

Article

Generational Visions of Urban Land and Green Infrastructure: An Extreme Case Sampling Approach to AI-Driven Participatory Planning with Children and Seniors

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Abstract

Public open spaces are vital for sustainable urban land management, yet design processes often marginalize demographic extremes like children and the elderly. While generative artificial intelligence (GenAI) emerges as a bridge to democratize public space design, its inclusivity across varying cognitive and digital literacy levels remains unexamined. This study deploys an “extreme case sampling” approach within a Design-Based Research (DBR) framework. Using the Human–AI Hybrid Planning Interface Model (HAIHPIM), we contrast empirical data from a rural child cohort (aged 6–13, $n = 12$) and an urban senior cohort (aged 60–96, $n = 6$) in Northern Germany, combining qualitative participant evaluations with ethnographic observations. Findings reveal a profound divergence in spatial imagination. Children exhibit high creative output but face cognitive barriers in prompt formulation, whereas seniors circumvent digital interface constraints through narrative spatial knowledge and historical reference mapping. Rather than a definitive tool for spatial justice, GenAI functions as an exploratory boundary object. It makes the informal spatial needs of marginalized groups discursively visible and highlights the indispensable role of human mediation in adaptive land governance.

Keywords: generative artificial intelligence; extreme case sampling; inclusive urban planning; green infrastructure; generational land use; demography; interface usability

1. Introduction

1.1. Problem Statement: The Structural Underrepresentation of Demographic Margins in Formal Open Space Planning

The sustainable transformation of urban and rural spaces faces a dual challenge in the 21st century: In addition to the ecological imperatives of climate change, the social dimension of sustainability—enshrined under UN Sustainable Development Goal 11—is increasingly coming into focus. Sustainable and resilient spatial development requires broad, democratic legitimization of design interventions in public space, traditionally addressed through citizen participation processes. However, the fundamental promise of participatory approaches to foster spatial inclusivity and incorporate everyday lifeworld experiences often encounters an epistemic barrier in planning practice. Despite theoretical claims to inclusive spatial governance, there remains a structural deficit of representation

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for social groups situated on the demographic margins of the population: children and adolescents, as well as older adults.

This deficit is a systemic product of the design of formal participation procedures, which, on Arnstein's [1] classic ladder of participation, frequently remain restricted to informational or consultative stages. Traditional instruments of open-space planning—such as town hall meetings, standardized online surveys, or formal public comment periods—are characterized by a high degree of institutionalization, bureaucratization, and abstraction [2]. They require specific proficiency in planning terminology as well as the ability to decode two-dimensional, technical plan drawings. As non-expert citizens often find it difficult to comprehend professional planning language or read technical drawings, these traditional methods frequently suffer from communication issues and fail to engage a representative cross-section of the public [3]. These demanding cognitive and habitual barriers, alongside issues of digital accessibility, lead to a striking communication asymmetry between the professional actors in the planning system and the affected citizens [3].

To explore the boundaries of this communicative divide, this paper examines two demographic extreme cohorts [4]. These groups represent the maximum cognitive, habitual, and technological distance to formal planning instruments, while simultaneously contrasting sharply in their spatial orientations (future-oriented play versus retrospective memory): The children's cohort (ages 6–13, $n = 12$): Children possess highly vital, needs-oriented, and informal spatial knowledge constituted primarily through haptic experience, play, and affective appropriation processes [5]. However, since formal planning procedures require a rational, verbalized, and text-based articulation, children's spatial knowledge remains epistemically invisible within the formal apparatus, even though sustainable neighborhood planning increasingly calls for the measurable implementation of child-friendly indicators [6]. There is a distinct lack of low-threshold, visual translation tools capable of making children's spatial desires present—and thus negotiable—without causing cognitive overload. The senior cohort (ages 60–96, $n = 6$): At the opposite end of the demographic spectrum, older adults possess spatial knowledge accumulated over decades, deeply rooted in biographical memory and local history. This implicit knowledge is invaluable for understanding long-term usage cycles and social practices within public spaces. In practice, however, access to this knowledge is blocked by physical-motor impairments, the institutional rhythms of care settings, and an often manifest distance from unmoderated, purely digital participation platforms [7].

While existing research highlights that artificial intelligence can foster community engagement and participatory decision-making, studies often focus on technical optimization or tech-savvy user groups. Furthermore, the opacity of machine learning algorithms often conflicts with the ideals of transparent, active citizenship. Consequently, there remains a significant empirical gap regarding GenAI's application as a visual translation tool for vulnerable, non-digital populations, necessitating a shift from reductionist, technocentric approaches towards more inclusive and equitable frameworks [8].

1.2. Objective and Research Questions

This study addresses the intersection of demographic representation deficits and digital transformation in spatial governance. The primary objective of this investigation is to outline the theoretical foundations of the Human–AI Hybrid Planning Interface Model (HAIHPIM) and exploratively evaluate its operational boundaries within a multi-stage Design-Based Research (DBR) framework [9]. The HAIHPIM framework supplements traditional map- and text-based participation by establishing generative text-to-image workflows—specifically text-guided inpainting via Adobe Firefly (<https://firefly.adobe.com/>, accessed on 20 September 2024 and 17 December 2024)—as interactive mediation in-

stances. Before introducing complex socio-technical theories, this paper approaches GenAI not as an autonomous solution, but simply as a potential mediating tool.

The study examines the extent to which this socio-technical arrangement can function as a boundary object in the sense of Star and Griesemer [10] and Trompette et al. [11]. Specifically, it investigates whether this setup can externalize, visually translate, and render negotiable the nonverbal, affective, or biographically implicit spatial knowledge of marginalized extreme cohorts [4].

Rather than prioritizing criteria of purely technocratic efficiency, this study focuses on the communicative dynamics of algorithmic image production and critically reflects on the social power of algorithms in the mapping and perception of public space [12]. It seeks to clarify how immediate visual feedback acts as an elicitation catalyst to mitigate articulation barriers at the demographic margins, where standard text- and plan-based instruments frequently fail.

To operationalize this objective within a qualitative, exploratory design, the study addresses three focused research questions:

RQ1: How does the HAIHPIM framework translate the informal, lived spatial experiences of children and older adults into concrete visual planning representations?

RQ2: What systemic barriers (cognitive, technological, or habitual) emerge during the interaction of these extreme cohorts with the interface, and what stabilizing role does the researcher play as a human “proxy interface”?

RQ3: What communicative risks—such as the visual distortion of participants’ intentions or the creation of an “expectation trap”—emerge when generative AI acts as a mediator for vulnerable populations?

By addressing these questions, this paper contributes to scientific progress along two axes. First, it expands participatory planning theory by introducing a reflexive perspective on human–machine spatial constitution—using theory as an analytical map for second-order observations of digital planning tools [13]. Second, it provides context-specific insights for municipalities seeking to critically navigate the dual mandates of digital transformation and social inclusion. Ultimately, the principal conclusions reveal that GenAI cannot serve as an autonomous technological fix for spatial justice, but rather functions as an exploratory boundary object. Its capacity to render the informal, nonverbal spatial needs of demographic margins discursively visible remains fundamentally reliant on active human mediation (i.e., the researcher acting simultaneously as an operational proxy interface and a pedagogical facilitator).

2. Theoretical Framework: Spatial Constitution and Algorithmic Mediation

2.1. The Normative Background: Epistemic Representation and the Production of Lived Space

The theoretical foundation of inclusive and socially sustainable open space planning requires a critical examination of how everyday spatial knowledge is represented within formal planning institutions. As a broad background for this study, we draw on Henri Lefebvre’s [14] socio-spatial theory. Lefebvre [14] distinguishes between *espace conçu* (conceived space)—the rationalized space of planners and architects—and *espace vécu* (lived space)—the space of everyday practice, experienced through subjective symbols and memories.

Formal municipal planning procedures operate almost exclusively in the mode of *espace conçu*. In stark contrast stands the *espace vécu*. A structural deficit of conventional citizen participation instruments lies in this systemic communication divide: traditional mechanisms force citizens on the demographic margins to translate their fluid, lived ex-

periences into the abstract, technical language of the conceived space to be formally recognized.

When children and older adults are marginalized in this process, it is often due to an epistemic translation barrier rather than a simple lack of interest. Because they frequently lack the professional vocabulary or technical literacy to decode and manipulate the instruments of the *espace conçu*, their highly specific spatial needs remain unaccounted for. Therefore, inclusive urban governance requires a methodology capable of bridging this communicative gap.

