# City Settlers: Participatory Games to Build Sustainable Cities

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# City Settlers – Participatory Games to Build Sustainable Cities

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## ABSTRACT

In this paper, we present the motivation for, and design of, City Settlers, a participatory simulation. In City Settlers learners engage in collaborative embodied play, competition, and sensemaking within the domains of sustainability, environmental complex systems, and city building. Learners work in teams running separate but interconnected cities, and need to deal with the interrelatedness of economic, ecological, and social systems which are integral to understanding sustainable development. Competing over some shared resources, and developing ad-hoc alliances during play – players have the ability to optimize for different goals (industrial progress, agricultural progress, or social longevity). Learners are also scaffolded to reflect on the ways different desired goals lead to different individual and collective outcomes.

## CCS CONCEPTS

• **Human-centered computing** → **Collaborative and social computing systems and tools**.

## KEYWORDS

Simulations, Mixed reality, Games, Collaborative Learning, Sustainability, Environmental Education



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## INTRODUCTION

There is a growing consensus that students need to develop greater literacies around sustainability and the interconnectedness of environmental systems. These literacies include several key elements: (a) understanding the need to satisfy present needs without compromising the survival of future generations; (b) recognizing sustainability as a dynamic condition characterized by interdependent economic, ecological, and social systems; and (c) developing the multidisciplinary understandings and skills needed to deal with the complex problems associated with sustainability [6].

However, given the multidimensional and interdependent nature of environmental systems, teaching these concepts is challenging, especially for young learners. One approach that has seen success is participatory simulations [2]. Participatory simulations, like the Cormas platform [2] place learners at the center of the phenomena under investigation in contextually rich and personally relevant ways, by situating them in immersive contexts and tasking them with managing agents and subsystems. This finds a natural fit with environmental systems, allowing learners to investigate and explore the complex interrelated systems related to sustainability (ecology, economy, and society), enabling learners to see how their individual decisions impact the overall longevity and health of the system.

While some of these systems are collaborative, most focus on students working in pairs on a single system [1]. While effective, these designs miss out on the opportunity for engaging multiple learners in interconnected ecologies, which may allow for more complex goal settings, divergent collaborative interactions, and deep whole class discussions about the impact of one group's decisions on the larger system. In response, we present the design of City Settlers, a multiplayer participatory simulation where teams of learners design and build virtual cities with industries and trade alliances while maximizing social or economic goals within ecological sustenance constraints.

## RELATED WORK

There is rich work on the design of simulations and activities intended to convey the complexity and inter-relatedness of environmental systems [10]. Katsaliaki & Mustafee [8] present an extensive review of serious games based on sustainable development, many of which have been used in classrooms. This work builds on the recognition of the power of serious games – computer games and simulations provide engaging environments with exposure to scenarios that are hard to create or observe in the real world, and make salient the features of the environment relevant to the learning goals of the classroom [3]. From acting in the role of a world economic advisor (SimEarth), to playing the role of an individual plant species competing for survival (Shrub Battle [4]), these games run the gamut of engaging learners in different aspects of global and local ecologies. These are particularly well suited to support classroom conversations and sensemaking about the complex interplay between sustainable growth and management of industrial development alongside residents' needs [5].

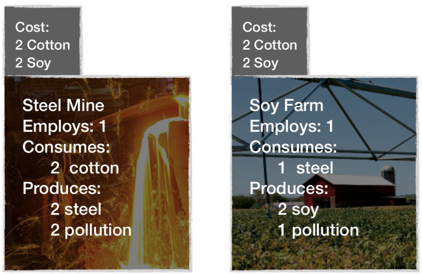


**Figure 1: Mockup of a beginning city's industry view which presents a metal producing factory and food producing farm.**

All of the examples described above focused on single-player simulations. In contrast, multi-player systems can allow for competing needs and perspectives and require learners to negotiate their understandings to find mutually beneficial actions [7]. This is especially noticeable in Antle, et al's Youtopia [1] – a table top ecology simulation designed to be used by multiple learners simultaneously with the goal of inviting rich conversation through embodied action on a system. In YouTopia, there is no designed-for optimal outcome. Instead, learners discuss among themselves the trade-offs between their decisions within the context of the larger ecological system.

