

Impacts of urban living lab (ULL) on learning to design inclusive, sustainable, and climate-resilient urban environments

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ABSTRACT

Urban design education research increasingly acknowledges the crucial need to create partnerships and collaborations with relevant stakeholders to support urban environments' planning, governance, design, and decision-making processes in the most holistic manner. However, an inclusive and sustainable urban environment does not have the same meaning for every city, making its design more challenging. The sensory spatial qualities of cities are complex and depend on many social, economic, political, cultural, and natural factors. Thus, this study explores the role of the urban living lab (ULL) methodology in designing inclusive, sustainable, and climate-resilient urban environments in a graduate design studio course. In this study, the ULL was more than a lab. It opened up the critical awareness of multiple links between research, experience, and practice in land use policy. This ULL pedagogical approach could be replicated in different urban contexts to support the decision and design phase of the land use policy process.

1. Introduction

The urbanization trend, increased population of older adults and people with disabilities, energy demands, climate change, and industrial processes in and around cities pose threats to current planning practice and education processes affecting all levels of public service, land use, transportation, and greenery. The 2030 Agenda of the United Nations highlighted the crucial role of sustainability and inclusivity as the key drivers (UN Agenda, 2030, 2015). It is globally recognized that inclusive and sustainable urban environments could not be achieved merely by developing creative solutions and applying technical standards in land use through the lens of urban management and land use planning (Southworth, 2016).

An inclusive and sustainable urban environment does not have the same meaning for every city, making its design more challenging. The sensory spatial qualities of cities, such as appearance, odor, texture, materiality, lighting, etc., are complex and depend on many social, economic, political, cultural, and natural factors, including walkability, safety, and journey to work. Inclusivity is often referred to as accessibility in both practice and education, which is defined referring to disabled people as the ability to reach and use a particular environment, product, or service (Rebernik et al., 2019). Although accessibility is the

precondition of inclusivity and sustainability, it limits the organic character of urban environments to standards, guidelines, and case studies. It eliminates climate risks that mean greater vulnerability and unequal access to land use (La Rosa et al., 2018).

Climate change adaptation has been the considerable scope in many international land policy frameworks (IPCC, 2014), sustainable development actions (Pickett et al., 2004), and disaster management strategies (UN-HABITAT, 2000). Although climate-resilient development shares common goals with sustainable and inclusive design strategies, the challenge is to deal with the complex dynamics of synergies and trade-offs between socio-economic development and climate change responses (Santika et al., 2019). Recent studies highlighted the crucial role of multiple players and the plurality of knowledge in informing inequalities of various climate policies and partnerships and improving structures and processes for climate resilience (Hulme, 2018; Klenk et al., 2017). So, an urban design course, because of its high complexity, acquires such learning and plurality integrated with innovation, which is often defined as collaborative innovation (Leminen et al., 2021).

Thus, this study aims to take learning inclusivity and sustainability out of the design studio into the field of reality, mediating the relationships between students and different stakeholders, such as users, government bodies, policymakers, design practitioners, etc. It proposes

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the urban living lab (ULL) as the holistic pedagogical method at the graduate level to achieve this goal. The urban lab is a generic term “that incorporates a great variety of different methodological and conceptual approaches to deal with the increased urban complexity, promoting new platforms for experimentation, citizen participation and collaboration” (Scholl et al., 2017, p.10). There are many live project experiences in urban education contexts both in the USA and in many international contexts, such as Mexico, Brazil, Malaysia, and Taiwan, allowing students to experience real-life scenarios with a team of experts and local community groups (Watson, 2016). While much of the existing literature draws more attention to the benefits of the ULLs regarding sustainability solutions, there have been fewer discussions on its pedagogical aspects to make inclusive cooperation among academia, public and private sectors, as well as research initiatives. In this study, the ULL is more than a lab. This study tightly focused on the evolution and diffusion of pedagogical approaches to rethinking how ULLs could be best structured, integrated, and implemented under university supervision.

The paper is organized into six sections. Following the introduction, the paper reviews various pedagogical approaches to teaching inclusive, sustainable, and climate-resilient urban design. In Section 3, the paper explains ULLs within the context of design pedagogy. Section 4 presents the methodology where the study proposes an embedded ULL experimentation at the graduate studio level. Section 5 is dedicated to the findings and discussions of the ULLs experimentation based on the learning, plurality, and innovation domains. The last section summarizes the conclusions drawn from the experimentation and highlights the potential implications of the ULL approach in urban design learning.

2. A review of pedagogic approaches in learning inclusivity, sustainability, and resiliency

Urban design education is based on the three main pillars; design, theory, and methods (Anon, 1982). The design pillar dominates the pedagogic approaches (Moudon, 2016). In the past, urban design education has been considered an exercise of arranging unbuilt geometric spaces to determine urban forms. Moudon (2016) explained urban design education in graduate studies under the traditional and new models. The traditional model is student-centric in that the student is placed in a laboratory setting to study the research problem qualitatively or quantitatively borrowing methods from humanities and social sciences. The new model requires interdisciplinary knowledge about geospatial data and human behavior that expands the scope of urban design to collaborative innovation among learning and a plurality of diverse stakeholders.