Within this context, the HAIHPIM framework is not conceptualized as a definitive, autonomous instrument for structural political transformation. Instead, it functions as an exploratory probe designed to tentatively visualize the lived space (*espace vécu*) of children and seniors. By capturing these nonverbal, informal needs and translating them into a visually accessible format, the model aims to render the qualitative dimensions of everyday space discursively visible, legible, and negotiable within formal planning streams.

2.2. The Core Analytical Framework: The Constitution of Space Through Spacing and Synthesis

While Lefebvre provides the broad normative background, the primary analytical framework for the empirical evaluation of the Human–AI Hybrid Planning Interface Model (HAIHPIM) is provided by the relational spatial sociology of Martina Löw and Gabriele Sturm [15]. This approach breaks with absolutist conceptions that treat space as a static, physical-material container. Instead, space is defined as a dynamic, “relational arrangement of social goods and people in places” [15]. The constitution of space is thus a processual, performative act that constantly unfolds through the dialectical interweaving of two structuring practices: spacing and synthesis.

To avoid using these concepts merely as descriptive labels, this study employs strict operational definitions for empirical observation. We define “spacing” operationally as the participants’ concrete verbal or gestural placement and arrangement of physical objects, infrastructure, or vegetation during the workshops. “Synthesis,” conversely, is operationalized as the cognitive and emotional meaning-making process, observed through participants’ narratives, memories, and affective reactions as they link these arranged elements into a meaningful spatial structure [15].

Within the demographic extreme cohorts examined in this study, these two processes exhibit specific configurations linked to age and life-world socialization. Children often articulate spacing in a haptic, dynamic, and playful manner; their synthesis is highly affective and frequently diverges from the functional rationalities of the adult world. Older adults, conversely, perform spatial synthesis primarily through retrospective linking. For this cohort, new or altered spatial structures are continuously synthesized with historically and biographically accumulated spatial experiences.

The HAIHPIM framework reconfigures the mechanics of this dual process by introducing a layer of technological-algorithmic mediation. The tool—generative inpainting via Adobe Firefly—partially decouples visual spacing from the participants’ direct physical or independent linguistic actions. Because cognitive, motor, or digital literacy barriers may prevent autonomous operation, participants communicate their intent to a human facilitator. We operationally define this role as the “proxy interface”: the human facilitator who translates the participants’ non-technical, informal spatial desires into algorithmically legible text prompts.

Consequently, spacing within this framework operates as a co-produced process: the participant provides the qualitative intent, the facilitator handles the linguistic-conceptual stabilization into software-compatible syntax, and the neural network executes the immediate relational arrangement of spatial structures on the screen. This arrangement alters the participants’ subsequent synthesis process, as they react to the hyper-realistic, algo-

rhythmically generated imagery within an immediate visual feedback loop. The AI thus functions as an intermediary elicitation catalyst, rendering implicit spatial knowledge visually legible.

Methodologically, however, this introduces both opportunities and communicative risks. A relational spatial approach allows this study to critically examine the boundary between supportive visualization and algorithmic over-shaping, evaluating the extent to which the proxy interface's translation and the inherent social power of algorithms [12] overwrite authentic local knowledge with commercially trained, standardized aesthetic patterns [16].

2.3. Technical Mediation: Text-Based Generative Inpainting as a Boundary Object

Alongside spacing and synthesis, the concept of the “boundary object” [10,11] serves as the second core analytical concept of this study. To systematically analyze how the HAIHPIM framework bridges the divide between the informal lifeworlds of demographic margins and the formal logics of institutional planning, the technological interface must be understood as a genuinely socio-technical phenomenon.

In this specific experimental setup, text-based generative inpainting via Adobe Firefly does not function as a neutral transmission channel, but rather as a boundary object [10]. Star and Griesemer [10] define boundary objects as entities that are flexible enough to adapt to local needs (plasticity), yet robust enough to maintain a shared identity across different social worlds (robustness). They enable productive cooperation at system boundaries without requiring a prior consensus among the actors.

In the context of the HAIHPIM framework, two disparate social worlds converge: the lifeworld practice of the participating citizens (playful imaginations or biographically retrospective memory) and the bureaucratic-technical world of formal open-space planning [2]. AI-assisted inpainting enters this critical system boundary by balancing two operationally defined structural dimensions:

- **Structural contextual stability (robustness):** In generative inpainting, the visual material is not generated entirely from digital nothingness. Operationally, this is the photographic foundation of the real space, such as the asphalted schoolyard in Balow, which remains as a geographically and materially stable anchor. This visual constancy allows professional planning actors to immediately situate the environment and assess the proposals for their basic administrative connectivity [2].
- **Local interpretive flexibility (plasticity):** Operationally, this dimension is represented by the precisely cropped masking areas (the inpainting zones). Here, generative AI allows for a high degree of openness to subjective appropriation. The hyper-realistic image elements generated via verbal prompt input are decoded by the cohorts as direct visual mirrors of their subjective needs. This plasticity enables the participants to project their specific relational spatial synthesis onto the canvas without destroying the overarching structure of the real space.

The image, modified by generative AI, thus transforms into an exploratory translational platform. It allows demographic margins to express their nonverbal or affective spatial knowledge within a concrete aesthetic format. This boundary object lowers the barrier of abstraction inherent in traditional plan-drawing tools, cultivating a shared discourse in which the hybrid image object can be simultaneously negotiated by both sides. A comprehensive overview of how these theoretical concepts are operationalized and linked to our research questions is provided in Table 1.

Table 1. Conceptual framework: Operationalization of theoretical concepts and their relation to the research questions.

Theoretical Concept	Role in the Study	Operational Definition for Empirical Analysis	Related Research Question
Lived vs. Conceived Space (Lefebvre)	Broad normative background	The epistemic divide between participants' informal, subjective spatial knowledge and the formal, technical tools of urban planning.	RQ1, RQ2
Spacing & Synthesis (Löw & Sturm)	Primary analytical framework	Spacing: Participants' verbal/gestural placement of physical elements. Synthesis: The cognitive/emotional meaning-making process through narratives and affective reactions.	RQ1
Proxy Interface (Derived from Mediation)	Methodological condition	The human researcher translating non-technical, informal spatial desires into algorithmically legible text prompts.	RQ2, RQ3
Boundary Object (Star & Griesemer)	Primary analytical Framework	The AI-generated image balancing Robustness (the stable photographic baseline) and Plasticity (the subjective, AI-generated inpainting zones).	RQ1, RQ3

3. Materials and Methods: Extreme Case Sampling and the HAIHPIM Framework

This chapter outlines the empirical and methodological design of the study. The procedure is embedded within an overarching, iterative research design. This approach systematically examines the usability, communicative viability, and socio-technical interface barriers of the Human–AI Hybrid Planning Interface Model (HAIHPIM) among demographic groups on the margins of society. The sampling strategy, the contrasting spatial and social settings, and the specific implementation of the participatory AI workshops are described in detail below. This serves the goal of ensuring complete traceability and methodological rigor of the qualitative data, transparently disclosing the methodological decisions in the spirit of critical planning science.

To operationalize the translation between informal spatial practices (*espace vécu*) and formalized planning rationales (*espace conçu*), this study introduces the Human–AI Hybrid Planning Interface Model (HAIHPIM) (Figure 1). Designed as an iterative, socio-technical framework within Design-Based Research (DBR), the HAIHPIM breaks the participation process down into six distinct operational phases:

- Preparation: Setting up the technical infrastructure and taking the site photography;
- Input: Briefing the participants and gathering their informal, subjective spatial knowledge;
- Generation: Using text-guided inpainting via a generative AI engine to co-create visual alternatives;
- Evaluation: Gathering structured qualitative feedback on the generated imagery;
- Translation: Expert filtering and interpretation of the visual outputs;
- Integration: Embedding the finalized conceptual impulses into formal planning streams.

Rather than acting as an automated black box, the HAIHPIM framework functions as a distributed agency network where the researcher stabilizes the linguistic transition, ensuring that the qualitative and biographical nuances of marginalized groups are preserved before the algorithm applies its aesthetic standardization.

