

Toolkit Proposal (Work-in-Progress): Participatory & Speculative Board-Game Making for AI and Environmental Governance Awareness

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Abstract

How can HCI and AI be developed to cultivate awareness and governance practices that move beyond solutionist narratives toward grounded and hopeful engagement with environmental justice? We introduce a participatory and speculative design toolkit for making board games that treat AI-enabled environmental data practices such as computational bioacoustics, geospatial mapping, legal corpora, and pollution datasets as design materials for environmental justice (EJ) education and local AI governance literacy.

The toolkit is structured around a modular set of playable minigames that collectively function as a governance simulator, incentivizing grounded institutional reasoning. Through staged dilemmas involving monitoring, data work, legal precedent, and infrastructural trade-offs, participants rehearse how environmental evidence is produced, contested, and mobilized.

Rather than evaluating impact through technical performance alone, we foreground the making process itself—relationships formed, contestation enabled, and situated reasoning developed—as a primary outcome. Hence the toolkit contributes a participatory infrastructure for awareness-building aligned with Sustainable HCI’s calls to move beyond efficiency framings toward deliberative, situated engagement with AI’s environmental implications.

Keywords

Participatory Design; Speculative Design; Sustainable HCI; Environmental Justice; AI Literacy; Bioacoustics; Games for Awareness; Board game

1 Positioning: Awareness Beyond Optimization

AI systems are increasingly embedded in ecological decision-making and public life, while their material and environmental impacts—data centers, energy and water demand, and infrastructural siting—are borne unevenly by local communities [4, 7]. In parallel, research in Sustainable HCI has cautioned against approaches that reduce environmental problems to technical fixes, arguing instead for attention to politics, uncertainty, and contested values [2, 3, 5].

This paper proposes a toolkit that treats *awareness* not as information delivery but as a situated practice: collectively making, debating, and negotiating what counts as evidence, impact, and acceptable trade-offs. We take a non-solutionist stance in which design methods should keep governance questions open rather than prematurely closing them through efficiency framings [1]. This stance is materialized through structured minigames that stage governance dilemmas, making infrastructural trade-offs experientially negotiable rather than abstractly described.

In this toolkit, AI is treated as a design material, enabling participants to experiment with how AI systems are configured, represented, and governed in relation to local concerns. In some cases, AI appears as a speculative artifact within the game world; an imagined system whose behavior and consequences can be debated. In others, it is grounded in real data and software infrastructures. The toolkit includes modular components that facilitate engagement with commonly used AI-supported materials in sustainability contexts, such as geographical information systems, computational bioacoustics workflows, climate and pollution datasets, and environmental policy instruments augmented with AI tools.

2 Toolkit components: AI-as-Material for Board-Game Making

The proposed toolkit is lightweight and reusable (printables, facilitation guide, optional digital assets). It supports groups—students, educators, artists, local stakeholders, and optional technical facilitators—in co-creating board games that simulate environmental monitoring and AI governance scenarios. The toolkit is designed to augment existing environmental education and community infrastructures rather than replace them.

2.1 Structured progression and core components

Grounding pack. Templates for collecting and representing local knowledge: short stakeholder interviews, “contested facts” cards, and a “what we do not know” register. By surveying stakeholders in the community, the activity will guide the participants into documenting crucial data that is not available anywhere else through participative approaches.

Speculative worldbuilding pack. Prompts for constructing a near-future narrative about governing an “acoustic commons” (farm, forest, or neighborhood soundscape) under constraints such as limited budgets, drought conditions, grid capacity, siting conflicts, or restrictive procurement. Design fiction enables participants to explore trade-offs and institutional friction deliberately rather than proposing simplified solutions [1].