In a similar vein, Liu's immersive simulations [9], and Moher's Embedded Phenomena [10] transform classrooms into mixed reality environments which augment face-to-face interactions with whole-class simulations. These designs allow for engaging experiences where learners fully embody their roles and gain an involved perspective on the operations of agents within a complex system. With a similar goal of exploring collaboration to support at individual, group, and classroom sensemaking around the complexity of sustainable development – we present our design of City Settlers.

## DESIGN

City Settlers is designed as a multiplayer participatory simulation in which learners manage the industrial and ecological aspects of cities, in consort with other groups managing their own cities. It is intended to be played in a classroom, with teams physically located in different parts of the room (each representing the physical location of their city in relation to their peers'), and learners moving around talking to members of their own and competing teams.

Each team begins with a starting population, pollution, and resource pool (currently represented by iron, gold, food, and cotton). Different level of pollution, resources, and buildings constructed in each city result in changing amounts of "happiness" and "health" metrics for the population. These in turn, affect the productivity of the populace, as well as influx or departure of people from the city.

Each round, teams are provided a shared pool of factories (iron or gold), farms (food or cotton), and parks (reduce pollution) they can choose to build. This shared pool is intended to encourage teams to strategize how they can develop their cities in complementary ways. This allows learners to try out different strategies across playthroughs, and discuss the merits and demerits of specialized versus generalized economies. Cities can also trade resources, enabling them to discuss and share strategies and engage in collective negotiation.

Players can see statistics about others' cities growth in terms of population, production, and pollution. Pollution is a mechanic which makes the embodied in-classroom experience particularly salient. Cities with an excess of pollution will leak pollution to neighboring cities. This effect is designed to simulate the impact of local actions on global networks through ecological mechanisms. This interconnectedness also makes it so learners have to strategize and negotiate regarding rapid growth strategies with the whole class.

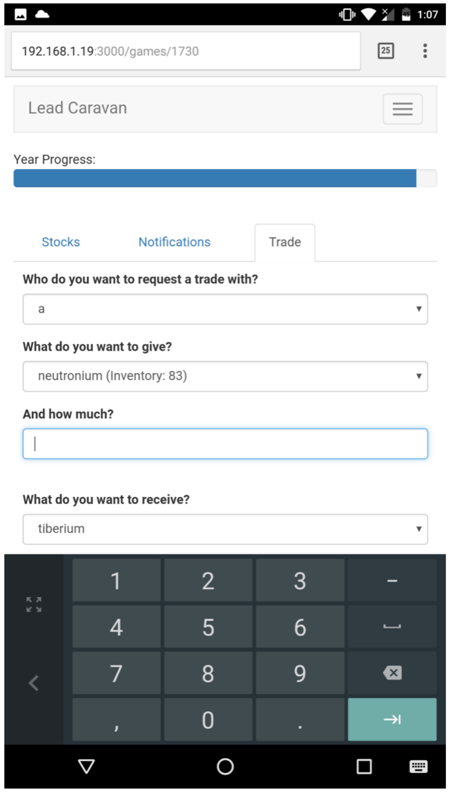


**Figure 2: Sample view of a trade screen available to players on their individual mobile devices, wherein they can exchange resources across teams' stock piles.**

To see long term sustainability of the world created by the learners, the game allows for an accelerated simulation of the state from when the simulation ends, allowing students to see how long their cities can sustain themselves. This is expected to support class reflections on the relationships between different strategic pursuits and different successes metrics (e.g., industrial output, happiness, population growth). Different perspectives on sustainability, and the different conditions required to attain them is a critical part of environmental literacy City Settlers is intended to support.

## FUTURE WORK

We envision City Settlers contributing to the growing body of classroom sustainability education. We plan on developing lesson plans that support state-specific curricula, and furthering research on understanding how interconnected simulations can support collaborative learning and sensemaking.

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