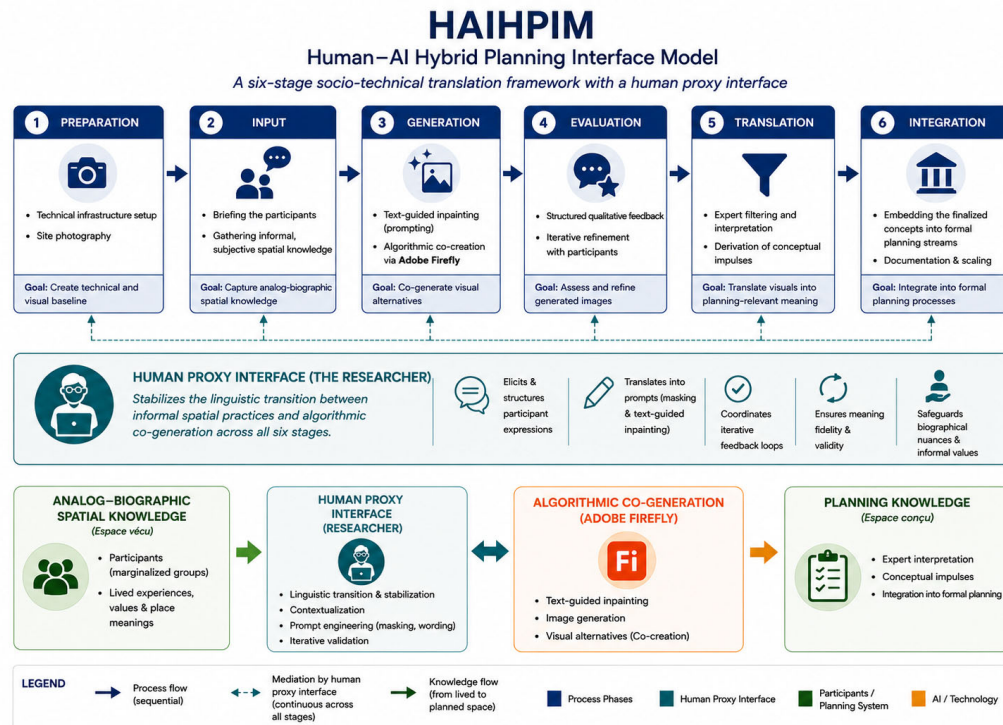


Figure 1. The Human–AI Hybrid Planning Interface Model (HAIHPIM): A six-stage socio-technical translation framework in which the researcher acts as a continuous human proxy interface, stabilizing the linguistic transition between analog-biographic spatial knowledge, AI-supported co-generation (Adobe Firefly), and formal planning knowledge.

3.1. The HAIHPIM in the Context of Design-Based Research: Integrating the Case Studies into the Overarching Project

The empirical data analyzed in this paper were collected over an 18-month research period spanning June 2024 to December 2025. The overall research project consistently followed the principles of Design-Based Research (DBR), which is established in scientific practice as an interventionist and theory-generating framework for developing, testing, and cyclically refining innovative tools in real-world usage contexts [9]. The overall project comprised a total of 13 iterative workshop cycles with a total of 133 participants. The remaining 11 workshop cycles, which primarily involved tech-savvy youth and young adults, served to iteratively test and stabilize the technical usability and fundamental interface mechanics of the model. This cyclical structure enabled the continued development of the HAIHPIM, based on ongoing feedback from planning practice, in information technology and facilitation practices.

For this paper, a targeted extreme-case sampling [4] approach was applied to this comprehensive dataset. This deliberate methodological focus on the extreme ends of the age, cognitive, and digital competence spectrum serves the purpose of revealing the technological, cognitive, and communicative barriers of algorithmic mediation under conditions of maximum contrast.

The HAIHPIM framework was developed through an iterative DBR process spanning 13 workshop cycles. While the majority of these cycles involved youth, young adults, and adults to establish and refine the baseline interface mechanics, Cycles 3 and 6 were

strategically designated as extreme cases. This sequential evaluation allowed the framework to adapt step-by-step to standard user requirements before testing its operational boundaries against highly divergent cohorts.

In line with Patton's [4] logic, learning from the extremes allows for deep, paradigmatic insights into phenomena that remain invisible within the demographic mean. This sub-study, therefore, focuses specifically on two cohorts that are structurally underrepresented and marginalized in formal participatory processes of open-space planning [1,7]: a rural cohort of children (Workshop 3: ages 6–13, $n = 12$) and an urban cohort of seniors (Workshop 6: ages 60–96, $n = 6$). Due to the small sample sizes, particularly the senior cohort ($n = 6$), the findings of this study remain exploratory and are not statistically generalizable.

Furthermore, the extreme case sampling design involves multiple confounding variables. The two workshops differ simultaneously in age, rural versus urban setting, site typology (schoolyard versus city park), seasonal baseline image, and degree of participant autonomy. Consequently, differences in spatial synthesis cannot be attributed exclusively to generational causality, but must be understood as the result of these highly specific, contrasting socio-technical settings. Through this extreme narrowing of focus and the deliberate exclusion of intermediate age groups, the resilience of the AI-supported interface is tested at the absolute limits of verbal articulation and digital operability. The comparative analysis of these two heterogeneous cohorts makes it possible to deconstruct the mechanisms of relational spatial constitution, namely spacing and synthesis [15], under the magnifying glass of algorithmic image production. In this way, it is methodologically ensured that the insights derived from the case studies do not merely reflect specific administrative decisions, but can be used as an analytical map for a reflexive, inclusive second-order urban governance [13].

3.2. Methodological Rationale for Extreme Case Sampling: Why Researching Demographic Margins Reveals Systemic Barriers in Digital Interfaces

The recruitment and composition of the samples follow the methodological logic of extreme case sampling as outlined by Patton [4]. To systematically elucidate the socio-technical and cognitive limits of the Human–AI Hybrid Planning Interface Model (HAIHPIM), two cohorts were deliberately isolated at opposite ends of the demographic and digital literacy spectrum. This deliberate exclusion of the demographic middle serves as an analytical lens to reveal systemic mechanisms of exclusion that frequently remain invisible in standardized, digitally supported participation processes due to the historical dominance of tech-savvy groups [7].

To test the operational resilience of the framework across diverse institutional and physical constraints, the study contrasts two distinct spatial, logistical, and social contexts within Mecklenburg-Western Pomerania:

- The rural setting (Workshop 3): This research cycle was conducted in September 2024 in the rural municipality of Balow. Participants were recruited via an official, institutionally supported invitation from the mayor in the context of the regional seminar, School of Rural Development. The sample comprises 12 schoolchildren, aged between 6 and 13. This setting represents a peripheral area where informal, child-centered appropriation practices play a vital role in shaping the everyday living environment, but are rarely structurally anchored in formal planning processes [6]. The participatory workshop with minors took place within a structured institutional framework characterized by the continuous presence of legal guardians and municipal representatives, including the mayor and local administrative staff. Written informed consent was obtained from all legal guardians before the workshop, and photographic documentation was restricted to hands and the physical models to ensure

the minors' privacy. This setup ensured continuous ethical supervision and safeguarding throughout the entire intervention, in accordance with the ethical guidelines of the University of Rostock.

- The urban setting (Workshop 6): In contrast to the structured rural setting, this research cycle was conducted in December 2025 at the Barnstorfer Anlage urban park in the Hanseatic and university city of Rostock. Recruitment occurred via a specialized procedure in public space, where a group of older adults from a local care facility, who were utilizing the park alongside their professional caregivers, were directly approached. Due to strict time constraints dictated by the care facility's institutional schedule, six individuals aged 60 to 96 were directly included in the empirical individual procedure, while other group members participated as validating observers on the periphery. To protect the privacy and dignity of this highly vulnerable group, no photographic or video documentation of the participants was conducted; only the AI-generated outputs and verbal transcripts were recorded. Verbal informed consent was secured from the participants and approved by the accompanying care professionals. The wide age range within this senior cohort, confirmed via consultation with their professional caregivers, reflects its specific methodological placement within the wider Design-Based Research framework. Only Workshops 3 and 6 utilized this extreme case sampling approach. Consequently, this cohort was not selected to establish a homogeneous statistical baseline, but to deliberately test the outer boundaries of the HAIHPIM interface regarding physical agency, digital literacy, and adaptive facilitation in late adulthood under real-world logistical constraints.

3.3. Empirical Settings and Recruitment: The Rural Community Center in Balow vs. The Urban City Park Barnstorfer Anlage in Rostock

The procedural flow of the two workshops was specifically adapted to the lifeworld and physical constraints of the respective extreme cohorts. This customization aimed to evoke a maximum degree of spatial agency without compromising the comparability of the core processes of relational spatial constitution, specifically spacing and synthesis [15].

Workshop 3 Procedure (Balow): The methodological framework was designed as a hybrid, parallel participatory process. While the children in the primary strand of the workshop, under the continuous guidance of the research team, modeled their planning utopias and visions for the redesign of their schoolyard (such as skate ramps, carousels, and large-scale slide landscapes) haptically and three-dimensionally using modeling clay, a digital HAIHPIM station was integrated in parallel. This technical setup consisted of a laptop connected to a separate, high-resolution, large monitor on which text-based generative inpainting via Adobe Firefly was applied.