More recently, a user-centered approach has been developed where the students could spend time on-site observing people’s everyday lives and investigating social and economic activities. Li et al. (2018) reviewed the pedagogic strategies for urban sustainability under the following principles; interdisciplinarity, cross-cultural collaboration, project-based learning, and human-centered design. Von Richthofen et al. (2018) proposed parametric design thinking as a pedagogic methodology to build sustainable, and liveable environments. Acuto et al. (2019) suggested informal urbanism as a pedagogic catalyst to reread the temporality of the city and analyze the living geometry. Keswani (2019) criticized current urban design education, which has looked at the design of urban practice as a geometric arrangement of physical parameters but no social parameters. An urban design studio teaching was explored in an informal marketplace in Ahmedabad, India, where everyday practice patterns and emerging economies became part of urban design pedagogy. Sunguroğlu Hensel et al. (2020) linked sustainable urban design thinking to multiscalar system thinking to interact with future human-centered design scenarios. Güler and Güler (2022) questioned the role of memory as an action-based pedagogical model for understanding cities’ cultural and ecological values. Catteneo et al. (2022) defined a joint studio as a new pedagogical approach to

providing an adaptive and collaborative structure to teach multidisciplinary points of view about a city.

“Urban design, like the city itself, is fundamentally multiple and therefore also subject to multiple pedagogies” ((Pafka and Dovey, 2018, p.276). Although a growing body of research comes up under various pedagogical models ranging from parametric thinking and rule-based design (Von Richthofen et al., 2018) to performance-based approaches (Biehl-Missal, 2012), urban design education has not employed a critical strategy focusing on political dimensions (Akpınar et al., 2016). Moreover, there are not enough seminars and workshops to foster collaborative interactions among practicing professionals, government officials, faculty, and local experts (Palazzo, 2011). At the same time, not only urban design educators but also all design educators are realizing the limitations of those models that require dealing with massive amounts of data on everything, such as land-use, geospatial data of geographic information systems (GIS), natural resources, social welfare, equity, capital energy, waste emissions, etc. (Van Vuuren et al., 2017).

The second problem is how to develop and implement proper engagement tools and mechanisms through which the students simultaneously study the literature as a baseline for assessing their novelty and work collaboratively with a team of different stakeholders in a real urban setting based on user participatory approaches (Alvarez et al., 2017). Instead of proposing global strategies, urban design teaching should address cultural identity and focus on co-creation with the plurality of different parties and collaborative innovation models to contribute to sustainability (Najafi-Tavani et al., 2018).

What type of learning, plurality, and innovation does a student need at the graduate level to address an urban environment’s inclusive, sustainable, and resilient character? Is the knowledge of theories, methods, and histories of urban form sufficient to manage diverse user needs with a humanistic focus and create sustainable cities for future publics? Although learning from case studies is significant to raise students’ awareness toward inclusive design and sustainable land use policy development, particularly the design studios, the centrality of urban design education should go beyond a research-based or market-driven studio experience of specific solutions (Park, 2020).

Thus, there is critical to formulating urban design education where students are encouraged to integrate research findings with actual data retrieved from multiple stakeholders and collaborate with the new living experimentation platforms. Such an urban design education differs significantly from traditional studio teaching or collaborative activities, participatory processes, and even evidence-based urban design education (Lak and Aghamolaei, 2020). The difference is primarily due to the informality of the urban fabric, which is related to mapping everyday life (Keswani, 2019) and the temporal ordering of an urban space adaptive to human needs (Alexander, 1979). Loukaitou-Sideris and Mukhija (2016) defined this informality as the key driver of urban design education, burgeoning in many Global North cities. There are four aspects of this informality, as suggested by Loukaitou-Sideris and Mukhija (2016): scope, context, process, and practice. Urban design educators should notice this four-tier framework to promote human interaction, lessen the conflict among diverse user groups, and encourage more inclusive, sustainable, and interconnected urban infrastructures along land use policies.

3. Urban living labs through the lens of design pedagogy

There are many definitions and forms of urban labs called; ‘change lab’ as transdisciplinary initiatives (Nevens et al., 2013), ‘city lab’ as participatory platforms of local governments (Brown-Luthango, 2013), ‘design lab’ as various forms of practices in policy, innovation, etc. (Chesbrough, 2003), ‘gov lab’ as collaborative approaches between public and various institutions (Seravalli et al., 2015), ‘impact lab’ focusing on experimental learning with the public and private sector (Voigt et al., 2009), ‘innovation lab’ as cross-disciplinary platforms fostering entrepreneurship (Von Hippel, 2005), ‘policy lab’ as