Bioacoustics-as-material pack. As AI models are increasingly used to sense and monitor ecological systems, it is important to render these practices accessible and interpretable. This pack invites participants to engage directly with bioacoustic artifacts—sounds, spectrograms, and annotations—facilitating contact with local fauna while introducing a fictional layer in which ecological literacy drives narrative change. Within the game world, recognizing bird

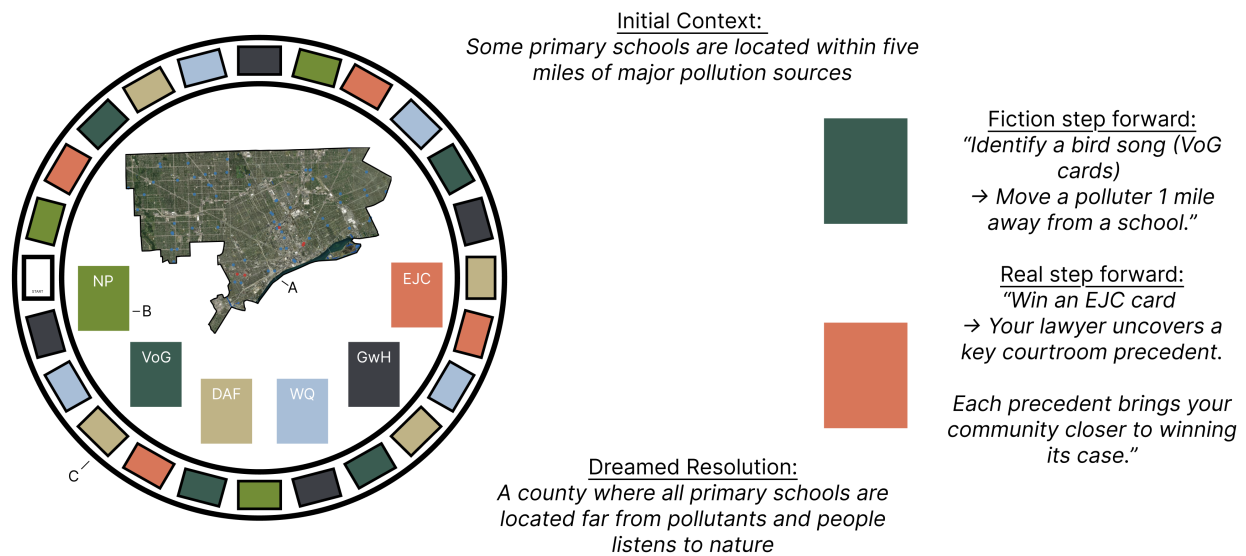


Figure 1: Conceptual overview of the board game prototype. The outer track represents collective progress, while the central map (A) situates local schools and pollution sources. In the fictional layer, identifying bird songs moves pollutants farther from schools through the Voices of the Garden (VoG) cards. In the real-world layer, winning Environmental Justice Courtroom (EJC) cards strengthens legal precedent, advancing the community toward structural change.

songs and interpreting soundscapes produces visible shifts in environmental conditions, creating, through play, a metaphorical relationship between knowledge, sensing, and governance.

News, History, and Law corpus-as-material pack. Curated excerpts from journalism, environmental justice litigation, policy documents, and landmark cases function as playable knowledge artifacts. Through a retrieval-based mechanic (e.g., Environmental Justice Courtroom cards), participants identify which arguments, precedents, or procedural moments were decisive. Legal and institutional knowledge thus becomes manipulable material rather than static reference.

Minigame library. Modular minigames operationalize monitoring and governance actions, including: (1) News Polygraph (NP; RAG-enhanced), (2) Voices of the Garden (VoG; enhanced with computational bioacoustics and RAG on ecology and bird song facts and quizzes), (3) Detroit Agricultural Facts (DAF), (4) Water Quality Facts (WQ), (5) Greenwashing History Quiz (GwH), and (6) Environmental Justice Courtroom (EJC). These minigames function as probes designed to spark discussion and collective reasoning rather than assessments of correctness. Across minigames, progress is represented through a shared community capacity meter advancing from 0% to 100%. Each successful action—whether identifying a species, resolving a dispute, or uncovering a legal precedent—incrementally strengthens the community’s collective position. Constraint events may slow or reverse progress, reflecting the contested nature of environmental governance. The game concludes when sufficient collective capacity has been built to shift the structural conditions represented on the board, allowing for partial, incremental, or transformative endings. These minigames form a

modular governance simulator, in which gamefied fictional ecological progress and real-world institutional reasoning are structurally coupled.

