everyone, and designing spaces that are sensitive to the needs of the community during urban planning and design?
18. Do you think games can help you share your ideas on sustainability topics like the environment, economy, and society in the design of cities? If you think so, what areas do you think you can contribute to, and how can games play a role in this?

Section 4: Pre-Game Urban Design Participation Motivation

19. How interested and willing do you feel about participating in the process of redesigning the public open spaces at Karaköy Perşembe Pazarı?
20. Do you feel anxious or stressed about not being able to correctly analyze the space's needs, having your suggestions ignored, or struggling to follow the process when participating in the urban design process of Karaköy Perşembe Pazarı?
21. Before the game experience, did you think you would struggle to evaluate Karaköy Perşembe Pazarı using maps and plans?
22. Do you think you have enough knowledge about environmental values, spatial functions, and urban sustainability (economic, social, and ecological aspects) to participate in the urban design process of Karaköy Perşembe Pazarı?
23. Do you have any additional comments or suggestions before transitioning to the game experience in this study?

URBANPLEXITY POST-GAME ENGAGEMENT IN-DEPTH INTERVIEW

Section 1: Impact of the Game Experience on Your Perspective of Urban Design Processes

1. After the UrbanPlexity game experience, has your opinion on the importance of participatory/multiple actor processes changed? If so, was this change positive or negative?
2. After the game experience, do you think you could play a more active role in urban design processes through gamification?
3. After the game experience, has your view on the necessity of experts being the sole decision-makers shifted towards a more participatory/multiple actor approach?
4. Did the game experience change your opinion about the usefulness of game-based participatory/multiple actor methods? If it did, was this change positive or negative?

Section 2: Factors Influencing Willingness to Actively Participate in the Game Process

5. Seeing that my ideas had a direct impact on the design during the game process increased my willingness to actively participate.
6. The ease of access to the game via computer and the fact that it could be played without additional hardware or software increased my willingness to actively participate.
7. The opportunity to express my ideas more freely and comfortably without direct communication with others during the game increased my willingness to actively participate.
8. Would you have liked to directly communicate with other players during the game process? If yes, what kind of communication method or mechanism would you suggest?
9. The game's fun, motivating, awareness-raising, and educational features increased my willingness to actively participate.
10. Receiving feedback on the sustainable impact of my design during the game increased my willingness to actively participate.

Section 3: Impact of the Game on Sustainability

11. After the game experience, my opinion on the importance of conducting projects based on environmental impact values in urban design processes changed positively.
12. The game allowed me to make decisions that promote environmental sustainability.
13. After the game experience, my opinion on the necessity of prioritizing economic sustainability goals in urban design changed positively.
14. The game raised my awareness of the efficient use of resources and economic sustainability.

15. After the game experience, my opinion on the necessity of prioritizing social sustainability goals in urban design changed.
16. The game increased my participation and contribution to the community.
17. After the UrbanPlexity game experience, how would you prioritize the sustainability dimensions in the urban design process? Please rank them from most important to least important.
18. How could the game be improved to be a more effective tool for participation in sustainability?

Section 4: Post-Game Urban Design Participation Motivation

19. After the game experience, my interest and willingness to participate in the process of redesigning public open spaces at Karaköy Perşembe Pazarı increased.
20. After the game experience, my anxiety about not being able to correctly analyze the space's needs, having my suggestions ignored, or struggling to follow the process decreased.
21. After the game experience, how successful do you think the game was in helping you visualize your design before the project is implemented? Did the game help you better imagine the space by visualizing your design?
22. After the game experience, I think my knowledge of environmental values, spatial functions, and urban sustainability (economic, social, and ecological aspects) has increased to participate in the urban design process of Karaköy Perşembe Pazarı.

Section 5: Effectiveness and Inclusivity of the UrbanPlexity Game Experience

23. UrbanPlexity provides an opportunity for participants to negotiate on sustainability values and initiate a collaborative urban design process.
24. UrbanPlexity presents spatial data in a simplified form that players can understand and use in their designs.
25. The game presents its interface and rules in an easily understandable way, creating an experience that players can easily follow.
26. The game encourages creative contributions by allowing players to express their ideas and suggestions freely in terms of urban design.
27. Did you find the game design sufficient for expressing yourself? If there were any gaps, what difficulties did you encounter? Which features seemed complicated to you?
28. What are your overall thoughts on the UrbanPlexity game experience?
29. Do you have any additional comments or suggestions regarding this study?

PUBLICATIONS FROM THE THESIS

Conference Proceedings

1. Güler, F.M., & Okumuş, D.E. (2024). A Digital Gamified Approach Meets Sustainability in a Participatory Urban Design Tool. Proceedings of the 6th International Symposium on Innovation in Architecture, Planning and Design, Istanbul, Turkey.