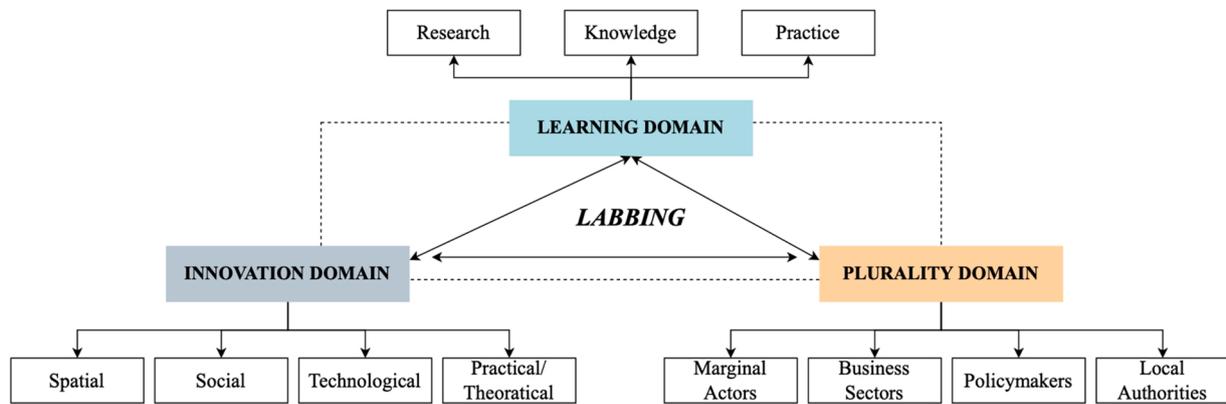


Fig. 1. The triangulation of the three domains in the study; learning domain, plurality domain, and innovation domain, drawn by the author.

non-partisan platforms (McGann et al., 2017), ‘reality lab’ focusing on testing solutions on real sites (Burkhard and Schmitt, 2009), ‘living lab’ based on user engagement through creative and innovative approaches (von Wirth et al., 2019) and ‘social innovation lab’ focusing on systematic change through experimentation of the social (Kieboom, 2014). Although these definitions are changing and developing so quickly in the research agenda, the common aspects of all these forms can be merged under the umbrella of various experimental approaches in an urban environment.

Scholl et al. (2017) integrated various aspects of the above-defined labs into the knowledge of urban design in the project Learning from URban Experiments with Living Labs and City Labs” (URB@EXP), funded by the Second JPI Urban Europe Pilot Call (2012) (JPI Urban Europe, 2015) and developed the following eight principles of urban labs to set up the successful transition of urban actions toward a sustainable city for everyone: (1) aligning agendas; (2) fostering plurality; (3) finding a position; (4) building the organization; (5) experimenting all the way; (6) maximizing learning; (7) creating public value and (8) continuing labbing. Regarding the first principle, ‘aligning agenda,’ a wide range of actors with various backgrounds, working practices, and professional skills are jointly engaged in common platforms of shared objectives. The second principle, ‘fostering plurality,’ focuses on including a range of possible participants and marginal actors, such as the business sector, NGO representatives, city residents, disabled users, and local authorities.

The third principle, ‘finding a position,’ is related to the autonomous role of urban labs, which are neither close to the local administration nor remain at a distance. The fourth principle, ‘building organization,’ is crucial to explore operation models on how the lab work and what are the roles and responsibilities of lab practitioners. The fifth principle, ‘experimenting all the way,’ focuses on the continuity of lab experimentation, through which the learning is conducted. The sixth principle,

‘maximizing learning,’ includes the diversity of learning outcomes gained during the various lab activities with multiple actors. The seventh principle, ‘creating public value,’ is significant in harvesting the findings of an urban lab and co-producing the values obtained from these findings. The last principle, ‘continuing labbing,’ focuses on integrating, replicating, or expanding the labs in urban governance to influence knowledge bodies in the short and long term.

Reviewing the literature showed that the ULLs are mainly proposed as an urban design methodology to promote smart cities, conceptualize sustainability initiatives and develop innovations with greater efficiency in using resources. The benefits of ULLs lie in the integration of end-users and the utilization of generated knowledge specific to the area, as each living lab can only be interpreted according to the spatial context they are developed in. Bulkeley et al. (2016) offered important insights on ULLs to establish boundaries among research, innovation, and policy to deliver sustainable goals for cities. Dabaieh et al. (2017) discussed teaching and learning green architecture trends in a ULL environment. Later, Dabaieh et al. (2019) proposed ULL, where the local community is involved in different phases of a Trombe wall system’s design and construction process, suitable for passive heating and cooling in hot arid climates. Von Wirth et al. (2019) implemented the broader impact of the ULL in Malmö, Sweden, and Rotterdam, the Netherlands, and identified the following six strategies to impact systemic urban change; transformative place-making, activating network partners, replication of lab structure, education, and training, stimulating entrepreneurial growth and narratives of impact. Leminen et al. (2021) advanced the understating of ULLs by exploring the diversity of collaborative innovation in six Nordic cities to overcome global sustainability challenges. As sustainability and inclusivity in cities are increasingly becoming more collaborative, user-centered, and open to co-creation of solutions (Greve et al., 2021), ULLs, which are still nascent state in many fields, including urban design education (Greve et al., 2020), have the potential to



Fig. 2. Surrounding areas of the Park area, including Park facilities and infrastructure, drawn by one of the student groups.

receive increasing attention as an essential pedagogical vehicle for urban design learning.