Governance reflection layer. End-of-session prompts ask participants to articulate what was realistic, what was sacrificed, who benefited, who bore costs, and what remained invisible. Each story will be different every time, which will create a stimulating space for different ideation and reflection. The aim is to produce shared traces of reasoning that can circulate within local organizations, amplifying their expression, supporting their growth, and informing future action.

Minimal commitments: sufficiency and accountability. The toolkit is distributed with a set of default commitments that prioritize sufficiency and accountability in the technical and social dimensions. It encourages sufficiency first prototyping, favoring local, smaller models when computational components are used, minimizing unnecessary cloud dependence, and explicitly surfacing these infrastructural trade-offs as part of gameplay and reflection. It introduces lightweight compute transparency practices, guiding participants to generate a coarse “energy receipt” for any digital component involved, emphasizing responsibility even when measurement is approximate. Finally, it embeds data governance prompts that ask who owns bioacoustic recordings, how consent is negotiated, and how these arrangements might be improved, ensuring that questions of stewardship and rights remain central rather than peripheral.

3 Evaluation and Planned Pilots

We approach evaluation as part of the design process rather than as a detached measurement exercise. Because the toolkit centers collective making and deliberation, we are less interested in technical performance metrics than in how sessions unfold: who participates, what kinds of conversations emerge, and whether new forms of shared reasoning become possible [5, 6].

In early deployments, we will document three dimensions of change. First, we will observe the range of roles and institutions that meaningfully participate in game-making sessions: students, educators, artists, community members, and technical contributors. Then we will observe how these roles shift during play. Second, we will track whether sessions generate durable connections: follow-up meetings, shared artifacts, or collaborations that extend beyond the game itself. Third, we will examine traces of governance literacy through short reflective prompts before and after sessions, focusing on whether participants expand their ability to articulate infrastructural externalities, uncertainty, incentives, and decision rights [4, 7].

Initial pilots are planned in sites that already sustain environmental education or community engagement infrastructures (e.g., farms, schools, and maker spaces), ensuring that the toolkit complements rather than replaces existing practices. The system is intentionally modular: local ecologies, stakeholders, constraints, and datasets can be substituted without altering the core progression logic of the game. This flexibility allows the toolkit to remain locally grounded while preserving its structural coherence.

Overall, the contribution of this work lies not only in the artifacts produced but in the participatory conditions it enables. By staging governance dilemmas, the toolkit operationalizes governance rehearsal through structured play, making infrastructural impacts materially negotiable rather than abstractly critiqued. Therefore it resists premature solutionist closure, and foregrounds deliberation, relationship-building, and situated reasoning as legitimate outcomes of Sustainable HCI practice [1–3].

4 Conclusion

We intend to facilitate the creation of experiences that include AI as a sustainable material in the direction of governance improvements. The use of imagination and the collective deep reflection on urgent matters can also be facilitated by this kind of use of AI. Also, by judging it themselves, the participants will be positioned in a circumstance that will require them to recognize between hype and real benefits, and tradeoffs on AI for sustainability. By situating ecological literacy, legal precedent, and infrastructural friction within a shared game space, the toolkit highlights awareness as practice rather than information transfer.

Building collective capacity through dialogue, negotiation, and speculative rehearsal constitutes a meaningful contribution to Sustainable HCI. Therefore the value of the toolkit lies not only in the artifacts produced, but in the relationships formed, the tradeoffs surfaced, and the deliberative spaces opened. Future work will explore deployments and adaptations across diverse ecological, cultural and institutional contexts, examining how such participatory infrastructures and speculative design methods can complement technical approaches to environmental sustainability.

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