Due to pronounced shyness, cognitive barriers to abstraction, and varying digital literacy among the youngest children, aged 6 to 7, the researcher served as a human facilitator, functioning as the proxy interface. The children articulated their spatial wishes verbally and physically pointed to the areas to be modified on the large screen, while the researcher performed the precise digital masking of the inpainting zones and fed the verbal prompts into the system. To ensure interpretive validity, the AI-generated images were immediately shown to the children, who validated or rejected the visual translations, prompting iterative prompt adjustments until the output matched their spatial intentions. Older children, aged 11 to 13, participated increasingly autonomously and handled the text input on their own. The entire interaction process was ethnographically documented through the recording of the children's verbal exclamations and affective reactions, capturing the dynamic nature of children's spatial synthesis.

Workshop 6 Procedure (Barnstorfer Anlage): Due to the participants' physical vulnerability and institutional care conditions, this group required a mobile, individual, and sequential procedure conducted outdoors. As a core methodological standard of the HAIHPIM framework, a digital photograph of the physical environment taken on-site ad hoc is typically used as the visual baseline for generative reworking. However, the gloomy, gray, and extremely low-contrast weather conditions in early December 2025 presented severe visual and ophthalmological barriers for the elderly participants.

As a proactive methodological adjustment to ensure accessibility, a high-contrast, color-rich summer photograph of the Barnstorfer Anlage from the previous year, 2024, was selected as an alternative digital working basis. This modification significantly increased visual accessibility in the context of digital urban perception [16], as the participants were able to decode the spatial depth structures and contrasts without error. Furthermore, because spatial synthesis in late adulthood relies heavily on long-term biographical recollection rather than immediate sensory snapshots, the seasonal variance of the baseline image served as a cognitive catalyst. However, we explicitly acknowledge this procedural decision as a genuine validity limitation: the idealized, blossoming summer photograph may have actively induced the romanticized, nostalgic responses that define the seniors' biographical synthesis, meaning the stimulus itself significantly shaped the resulting findings. The researcher moved successively from person to person using the mobile interface. The seniors developed a distinct enjoyment of the interaction, consulted with one another, and collaboratively generated design ideas, including historicizing pavilions and accessible gathering areas, which were algorithmically inscribed into the summer image via the facilitator.

3.4. Data Collection, Qualitative Triangulation, and Limitations: Methodological Adaptation and the Incompatibility of Standardized Digital Polling

The standardized HAIHPIM framework typically incorporates a rigorous quantitative evaluation of the user experience (UX) and participation quality via the digital real-time survey tool Mentimeter (Mentimeter AB, Stockholm, Sweden), utilized directly on participants' smartphones or tablets. In the extreme cohorts studied, however, profound age-related, habitual, and context-dependent barriers emerged. These barriers rendered standardized digital polling sociotechnically incompatible, necessitating a proactive methodological adaptation of data collection in the field.

To ensure traceability, all field notes, transcribed verbal evaluations, and generated AI images were subjected to a systematic qualitative analysis. The textual and observational data were coded inductively using thematic analysis to identify the central patterns of spacing and synthesis, while the visual outputs were systematically compared against the original verbal prompts to assess the degree of algorithmic distortion. To maintain transparency, the complete list of the eight standardized evaluation questions, alongside an example coding scheme and prompt rubric, is provided in the Supplementary Materials.

Adaptation for the senior cohort (Workshop 6): In addition to manifest physical-motor and visual barriers preventing the operation of small-scale mobile devices, this cycle was constrained by the acute institutional schedules of the care facility. While the researcher was conducting the sequential individual interview with the fourth person, the nursing staff initiated the logistical process of moving the entire group. To preserve the integrity of the data under these real-world constraints, the standardized procedure was adapted ad hoc into a focused, oral group interview. The researcher verbally presented the eight standardized evaluation questions of the HAIHPIM framework to the group and manually recorded the collective, consensus-based responses.

Adaptation for the children's cohort (Workshop 3): Due to the young age and varying cognitive development stages of the participants, independent and abstract use of the digital rating tool Mentimeter was deemed methodologically inappropriate. To prevent cognitive overload and frustration, the evaluation questions were translated into a verbal format. The younger children, aged 6 to 9, provided their ratings in a playful, binary manner via physical hand signals and expressive affective verbalizations of agreement or disagreement, which were documented manually. The older children, aged 12 and 13, provided more nuanced qualitative feedback by translating their evaluations into the familiar system of standard school grades, ranging from 1 to 6, thereby making their assessments more precise.

3.5. Critical Reflection on the Researcher's Role and Methodological Limitations

These methodological modifications represent a deliberate design choice. Rather than treating researcher mediation as a confounding variable to be minimized, the HAIHPIM procedure conceptualizes it as a necessary translational layer between informal participant knowledge and algorithmic syntax. This entails an inherent interpretive risk, as the researcher's framing of vague verbal inputs into software-compatible prompts cannot be fully separated from the resulting visual output. The final images are fundamentally co-produced by the participant, the researcher, and the algorithm. The proxy interface serves as a necessary inclusion mechanism for vulnerable populations, but simultaneously acts as a source of interpretive bias.

This dynamic is accepted and disclosed as a transparent limitation of this exploratory study. Furthermore, collecting evaluative data through direct, verbal responses within ad hoc group interviews or physical hand signals introduces the risk of interviewer effects and the reproduction of social desirability structures within the peer groups. While these dynamics allowed for immediate, collective deliberation during the workshops, the potential for peer pressure or compliance bias is recognized as an inherent limitation of this exploratory design, one that future studies might address through independent observation or member-checking procedures. Consequently, the HAIHPIM framework does not operate as an autonomous, fully automated digital tool, but rather as a highly moderated, socio-technical practice inextricably intertwined with the translational role of the researcher.

4. Results

In this chapter, the empirical results from the two extreme cohorts under study are systematically compared and analyzed. The reconstruction of the field phases documents how children and seniors interact with the algorithmic interface, what divergent aesthetic and functional preferences they articulate, and how informal, everyday spatial knowledge is modified and mediated through the process of text-based generative inpainting. The following findings are based on a qualitative triangulation of the generated visual artifacts, the dense ethnographic field notes from the interaction cycles, and the qualitative operationalization of the evaluation data.

4.1. The Children's Cohort (Balow Municipality): High Creative Engagement, Visually Presentational Spacing, but Significant Cognitive and Temporal Barriers in Prompt Formulation

The starting point for Workshop 3 in the rural community of Balow, conducted in September 2024, was determined by the dreary, heavily paved, and design-minimalist current state of the local schoolyard. The empirical analysis shows that the implementation of the HAIHPIM framework facilitated a significant shift in the children's spatial perception and constitution once their initial shyness toward the technical apparatus, specifically the large monitor and laptop, was overcome. In the course of image modifications

via Adobe Firefly, four dominant design elements emerged from the children's spatial preferences, which were successively inscribed into the photographic foundation of the schoolyard:

- Large swimming pools;
- Extensive, non-rationally formed slide landscapes;
- An obstacle-filled terrain course;
- An unnatural climbing wall.

Noteworthy here is the specific aesthetic character of these objects. The highest collective consensus and emotional enthusiasm within the cohort (shared enthusiastically by 10 of the 12 participants) were by no means achieved through realistic, architecturally plausible, or true-to-scale designs. Rather, the visual elements that generated the strongest response were explicitly those created in surreal, abnormal, and emphatically hypertrophic forms. This emotional investment became ethnographically evident when the children collectively cheered for hyper-scaled infrastructure, with participants exclaiming verbatim: "I want a big slide, a biiiiiig one, like this. It shall look like my tongue, hahaha!" and "I want an obstacle course with sharks, like in Ninja Warrior, and with ponies. I love ponies, I want a race course around our school yard."

These statements illustrate how the interface triggered an unconstrained spatial imagination that completely bypassed institutional design constraints. This playful deconstruction of formal logic ultimately resulted in a hyper-realistic visualization that, while reflecting the children's utopian desires, simultaneously exhibited the typical aesthetic smoothing of commercial algorithms (Figure 2). Evaluated through a landscape-architectural lens, the children's outputs pointed overwhelmingly toward high-maintenance, low-permeability land uses. Their visions neglected classical ecosystem services or canopy cover in favor of functional play value, inadvertently proposing highly sealed surfaces (such as massive water basins and paved obstacle courses).