4. Methodology: urban living lab experimentation experience

The overall aim of the ULL experimentation in the study is to embed the ULL in the whole studio experience at the graduate level and contextualize its constitutive elements in the learning process. This experimentation was based on the triangulation of the learning, plurality, and innovation domains (Fig. 1). Each domain has challenges in integrating design pedagogy's theoretical and contextual aspects. The three subsections below explain how a graduate design studio course in the study was structured around these domains.

4.1. Learning domain

A park environment was chosen for the learning domain because of its vital significance for inclusivity and climate resiliency, especially in the sustainable development of rapidly urbanizing areas (Schäffler and Swilling, 2013). Parks play a crucial role in climate regulation and a city's energy consumption by carbon sequestration (Kim and Coseo, 2018). They also contribute to citizens' quality of life, such as healthy aging, physical wellness, children's recreational facilities, etc. Furthermore, parks also increase adaptive capacity and make cities more resilient to environmental phenomena like floods or heatwaves.

The park, called X, is located on the west side of X city, country, and was built in 2007 in memory of X, who was mayor of X city between 1977 and 1980. It was designed on 68.000 square meters of land in the heart of X neighborhood as the most significant green zone, surrounded by the residential and commercial zones (Fig. 2). The X neighborhood is placed 10 million square meters on the M1 and M3 subway train routes, making the Park easily accessible. The residential zones consist of low-rise buildings with gardens and mid-rise gated communities with communal gardens. The commercial zones include small shops, hair-dressers, shopping malls, and a farmer marketplace. Regarding the Park's land use, there are green elements of around 44.000 square meters, the sports fields around 5.500 square meters, including two private tennis courts, two public basketball and two public football fields, two playgrounds around 900 square meters, and a walking path (Fig. 2). There are three public car parks for the Park users and two cafes serving in the daytime.

The learning objectives of the studio course were designed in a way that the students transformed geospatial data of this Park, such as building heights, streets, land cover, trees, etc., into the socio-spatial circumstances, cultural specificities, power dynamics, and economic potential along the requirements of inclusive design, sustainable design, and climate resiliency. So, the studio course acted as a catalyzer to establish an experimental dialogue with the learning domain and as a facilitator to collaboratively co-create theoretical and practical knowledge with diverse urban actors.

4.2. Process of plurality domain

The course was a blended graduate studio course comprising 13 graduate students from architecture, interior architecture, urban design, and product design. The author taught the course. Before the start of the course, the municipality representatives and the city council president contacted the author about the necessity of the inclusive and sustainable features of parks in general. They proposed to re-design this Park with the students. So, the author, based on this initiative, reformulated the current graduate course. While reformulating the course, the author also collaborated with academicians from Lund University and experts from Raul Wallenberg Institute (2020). They have previous knowledge of the city lab approach and evidence-based human rights research with multiple stakeholders at the city scale.

The course was conducted for 14 weeks with four hours of contact

Table 1

An overview of each phase regarding the conducted weeks, key outcomes, involved actors, and deployed methods.

Phase name	Weeks	Key outcomes	Involved actors	Deployed methods
Phase I: Structuring the problem	Week 1–3	Review of existing research on ULLs Analysis of park examples Guiding principles Design Standards Strategies Existing design criteria Existing key priorities	Experts (energy, disability) Designers (architects, urban planners) Diverse users Local authorities	Case study analysis Literature review Commentary Bibliography Brainstorming Focus groups
Phase II: Gathering the data	Week 4–7	Site analysis Contextual knowledge User needs analysis Existing barriers	Designers (architects, urban planners) Diverse users Local authorities Policymakers Civil society	Questionnaires Photographing Participatory observation Structured/Semi-structured interviewing Digital survey Scenario workshops Task analysis Map building Persona development Affinity diagraming Correlation diagrams Statistical analysis (t-tests, frequency, etc.) Priority ranking Participatory designing Scenario building Drawing Critiques Group discussions
Phase III: Exploring the gathered data	Week 8–11	Explored design criteria Explored key priorities User needs analysis Demand diagrams Ranked priorities Concept ideas	Designers (architects, urban planners) Experts (energy, disability) Diverse users Local authorities Policymakers Civil society	
Phase IV: Proposing solution alternatives for implementation	Week 12–14	Two-dimensional drawings (plans, sections) Three-dimensional graphics (perspectives) Scenario alternatives Division of zones Material choices	Designers (architects, urban planners) Experts (energy, disability) Diverse users National/International faculty members Local authorities Policymakers Civil society	

time and six additional hours of individual studies per week in the Spring Semester 2020. Half of the course was taught face-to-face, and the other half was online because of the COVID-19 pandemic. The pandemic quarantine restrictions unexpectedly influenced the studio experience positively. It enriched the plurality domain of the ULL experience so that the students explored a new interactive way of ULL. The collaborative dialogue among all the stakeholders was done more visually and orally. A holistic dimension was achieved nationally and internationally to integrate space, program, technology, environment, culture, and users' abilities. Moreover, all the stakeholders were in an equal position without barriers while using online sources, annotating the drawings, and discussing. However, the biggest challenge was the



Fig. 3. The exemplary presentation platforms: (a) Phase I; (b) Phase III, and IV.

lack of a physical studio environment, which made the working hours longer than planned at the beginning of the semester. The study tackled this challenge by extending the submission period to two weeks.