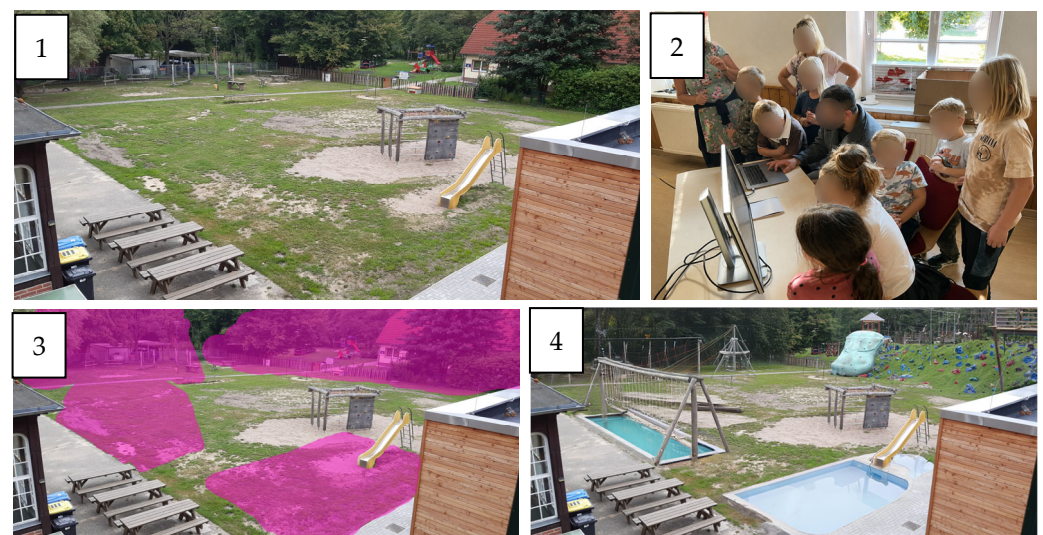


Figure 2. Empirical application of the Human-AI Hybrid Planning Interface Model (HAIHPIM) in the child cohort (Workshop 3, rural context). Clockwise from top left: (1) baseline condition of the schoolyard before the participatory workshop; (2) participatory AI co-generation session illustrating the researcher acting as the human proxy interface during prompt mediation; (3) AI-generated design proposal created with Adobe Firefly; and (4) researcher-defined inpainting mask specifying the spatial intervention areas. The sequence illustrates the complete HAIHPIM workflow from analog-biographic spatial knowledge and verbal articulation to AI-supported visualization and iterative translation into planning-relevant design concepts.

First presenting this purely empirical observation, we can subsequently interpret it through a sociological perspective on space, as outlined by Löw and Sturm [15]. The spacing of the children, understood as the placement of objects and people in space, took place as a visually present, strongly emotion-driven act. The HAIHPIM framework did not function here as a rational–technocratic planning tool, but rather as a digital catalyst for a playful, radical utopia. The immediate visual projection of their ideas, some of which were extremely exaggerated, onto the large monitor rewarded the children with instant gratification and motivated them to make further collaborative exclamations. Theoretically, this phenomenon can be understood as a form of immediate playful arrangement (or “utopian spacing”). Physical feasibility and institutional planning logics were completely suspended in the here and now of the creative act to reinvent the space as a malleable playground.

This free spacing, however, encountered significant linguistic and cognitive barriers, underscoring the need for linguistic–conceptual stabilization by the researcher acting as a human facilitator and proxy interface. Since the younger children, aged 6 to 7, often articulated their spatial wishes only in vague, colloquial fragments (“something to climb”, “big water”), the researcher had to translate these informal expressions ad hoc into precise, AI-compatible German nouns (“climbing course with ropes”, “big blue swimming pool with clear water”). The purely German-language prompting functioned here as a semantic filter. It stabilized the child’s wish, while the multilingual Adobe Firefly model operating in the background promptly translated the terms into a glossy, commercialized playground aesthetic. The researcher thus acted as an indispensable translator at the interface between the child’s lived world and algorithmic syntax [12].

Qualitative Evaluation of the Interface Experience Based on the HAIHPIM Dimensions: Despite the aforementioned sociotechnical incompatibility of the quantitative survey tool Mentimeter, a systematic validation of the interface experience was ensured through the verbally presented evaluation dimensions. The aggregated qualitative interface metrics for all eight dimensions across both cohorts are systematically presented in a summarizing table at the end of this chapter..

- **Spatial Agency and Emancipation:** The dimension of spatial agency received the highest positive ratings from the children. The immediate visualization of their own ideas in a real-world spatial context compensated for the classic visual deficit in children’s participation.
- **Creativity and Inspiration:** Generative AI served as a massive source of inspiration. Each generated image triggered new, even more surreal spatial demands from the peer group.
- **Joy and UX (Joy of Use):** The emotional impact was striking. While the younger children, aged 6 to 9, expressed their enthusiasm through loud, synchronized verbal exclamations (“yeaaaaaah” or “nooooooo”) and physical hand signals, the oldest children, aged 12 to 13, translated this experience into the familiar system of standard school grades. They explicitly awarded grades of 2 and 3 (on the German 1–6 grading scale, where 1 represents the best performance), declaring that they had successfully overcome the abstraction barrier typical of standard digital tools.

4.2. The Senior Cohort (Rostock): Sociotechnical Interface Barriers and the Appropriation of AI Imagery as an Evocative Stimulus for Biographical Spatial Knowledge

In stark contrast to the children’s utopian imaginings, Workshop 6 at the Barnstorfer Anlage in Rostock, conducted in December 2025, revealed an entirely different facet of socio-technical spatial constitution. After visual barriers were successfully minimized by substituting the high-contrast summer photograph from 2024, the HAIHPIM framework functioned less as an active, future-oriented design tool for the six directly involved sen-

iors and more as an evocative stimulus for releasing deeply sedimented, informal, and biographical spatial knowledge.

The visualizations generated in the course of the inpainting process were characterized by a classically romanticized, almost stately park aesthetic, featuring historical pavilion structures, ordered sightlines, and structured green spaces. The qualitative analysis of the interview transcripts illustrates a key empirical dynamic. In formulating their spatial wishes, the seniors drew intensively on intertextual and interspatial comparisons with historically significant reference spaces. Explicit, narrative links to well-known cultural landscapes were articulated (and supported by a consensus of all six participants):

- Historical park structures: Comments such as, “A castle with park grounds like in Potsdam or Schwerin would be lovely, oh, it was so beautiful when we were there,” demonstrate that the local spatial context was directly merged with distant, biographically positive places of memory.
- Blossoming beauty and strolling: The desire for a “beautiful, well-maintained cherry tree avenue with lovely trees and colorful blossoms, like in Bonn, for strolling,” illustrates the manifest need for an aesthetic and contemplative enhancement of urban green spaces.
- Quality of stay and social interaction: In addition to requests for “something with water for walking or sitting down,” the intergenerational dimension was heavily emphasized through wishes for “a place for me and my grandson to relax and play.”

The activation of retrospective–biographical spatial knowledge led the seniors to deliberately reactivate historical and romanticized spatial typologies to counteract the looming functional sterility of modern urban space (Figure 3). Evaluated through a landscape-architectural lens, the seniors’ visions stood in stark contrast to those of the children: their inputs demanded high urban canopy cover (cherry tree avenues), structured ecosystem services (microclimate regulation through shading), high permeability, and accessible, soft-landscaped path networks.



Figure 3. Algorithmic externalization of retrospective biographic spatial knowledge (Workshop 6, urban senior cohort). From left to right: (1) original site photograph, (2) researcher-defined inpainting mask used for AI-guided image generation, and (3) AI-generated design proposal (Adobe Firefly) visualizing historically inspired and romanticized landscape typologies derived from participants’ narrative mapping. In accordance with the study’s ethical protocol and the explicit privacy preferences of the senior participants, no photographic documentation of the participatory AI generation session was recorded.

It must be emphasized that these divergent outcomes cannot be causally attributed to generational differences alone, as the setting, procedure, and specifically the use of the idealized summer image inherently shaped the seniors’ responses. However, interpreted from a sociological perspective on space, as outlined by Löw and Sturm [15], the process of synthesis heavily dominated this cohort. The seniors instantly linked the algorithmically generated objects and placements visible on the screen to their own lived environments, past travels, and historical spatial experiences. Theoretically, this constitutes a retrospective memory-linking (biographical synthesis). The interface does not generate uto-

pian visions of the future, but rather reactivates spaces of the past in order to critique the functional shortcomings of the present space [16].