The course was broken into four phases; structuring the problem, gathering the data, exploring the collected data, and proposing solution alternatives for implementation. The ULL was the key component for the phases, rather than being defined only for one phase as in most studies. Table 1 gives an overview of each phase regarding the conducted weeks, key outcomes, involved actors, and deployed methods. Fig. 3 illustrates the exemplary presentation platforms of Phase I, III, and IV. Before starting the process, the students formed groups to work with during the semester. There were four groups. Each group was composed of at least one student having an undergraduate degree in urban design, one in architecture, and one in interior architecture. Potential stakeholders were invited to the course's first lecture to be a member of each group. Each group had at least one expert on sustainable and inclusive design, one representative from the municipality, one urban designer, one architect, one representative from NGOs, and one physically impaired and one visually impaired user. Each group was responsible for building its organization and coordinating its working strategies. Each group created a weekly group chart as a road map to implement this coordination. The ULL operational model of each group was related to their decision-making and conflict management strategies. However, a typical organizational structure was ensured in all the groups where equal participation and clear communication were maintained.

Regarding the four phases, all the stakeholders and the invited international faculty members (Lund University and Raul Wallenberg Institute) engaged in the shared design practices that emerged from the lab experimentation. A collective process of reflection was achieved based on student evaluations. All the stakeholders in Table 1 discussed and reflected on participation at a strategic level by virtually drawing their ideas on the shared Zoom screen of each group's drawings and digital models. Regarding implementing the four phases, all the alternatives were presented as a booklet to the Mayor of X city.

4.3. Innovation domain and its assessment

Assessment should aim “to educate and improve student performance, not merely to audit it” (Wiggins, 1998, p.7). Therefore, multiple levels of assessments are needed to address the elements of the innovation domain, as well as to meet the five principles of scholarship in teaching and learning (SoTL) (Felten, 2013); inquiry focused on student learning, grounded in context, methodologically sound, conducted in partnership with students, appropriately public. So, this study used two types of assessment; classroom assessment for spatial and theoretical elements of the innovation domain and the first three principles of SoTL, and large-scale assessment for technological, social, and practical elements of the innovation domain and the last two principles of SoTL. In the

course, classroom assessment was defined as the summative grading of the submitted reports and presentations at the end of the three phases and the final solution alternatives at the final phase. The grading was done based on the academic performance of each group and their level of engagement with the course. A specific rubric was developed in line with Loukaitou-Sideris and Mukhija's (2016) informality aspects. The students' works were scored out of 20 points on each scope, context, process, practice, and as well as group participation ratio in the experimentation throughout the whole semester.

The large-scale assessment was defined as the effectiveness of the ULL in proposing solution alternatives. In this respect, the jury graded the solution alternatives based on 17 Sustainable Development goals, which United Nations developed to improve health and education, reduce inequality, and spur economic growth (UN Agenda, 2030, 2015). Such assessment offered considerable potential for increased understanding of the student awareness of inclusive, sustainable, and climate-resilient design and its consequences in a global context. The students were also evaluated on the gain from the ULL. They were not asked directly. Instead, there were three interview sessions at the course's beginning, middle, and end. During these sessions, a self-assessment questionnaire was given to the students to assess their level of knowledge on 17 Sustainable Development goals based on a five-point Likert scale (1 for poor and 5 for excellent). This survey aimed to test students' understanding of SDGs before, during, and after. Moreover, at the end of the course, the student's comments on the learning experience were also assessed qualitatively by asking the following three usability questions: (1) to what extent did you achieve the inclusive, sustainable, and climate-resilient design criteria through the ULL? (2) to what extent did the ULL enable you to structure the problem, gather data, explore the gathered data and propose solution alternatives in terms of time, achievement of the design requirements, and learning outcomes? (3) To what extent were you satisfied with your learning from the ULL, and did you find the process exciting and enjoyable?

5. Results and discussion

5.1. Learning process of the urban living lab methodology

The learning domain was assessed based on three criteria; the student's academic performance in the course, the student's self-assessed knowledge gained from the ULL, and the student's responses to the usability questions. In the course, the academic performance was meant the overall mean value obtained from the three presentations and three reports contributing 54% of the total (each 9%), the solution alternative contributing 36 %, and engagement in the course contributing 10% of the total. At the end of the semester, the course mean value for the performance was 87.05 out of 100, which was a high value for the