Here, too, the researcher proved essential as a linguistic–conceptual stabilizer and human facilitator. The seniors verbally directed the researcher to place objects by sharing elaborate narratives. The researcher had to translate these narrative memories into precise German prompts, such as “white historic wooden garden pavilion” or “pink-blooming cherry trees along the path”.

Furthermore, the HAIHPIM framework triggered an unexpected social momentum in the public space, which can be described as a “campfire effect.” The mobile interface attracted surrounding residents of the care facility who were initially acting only as passive observers. Spontaneously, the sequential individual procedure evolved into a collective, discursive space. The seniors consulted with one another, collaboratively validated the images, and shared amusement at the astonishing visual transformation of the space.

Qualitative Evaluation of the Interface Experience Based on the HAIHPIM Dimensions: Due to the acute institutional time pressure from the care staff, the evaluation was conducted ad hoc as a focused oral group interview:

- **Realism and the “Expectation Trap”:** The hyper-realistic visual output of Adobe Firefly achieved such a high degree of suggestiveness that it revealed a fundamental communicative ambivalence. The sincere question, “When are you going to build this?”, followed by collective laughter, perfectly encapsulates the risk of an expectation trap. The image was briefly misinterpreted as a literal architectural promise, while the subsequent laughter signaled a pragmatic distancing and an awareness of the experimental, ephemeral nature of the intervention.
- **Comprehensibility and Explainability:** Once weather-related visual contrasts were mitigated, the seniors immediately understood the mechanics of inpainting, describing it as simply erasing and refilling image areas, and rated the process as highly transparent.
- **Reliability and Trust:** Despite an inherent skepticism toward modern mobile devices, the seniors collectively expressed a high level of trust in the HAIHPIM procedure. Crucially, this trust was anchored in the human proxy interface, as the participants felt their life stories were taken seriously and valued through the researcher’s active facilitation.

4.3. Contrastive Analysis: A Systematic Comparison of the Functional Interface Barriers of Both Extreme Groups

The systematic comparison of the two demographic extreme cohorts reveals fundamental divergences in the functioning, adoption, and perception of the HAIHPIM framework. Crucially, the reliance on the human proxy interface required entirely distinct modes of linguistic–conceptual stabilization for each group. As demonstrated in Table 2, the researcher had to translate highly divergent lifeworld articulations—ranging from the children’s colloquial, surreal fragments to the seniors’ elaborate biographical narratives—into standardized, software-compatible AI syntax.

Table 2. Examples of Linguistic–Conceptual Stabilization via the Proxy Interface.

Participant Cohort	Raw Verbal Input (Informal Spacing)	Translated AI Prompt (Adobe Firefly, German)	Generative Output/ Aesthetic Smoothing
Children (Age 6–9)	“I want a big slide, a biiiiiig one, like this. It shall look like my tongue, hahaha!”	Riesige, hyperrealistische schlumpffarbene Rutsche, organisch geformt, fließendes Design, Spielplatz-Architektur für Kinder	The algorithm smoothed the grotesque “tongue” concept into a glossy, modern architectural slide structure.
Children (Age 11–13)	“I want an obstacle course with sharks, like in Ninja Warrior, and with ponies...”	Moderner Kletterparcours für Kinder. Spielzeug-Haifische im Wasser, nicht so tief, Kletterbereich aus Holz, bunt gefärbt, hochauflösend.	The surreal combination of sharks and ponies was domesticated into standard, safe playground typologies.
Seniors (Age 60–96)	“A beautiful, well-maintained cherry tree avenue with lovely trees and colorful blossoms, like in Bonn, for strolling. How about a palace? Like in Sanssouci. That would be lovely”	Historische Parkanlage, Schlossgebäude im Stile Sanssouci wie in Potsdam, gepflasterter Spazierweg, flankiert von großen japanischen Kirschbäumen als Baumalleen in voller rosa Blüte, romantische Stimmung, warmes Licht. Wasserkanal zum Schluss. Familie mit Kindern, die picknicken	The localized, biographical memory (“like in Bonn”) was rendered into a globally standardized, romanticized stock-photo aesthetic.

Table 2 provides crucial evidence of both successful technological mediation and the profound extent of researcher-induced transformation. The translation from a child’s playful, fragmented comment or a senior’s subjective memory into a highly detailed, aestheticized landscape prompt is not a neutral act. Rather, it reveals the proxy interface as a significant source of interpretive distortion, where authentic spatial intentions are filtered and reshaped to align with algorithmic processing logic.

Building upon these operational differences in prompt formulation, the following matrix (Table 3) systematically contrasts the overarching empirical findings along the central theoretical and socio-technical dimensions of analysis. While these labels reflect the divergent outcomes, they must be understood within the context of the differing workshop procedures and settings.

Table 3. Contrastive analysis matrix of generation-specific interface interaction.

Analysis Dimension	Children’s Cohort (<i>n</i> = 12, Balow Schoolyard)	Senior Cohort (<i>n</i> = 6, City Park Barnstorfer Anlage)
Dominant Mode of Spatial Constitution	Immediate Playful Arrangement (Utopian Spacing): Action-oriented placement of objects in the here and now without historical reference.	Retrospective Memory-Linking (Biographical Synthesis): Linking algorithmic artifacts with memories, past lived experiences, and historical places.
Aesthetic Preferences	Surreal and abnormal: Preference for playful, physically implausible, and exaggerated architectural forms.	Classically idealized: Preference for ordered, harmonious, barrier-free, and historicizing spatial structures.

Linguistic-Conceptual Stabilization	Vague–fragmentary: Translation of children’s colloquial concepts into concrete object nouns via the proxy interface.	Narrative–metaphorical: Distillation of elaborate biographical narratives into precise design prompt components.
Social Interaction Dynamics	Explorative–autonomous: Rapid conceptual takeover of the schoolyard, independent prompt writing by older children, and high visual response speed.	Collaborative campfire effect: Strong dialogical interaction and the spontaneous emergence of a discursive outdoor space involving passive observers.
Relationship to Visual Output (UX Dimension)	The image as playground: Functionality, budgetary feasibility, and material realizability are largely irrelevant to the user experience.	The image as promise (Expectation Trap): Hyper-reality temporarily suggests immediate material buildability, followed by reflective skepticism.

A comparative analysis of Table 3 makes it clear that generative AI interfaces should not be viewed as autonomous, universally applicable planning tools at the demographic margins of society. Rather, their function shifts toward that of an exploratory probe mediated by the proxy interface. For the youngest generation, they serve as a playful deconstruction tool that breaks formal institutional planning logics. For the oldest generation, however, they function as a highly evocative medium that stimulates biographical memories, reactivating implicit spatial knowledge through immediate visual appeal.

The actual scientific yield thus lies not in the demonstration of a standardized, technological automatic translation, but in the dense visualization of deeply sedimented or utopian spatial needs [5,6]. The HAIHPIM framework provides the translational platform for this process, though its methodological success remains inextricably linked to the researcher’s guiding and stabilizing translation efforts.

To systematically present the user experience across both cohorts, Table 4 provides the aggregated qualitative interface metrics corresponding to the eight standardized evaluation questions of the HAIHPIM framework, derived from the verbal evaluations, hand signals, and group consensus.

Table 4. Summary of Qualitative Interface Evaluations across the 8 Standardized Questions.

Standardized Evaluation Question	Children’s Cohort Response (Verbal/Grades/Hand Signals)	Senior Cohort Response (Consensus Group Interview)
1. Do you like your result? (Gefällt dir dein Ergebnis?)	Mean Grade: 1.00. Immense satisfaction and loud cheering when seeing their surreal ideas visually materialize.	High: Expressed deep satisfaction with the romanticized, historical aesthetic.
2. Was it fun? (Hat es Spaß gemacht?)	Mean Grade: 1.00. Extremely high entertainment value and engagement	High: Distinct enjoyment, leading to a collaborative “campfire effect” in the park.
3. Was the time sufficient? (War die Zeit ausreichend?)	Mean Grade: 6.00. Rated as completely insufficient. Rapid idea generation led to an intense desire for extended sessions.	Constrained: Institutional care schedules dictated acute time pressure, requiring an ad hoc group interview.
4. Are the generated objects/spaces true to scale/realistic? (Sind die Objekte/Räume maßstabsgetreu/realistisch?)	Mean Grade: 1.25. Interestingly, despite the objectively surreal designs, the children subjectively rated the scale and realism as excellent	High: Emphasized and requested architecturally and historically proportionate structures.

5. How easy was the handling? (Wie einfach war das Handling?)	Mean Grade: 1.00. Handling was perceived as perfectly easy (successfully facilitated by the proxy interface).	Facilitated: Relied entirely on the proxy interface due to visual/motor barriers, but logic was easily understood.
6. Was the input sufficient? (War der Input ausreichend?)	Mean Grade: 1.00. Fragmentary, colloquial inputs were successfully expanded and felt completely represented.	High: Elaborate, narrative memories provided rich and sufficient input for the translation.
7. Could the photo/location be edited well? (War das Foto gut zu bearbeiten?)	Mean Grade: 1.00. The design-minimalist, heavily paved schoolyard served as an unproblematic blank canvas.	High (after adjustment): Editing succeeded primarily because the low-contrast winter photo was replaced by a summer image.
8. Would you like to repeat this? (Möchtest du das mal wiederholen?)	Mean Grade: 1.00. Extremely eager to continue the playful deconstruction of the space.	High: Expressed strong interest, encapsulated by the sincere question, “When are you going to build this?”

5. Discussion

Algorithmic inclusivity and the need for planning assistance: The empirical findings from the contrasting workshop cycles highlight the significant potential of the Human–AI Hybrid Planning Interface Model (HAIHPIM) to facilitate spatial articulation among demographically marginalized groups. Yet, at the same time, they reveal profound ethical, methodological, and communicative ambivalences. Given the exploratory nature of this study, these results must not be interpreted in a purely technophilic manner. Instead, we must critically reflect on the socio-technical interaction protocols. This reflection exposes the inherent risk of algorithmic tokenism and helps calibrate the tool for an emancipatory planning practice.

5.1. The Process of Aesthetic Smoothing and Global AI Urbanism

A central yet problematic phenomenon identified in this study is the tendency of commercial text-to-image models, such as Adobe Firefly, to subject the participants’ informal, non-conformist, and rough spatial designs to an intensive process of aesthetic smoothing. The visual analysis of the generated outputs documents a fundamental discrepancy between the unwieldy, lived reality of the actors and their algorithmic representation. In the children’s cohort, deliberate departures from planning rationality, such as abnormal, physically implausible playground equipment and oversized swimming pools, were instantly translated by generative AI into the visual semantics of commercial architectural renderings. The surfaces appear flawless, the light reflections are highly idealized, and the inherent, qualitative rawness of the children’s ideas is completely leveled out. This visual domestication manifested even more drastically in the senior cohort, where verbally articulated, nostalgic-biographical wishes for tree-lined avenues and pavilions were transformed into a romanticized, highly harmonized park landscape.

These empirical observations provide the grounding for a broader theoretical concern: This phenomenon can be theoretically understood as an expression of what we conceptualize here as “Global AI Urbanism”. Drawing on Rose [16], the training data underlying these AI models actively pre-structure the urban imagination. These datasets consist predominantly of Western commercial stock photography and the idealized renderings of global city marketing agencies. In its current technological form, the HAIHPIM framework thus runs the risk of reproducing a subtle form of algorithmic homogenization. The authentic, locally rooted, and often contradictory spatial knowledge of vulnerable groups is overwritten by a sterile, globally interchangeable feel-good aesthetic. This visual nor-

malization of taste risks depoliticizing the planning discourse by hiding the actual social complexity of space behind a glossy pixel facade.

However, aesthetic smoothing should not be framed exclusively as a limitation. This visual normalization also serves a highly productive, bridging function. By translating strange, informal, or physically implausible ideas into polished, professional-looking renderings, generative AI helps participants see their desires in a format that is immediately legible and familiar to formal planners. In this sense, aesthetic smoothing acts as a necessary translational mechanism to make marginalized, lifeworld spatial knowledge compatible with institutional planning discourse.

5.2. *The Expectation Trap as a Democratic Risk*

This hyper-realistic visual effect results in a severe practical planning challenge, which has been conceptualized as an “Expectation Trap” within the scope of this study. The immediate visual evidence of the AI-generated imagery possesses immense suggestive power. This was demonstrated empirically by the open, almost longing question posed by the senior participants: “When are you going to build this?”

When such unmoderated tools are implemented in formal participatory processes, they inevitably generate anticipated realities and awaken normative demands, as evidenced by the seniors’ direct architectural expectations. However, municipal planning institutions are constrained by strict budgetary restrictions, lengthy legal review processes, and formal balancing procedures. Consequently, the generated catalogue images can rarely be realized in material reality. In the sense of Innerarity [17], AI-supported participation thus risks degrading into an instrument of “tech-washing” if these images are presented without clear disclaimers. It suggests maximum participation and creative power. Yet, it carries the inherent risk of leaving behind frustrated citizens once the visual promise shatters against institutional reality. This potential for political disillusionment represents the exact opposite of the intended spatial agency, underscoring the need for cautious, empirically grounded claims regarding AI’s democratizing potential.

Against this background, planning theory must fundamentally rethink Arnstein’s [1] classic ladder of participation in the era of algorithmic mediation. A linear hierarchy that rigidly distinguishes between tokenism and citizen power falls short when a generative entity acts as an intermediary. The HAIHPIM framework requires a neopragmatic reconceptualization as hybrid governance. Within this structure, power and agency are no longer negotiated in a purely binary fashion between citizens and administration, but are distributed in a permanent triad between human, space, and algorithm. Spatial agency emerges here not through the supposedly autonomous act of the citizen, but through the ability to collectively appropriate algorithmic control loops and strategically disrupt their aesthetic standardizations (Figure 4).

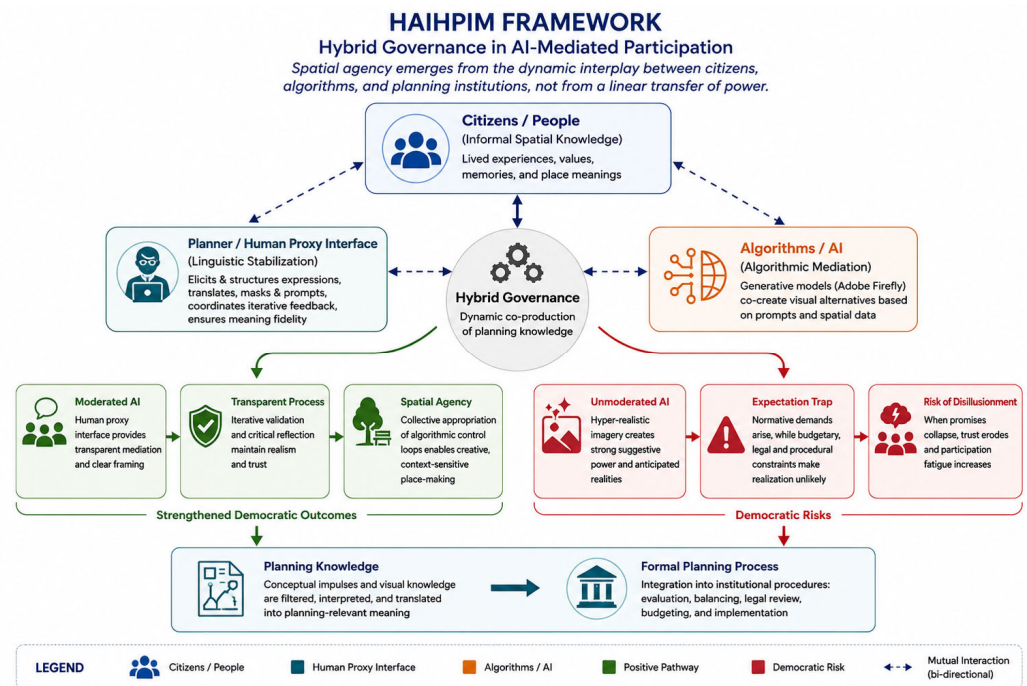


Figure 4. Hybrid governance in the Human–AI Hybrid Planning Interface Model (HAIHPIM). Spatial agency emerges from the dynamic interaction between citizens, the human proxy interface, and generative AI. The framework illustrates how continuous human mediation transforms informal spatial knowledge into planning-relevant knowledge while highlighting two possible outcomes of AI-mediated participation: strengthened spatial agency through transparent co-production or the *Expectation Trap*, where hyper-realistic AI visualizations generate unrealistic expectations and democratic risks.

5.3. The Altered Role of Planners: The Necessity of Human Facilitation and Scribal Assistance at the Margins of Society

The empirical evidence prompts a critical reevaluation of the human facilitator's role within the HAIHPIM framework. The proxy interface must be explicitly acknowledged as a structural duality. It operates as a fundamental condition of access and inclusion for non-digital demographics, while simultaneously acting as an inevitable source of interpretive bias. Because both children and seniors were equally dependent on the human facilitator to feed their spatial needs into the technological matrix, planning activity must by no means be limited to the mere mechanical typing of prompts.