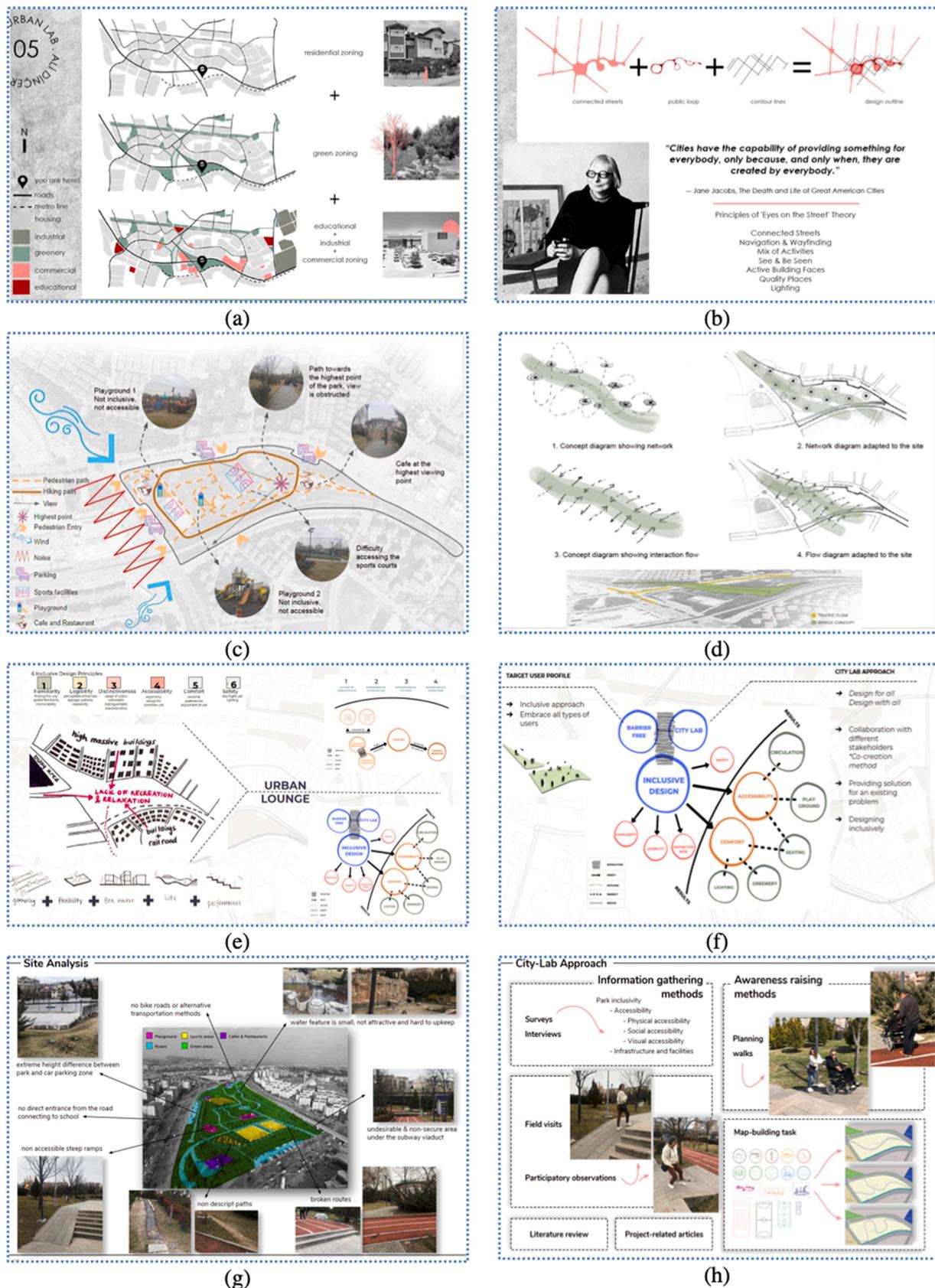


Fig. 4. Site analysis and correlated conceptual ideas: (a) site plan of the first group; (b) conceptual idea of the first group; (c) site plan of the second group; (d) conceptual idea of the second group; (e) site plan of the third group; (f) conceptual idea of the third group; (g) site plan of the fourth group; (h) conceptual idea of the fourth group.

learning outcome. It means that the students achieved the following learning outcomes of the course; demonstrating good knowledge of research, applying them to urban design practice, and critically assessing urban contextual information within the field of collaborative design. All the students attended the course at least 85 % of the time. Although the students reported the challenge of the plurality domain, i. e., working with diverse stakeholders timely during the regular course hours, the course attendance was high. The most successful student group, which had the highest grade point of 92, engaged more in the practice-based insights that assisted them in aligning their agendas efficiently while responding to the park problems with the ambition of creating long-term solutions. It stimulated open-minded experimentation, which was in line with the literature supporting the eight principles of a thriving urban lab (Scholl et al., 2017).

According to the self-assessment questionnaire results, the student knowledge level on 17 Sustainable Development goals increased significantly ($p = 0.000$). The overall mean value was 3.47 at the beginning, 3.98 in the middle, and 4.25 at the end of the studio course. The ULL opened up the students' critical awareness toward equality, peaceful and inclusive societies, urgent actions for climate change, and sustainable urban living patterns. This increase could be evidence of the achievement gained from the collective process of reflection in the ULL experimentation. Thus, the most significant increase in their knowledge level occurred regarding the 15th goal of Sustainable Development. The goal is to "protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss" (UN Agenda, 2030, 2015). At the beginning of the course, the mean value for this goal was 2.12, in the middle 3.47, and at the end 4.31. Apart from the benefits of the ULL, its collaborative aspect helped the students comprehend the significant influence of urban experimental learning in shaping human impact on alternative futures, which was a barrier to traditional pedagogical approaches.