In the sense of Kitchin [12], overcoming these technological barriers requires active linguistic-conceptual stabilization. The facilitator functions as a semantic catalyst, structurally organizing the fragmented, emotional, or narrative-biographical statements of the participants through a translational logic, without censoring their qualitative core. To effectively counter the described *Expectation Trap*, the facilitator must also imperatively act as an AI critic. This means that the algorithmically generated images within the workshop setting must never be presented as final, sacrosanct designs. Instead, they must be explicitly framed and declared as conversational imperfections. Only through the deliberate, discursive deconstruction of the polished, smoothed image surface in permanent dialogue with the participants can the suggestive visual power of the technology be prevented from overriding citizen discourse. The task of future-oriented facilitators thus shifts from creating the image toward the critical moderation of its inadequacies. Only through this discursive deconstruction of algorithmic outputs can the HAIHPIM framework begin to function as a facilitation tool oriented toward more equitable spatial articulation for marginalized cohorts, rather than as a reproduction mechanism for commercial aesthetics.

5.4. Methodological Limitations

While the HAIHPIM framework demonstrates significant potential, several methodological limitations must be explicitly acknowledged. First, the extreme case sampling approach utilized very small, specific cohorts ($n = 12$ children and $n = 6$ seniors). Consequently, these findings are highly exploratory and cannot be statistically generalized. Second, the necessary reliance on the researcher as a human proxy interface introduces an unavoidable interpretive bias. Translating informal, emotional spatial wishes into software-compatible syntax means the final visualizations are heavily co-produced by the human facilitator, rather than being purely autonomous citizen outputs. Finally, the generative artificial intelligence itself exerts a substantial shaping effect on the results. The inherent tendency of commercial models toward aesthetic smoothing and Global AI Urbanism means that authentic, rough, or unpolished spatial concepts are frequently overwritten by standardized visual norms. Future research must address these limitations by testing the framework across larger demographics and comparing the outputs of different, potentially open-source or hyper-locally trained AI engines.

5.5. Practical Implications for Planners and Municipalities

For practical planning and municipal applications, these insights yield clear operational directives. To actively prevent the “Expectation Trap” in real participatory settings, facilitators must establish strict communication protocols. They must frame AI-generated images explicitly as abstract “discussion objects” and communicative tools, rather than binding architectural promises. Furthermore, future empirical research and municipal practice should explore whether deploying different generative AI tools, alternative prompting strategies, or hyper-locally trained AI models might produce varying degrees of aesthetic smoothing, thereby mitigating the effects of Global AI Urbanism.

6. Conclusions

6.1. Theoretical and Practical Contributions: Clarifying the Generational Interface Conflict at the Demographic Margins

This study empirically examined the Human–AI Hybrid Planning Interface Model (HAIHPIM) under maximum contrast conditions at the demographic margins of the population. The methodological focus on school children ($n = 12$) and seniors ($n = 6$) utilizing extreme case sampling allows exploratory insights and conceptual propositions to be drawn regarding the potentials and limitations of algorithmic mediation in participatory urban and regional planning.

For the theoretical and practical explanation of this generation-specific interface conflict, the spatial–sociological axes according to Löw and Sturm [15] as well as the concept of boundary objects according to Star and Griesemer [10] proved to be complementary and epistemically indispensable. The results demonstrate that generative AI interfaces are far more than mere visualization tools; they function as intermediary translation instances between informal spatial knowledge and formal planning requirements.

Star and Griesemer [10] precisely decode why the AI-generated artifact can bridge communication barriers between lifeworld actors and institutional planning frameworks by acting as a robust yet flexible boundary object. Concurrently, the relational space theory of Löw and Sturm [15] explains how the cohorts cognitively process these visual stimuli. In doing so, two opposed modes of spatial constitution were identified. While the child cohort utilized the interface for playful, affect-driven spacing, the framework served the senior cohort as an evocative stimulus to unlock a retrospective, biographic synthesis.

Despite pronounced technological and cognitive barriers that necessitated the permanent deployment of a human facilitator acting as a proxy interface, this qualitative

study allows for a dense reconstruction of nuanced forms of articulation regarding spatial agency. The findings do not claim a statistically generalizable causal proof. Instead, they document, as analytical and illustrative propositions, how the methodological coupling of visual generation and human mediation can act as a catalyst for lifeworld spatial needs. At the same time, the study reveals a critical ethical dimension: the inherent tendency of commercial models toward aesthetic smoothing risks transforming authentic local spatial concepts into standardized images of a Global AI Urbanism [16]. Furthermore, the hyper-realistic visual effect carries the risk of an Expectation Trap, leading to institutional tokenism when visual promises remain materially unfulfilled.

The results make it clear that algorithmically generated planning proposals are not neutral but can actively reproduce existing normative aesthetics and power structures. The unmoderated use of AI in urban planning, without critical discourse, could therefore exacerbate epistemic exclusion rather than reduce it.

6.2. Scientific Innovation and Future Outlook: Contributions to the Current State of Research

For the future implementation of digital interfaces in transformative urban governance, six central research and practical planning recommendations can be derived from this exploratory extreme case analysis:

- **Technological Fine-Tuning (Hyperlocal AI):** To counteract a standardized Global AI Urbanism, future planning AI models must be trained or fine-tuned with specific, local–regional visual and real-world datasets. In the sense of a neopragmatic landscape theory according to Kühne [13], this fine-tuning is not a mere IT task, but rather an attempt at a second-order cartography. Only in this way can algorithms preserve the raw, historically evolved identity and the landscape characteristics of a specific place, instead of reproducing sterile, highly polished utopias.
- **Shift in the Facilitator's Role to AI Critic:** Planners must not act as passive operators in AI-supported workshops. They must be pedagogically trained to critically deconstruct the generated images together with citizens as AI critics. Algorithmic flaws must be proactively declared as conversational imperfections that stimulate discourse rather than pretending to offer ready-made solutions.
- **Combination of Analog and Digital Tools:** As the hybrid design of the schoolyard workshop demonstrated, digital interfaces unleash their most productive power when they do not replace, but rather synergistically expand, haptic, low-threshold analog methods, such as physical clay modeling.
- **Testing across Diverse Demographics and Contexts:** To move beyond the limits of this exploratory study, future research must test the HAIHPIM framework with larger, more diverse demographic samples and across varying urban planning contexts to validate these initial propositions.
- **Comparing Generative AI Systems:** Future studies should systematically compare outputs from different generative AI models (e.g., Midjourney, DALL-E, or open-source Stable Diffusion models) to assess whether the degree of aesthetic smoothing and interpretive distortion varies across different algorithmic architectures.
- **Involving Professional Planners:** To verify the practical impact of AI-generated boundary objects, future research designs must include professional municipal planners as a participant group to examine whether these algorithmically mediated images actually influence formal planning discourse and administrative decision-making.

In summary, the HAIHPIM framework offers a valuable exploratory proposition for strengthening social sustainability in urban development. The deployment of generative AI makes an exploratory contribution to making the nonverbal and emancipatory visions

of demographic marginal groups discursively visible. However, this requires a critical reflection on the socio-technical framework conditions and the role of human facilitation. By rendering the lived space (*espace vécu*) of these cohorts legible to formal planning streams [14], the framework exposes both the potentials and the real communicative hurdles on the path toward an inclusive production of space. However, given the constraints of a single-facilitator setup and highly limited sample sizes, the structural limits of this current evidence must be explicitly acknowledged before claiming definitive advancements in inclusive governance.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/land15071260/s1>, S1. The Proxy Interface Prompt Rubric; S2. Example Coding Scheme for Qualitative Data Analysis.

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Institutional Review Board Statement: Ethical review and approval were waived for this study due to the non-interventional nature of the research design. All participatory workshops were conducted anonymously or pseudonymously, and data collection involved no clinical, psychological, or high-risk experimental procedures. This determination was confirmed in accordance with the ethical guidelines of the University of Rostock.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Verbal informed consent was obtained from the legal guardians of the child participants. Verbal informed consent was obtained from the senior participants (and, where applicable, institutional care home staff coordinating the sessions) before the ad hoc workshop.

Data Availability Statement: The qualitative data and AI-generated visual outputs presented in this study are available on request from the corresponding author due to privacy and ethical restrictions regarding the demographic cohorts involved.

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Conflicts of Interest: The authors declare no conflicts of interest. Reference [13] is authored by a doctoral supervisor of the corresponding author (O. Kühne, University of Tübingen). The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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