Regarding the 11th goal, which is to "make cities and human settlements inclusive, safe, resilient and sustainable" (UN Agenda, 2030, 2015), there was no significant difference in the student gained knowledge level, which was surprising. The reason for this is that the students were at the graduate level and had gained theoretical knowledge of inclusive and sustainable design before. However, the continued improvement of this knowledge is an ongoing learning process requiring cross-disciplinary platforms.

The student's responses to the three usability questions showed that the learning process through the ULL was usable in general. Regarding the first question, "to what extent did you achieve the inclusive, sustainable, and climate-resilient design criteria through the ULL?" most students (9 out of 13) found the ULL effective in achieving the inclusive, sustainable, and sustainable design criteria climate-resilient design criteria of the design problem. Three students stated, "the continual dialogue and the active participation were good platforms for us to holistically consider socio-spatial circumstances, cultural specificities, and economic potentials," as discussed by Loukaitou-Sideris and Mukhija (2016). This quotation also supported that the collective process of reflection was achieved. Only two students had concerns about the effectiveness of the ULL; "we had to deal with too many inputs, egoistic demands and lost time while trying to solve them." The responses to the second question, "to what extent did the ULL enable you to structure the problem, gather data, explore the gathered data and propose solution alternatives in terms of time, achievement of the design requirements, and learning outcomes?," showed that the ULL was found efficient in general. However, more than half of the student (7 out of 13) defined the process as super messy. Four students complained, "the most challenging aspect is to simultaneously think lots of theoretical and practical urban aspects with all the stakeholders." Although the students agreed on the efficiency of the ULL in structuring the problem, they could not agree with the method's performance when the time was concerned.

Regarding the last question, "To what extent were you satisfied with your learning from the ULL, and did you find the process exciting and enjoyable" most students (11 out of 13) found the learning process satisfactory. They enjoyed while they were learning by doing collaboratively. The other two students stated, "we were uncomfortable working with other stakeholders, although we know the significance of the plurality for inclusive and sustainable design. Maybe we don't want to leave our learning comfort zones". In these student interviews, the online part of the course and the technology use were never defined as the limitation or negative aspects of the learning process.

5.2. Student engagement with plurality domain

The plurality domain of the experimentation was achieved so that each student group had a different engagement pattern with the contextual information of the Park and multiple data gathering strategies conducted with end-users. The groups started with the site analysis as the initial step of the problem structuring, which was later transformed into the conceptual design idea. In line with Loukaitou-Sideris and Mukhija's (2016)'s study, they spent time at the site to observe the temporality and everyday life in the Park. Each group formulated a well-defined concept of urban design derived from this informality. Fig. 4 illustrates site analysis and correlated conceptual ideas of the four groups.

The first group considered the stakeholders as co-creators and pointed out their decision-maker position for the social integration of disadvantaged and non-disadvantaged groups. They also translated the theory of Jane Jacobs (1961) "eyes on the street" into the Park. Based on the gathered input from the stakeholders at the end of the third phase, this group found that perceived safety in parks was the critical driver of inclusivity and sustainability affected by lighting, navigation, and wayfinding (Fig. 4a and b). According to their statistical analyses, disabled people and older adults rated walking paths as the most crucial element. At the same time, municipality representatives found sheltered zones from the weather conditions to the most vital park feature. This finding highlighted the difficulty of establishing a consensus on a plurality of visions and modes of operation.

The second group found a significant correlation between children's accessibility and nature continuity (Fig. 4c and d). Their brainstorming sessions with the stakeholders showed that visiting frequency depended on the inclusive character of walking and seating. Their photo completion task analysis with local authorities, policymakers, and designers resulted in four coded categories to re-design the park inclusively and sustainably; walking/circulation, lighting, seating, and waste management. The third group compared sustainable park design to prior park types based on the study by Cranz and Boland (2004). It investigated the role of the six inclusive urban design principles (Burton and Mitchell, 2006) on contemporary parks through scenario workshops, semi-structured interviews, and questionnaires with the stakeholders. According to their findings, comfort in the park was considered an overarching principle (Fig. 4e and f). This finding supported the significance of designing for informality.

The fourth group focused on the three accessibility categories, physical, visual, and symbolic, and structured the problem under the concept of continuity, which meant the well connected to circulation paths (Fig. 4g and h). They conducted a map building with visually and physically impaired adults and children. They found that the park should be designed so that both walking loops and children's play areas promote comfort, relaxation, discovery, and engagement in terms of family togetherness. While exploring their gathered data, the ULL experience allowed all the students to study the marginal actors as one of the elements of the plurality domain along urban space theories. This ULL experimentation with the business sector, marginal actors, policy-makers, and local authorities pointed out that city labs differed from the scientific experiments because of the difficulty of keeping all stakeholders engaged with and focused on inclusive and sustainable design



Fig. 5. The four plans and perspectives of the solution alternatives: (a) solution alternative 1; (b) solution alternative 2; (c) solution alternative 3; (d) solution alternative 4.

thinking and decision-making.

5.3. Innovation practice: success or failure of the designed outcomes

In this ULL experimentation, both the students and the stakeholders worked to co-create innovative design solutions ranging from designing inclusive spatial elements, such as local farmer's markets, tactile surfaces, etc., to integrating theoretical urban design concepts, such as Jane Jacobs 'eyes on the street', and implementing technological systems, such as plant library, navigation, and wayfinding apps, etc. Success or failure of the designed outcomes was based on the success of solution alternatives in 17 UN Sustainable Development goals.

Fig. 5 illustrates the four innovative solution alternative plans and perspectives. The provision of a shelter unit as a continuous circulation element was the common idea in the alternatives to cope with the adverse effects of climate change. The solution alternatives were successful based on the jury evaluation in the final phase. The student group with the highest performance grade also had the highest grade on the jury. This group differed from the other solution alternatives by solely focusing on the five basic human needs; comfort, relaxation, discovery, and passive and active engagement with the natural environment. In line with the literature, Abdelhamid and Elfakharany (2020) also defined these as the critical inclusive and sustainable aspects of a thriving urban public park. Many parks lack these aspects because of designers' passive engagement with the surrounding environment, such as watching and observing people's activities. Although the other three groups considered one or two of those aspects, these five aspects should be regarded as a whole and simultaneously because they are correlated with each other depending on the needs and expectations of diverse stakeholders. Moreover, this group maintained a good activity level by ensuring who was doing what. Establishing a balanced task distribution is crucial when responsibilities are shared in collaborative design processes.

From the course experience, it is apparent that urban design learning is a multi-parameter process. The components of inclusivity, sustainability, and climate resiliency in urban environments are multiple and complex, which vary depending on the contextual information, content-related aspects, and priority actions. ULL can respond to many of these components, but not all. However, one significant question of how the impacts of ULLs can be measured still remains unanswered within the learning context. This study has responded to this question by taking SDGs as a benchmark in evaluating the success or failure of the experimentation. As stated by Keswani (2019), the evaluation of impacts should be derived from the needs and circumstances of multiple actors of informality. Thus, mutual learning and needs-oriented design practice cannot really be presented as an impact on learning. This points out that ULLs should expand their scope of evaluation to include functionality. Stimulating the creative process, establishing continuous dialogue, and balancing power relations of diverse contexts are inevitable requirements while measuring the impacts of the ULLs.

6. Conclusion

This study explored the role of the ULL methodology in designing inclusive, sustainable, and climate-resilient urban environments in a graduate design studio course. This methodology has been proved to be a functional and responsive approach to the pedagogical requirements of urban design learning. A fundamental design challenge remains as hard to solve as ULL is an innovative and shared process rather than an end in itself (Dabaieh et al., 2017). It helped the students understand that inclusive and sustainable urban design was composed of scientific principles and design standards. It is also linked to the practice-based knowledge where dynamic human actions have multi-parameter correlations with the urban environment and complex impact on future developments. Thus, the contribution of this study is to introduce urban inclusivity and sustainability, which remain vague and elusive concepts

and fail to be taught in practical actions in land use policy (Li et al., 2018) while responding to the learning outcomes of a research-based graduate design education.

It should be noted that applying ULL requires a more collaborative approach with various stakeholders compared to citizen-centric community engagement approaches. Still, at the same time, communities and stakeholders are unhappy with the traditionally carried out engagement activities. In the study, the role of citizens goes beyond the participants or users. They were defined as innovators (Wolff et al., 2015).

Regarding the policy implications, this methodology opened up the critical awareness of multiple links between research, experience, and practice in designing inclusive, sustainable, and climate-resilient urban environments. However, in line with the literature, in this study, contextualizing the ULL's constitutive elements to the learning process and taking up this challenge within the urban design pedagogy was an extremely difficult experience. This ULL methodology led to thinking about what is specific about inclusive and sustainable urban design learning. The first factor could be related to the knowledge domain. Inclusive and sustainable design knowledge is not primarily textual; instead, it requires innovative knowledge management with its practitioners, public and private sector, and various stakeholders with diverse abilities, needs, demands, and expectations. Therefore, such a mechanism in design education needs partnership development, knowledge exchange, innovative methodologies, and a collaborative learning process. The second factor could be related to the studio environment, which was defined as a transitory space where students learn through design practice without being aware of what is learned (Schön, 1987).

This study is the first attempt to use a graduate studio course to explore the ULL's potential to teach inclusive, sustainable, and climate-resilient urban design practice. This ULL approach could be replicated in different urban contexts supporting the decision and design phase of the land use policy process. The synergies developed during the ULL could minimize trade-offs and conflicts among diverse stakeholders. ULL can also be conceived as an innovative methodology to balance conflicting values and needs during urban regeneration projects. The premise here is to embed an effective, efficient, and satisfactory urban lab experience, practice, and knowledge in urban design pedagogy.

Moreover, the role of information technology and online teaching should not be neglected for the effectiveness of the ULL in urban design education. The pedagogical strategies applied in this study were developed for a graduate design studio course. However, these benefits could be applied across any discipline in the context of inclusivity and sustainability for future generations. Future studies could also use New Urban Agenda as a part of the ULLs, which is more directly related to urban matters. The ULL made it possible to obtain an overall framework for making your city resilient. It aims to co-create public values, experiment with real-world problems with transdisciplinary participation, and explore alternative futures.

Disclosure statement

The author reported no potential conflict of interest.

Data Availability

Data will be made available on request.

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