# Design for Change: Digital Tools and Games for a Sustainable Future

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**The Fourth U.S. National Climate Assessment described pressing issues facing cities and people related to climate change, threatening human health, ecological systems, infrastructure, agriculture, and increased storm events.[1] However, the report concludes by stating that while many impacts of climate change are unavoidable, much is still largely determined by our collective actions. The collaborative project Design for Change: Digital Tools and Games for a Sustainable Future is an transdisciplinary research project based on the belief that game-play and game-design are not only powerful ways to learn, but they also have the great potential to bring people together to share an experience that can impact them in significant ways. The project seeks to reframe problems related to environmental health as an opportunity for design innovation and community engagement, with the goal of building knowledge, generating collective optimism, and developing actionable solutions.**

**Design for Change involves the development of climate change games by students of various education levels. The research question asks how can a pedagogy applying design and game-play help students better understand urban complexities and propose solutions related to the effects of climate change on the built environment? The collaborative research directly addresses the need for new approaches to educational practices and methods through the development of digital tools and game design based interactive learning to create a more engaging platform to learn about sustainability. This project combines the expertise of Dr. Renee Jackson, Assistant Professor of Art Education & Community Arts Practices, whose research is focused on learning about social justice through game-design and integrating games into curriculum and Gabriel Kaprielian, Assistant Professor of Architecture, whose research is on climate change adaptation of the urban environment.**

## INTRODUCTION

Given the urgency of action needed to tackle issues of socio-ecological sustainability, Dr. Madeleine Sclater argues that new, creative, collaborative approaches to educational practices and methods, mediated by technology, are necessary to deeply engage people and develop their consciousness of sustainability issues.[2] Taking Sclater's call for creative collaborative approaches mediated through technology to heart, this project proposes that learning and teaching about the climate emergency happens best through collaborative game-design and collective game-play. The project draws inspiration from the playful work of designers in the 1950's and 60's exhibited in "Serious Play: Design in Midcentury America" co-organized by the Milwaukee Art Museum and the Denver Art Museum, as well as, games of the built environment that have shaped the minds of both designers and non-designers alike, such as Froebel's Gifts, *SimCity*, and Buckminster Fuller's *World Game*.[3]

The paper begins first with a framing of precedent games that have inspired the "Design for Change" project. We will share two projects that have each been completed related to the collaboration; (1) design and fabrication of sea level rise board games by students in an interdisciplinary university program; (2) three iterations of "Arcade Our Way" game design projects with middle school students, focussing in particular on the third iteration where students worked with an independent video game developer to collaboratively design a game related to socio-ecological sustainability within their communities. We will then describe the current joint curriculum and workshop that we are creating combining Art Education and Architecture students. Lastly, the conclusion offers reflections on lessons learned for applying game design in art and architectural pedagogy, strategies for successful implementation, and potential for further development.

## GAMES OF INSPIRATION

Games have been used for both learning and entertainment across time.[4] The "Royal Game of UR" is thought to be the oldest game, dating back 4500 years. Games have been used by artists to disrupt systems and interfere with linear ways of thinking and doing.[5] Games are increasingly considered to be powerful learning tools not only in terms of content, but also by developing capacities such as problem-solving skills, creative thinking, collaboration and systems thinking.[6]

Figure 1. Sea Level Rise Board Game - Designed and Fabricated by DISC Students. Gabriel Kaprielian.

There have been many games over the years that relate to architecture and city building, including geometric blocks (*Legos*), board games (*Settlers of Catan*), and video games (*SimCity, Minecraft*). In *Architecture and Play*, Tamar Zinguer describes important "architectural toys" in the 19th and 20th century that have inspired generations of designers: "Friedrich Froebel's Gifts (1836), cubes, spheres, and cylinders that are gradually broken down to smaller geometrical parts; *Anchor Stone Building Blocks* (1877), comprising hundreds of miniature stone shapes that yield castles, forts, and churches; *Meccano* (1901) and *Erector Set* (1911), including small metal girders to construct bridges and skyscrapers mimetic of contemporary steel structures; and *The Toy* (1950) and *House of Cards* (1952), designed by Charles and Ray Eames, which are lightweight cardboard "kits of parts" based on methods of prefabrication."[7]

Froebel's Gifts have been noted to be particularly influential in the early formation of architects Frank Lloyd Wright, Buckminster Fuller, and Le Corbusier.[8] Wright, born in 1867, received a set of Froebel's Gifts as a child from his mother. He later said that this was the moment that he "began as an architect... For several years, I sat at the little kindergarten table ruled by lines about four inches wide. The smooth cardboard triangles and maple-wood blocks were most important."[9] The son of Wright, who also played with Froebel's Gifts, later went on to invent *Lincoln Logs*.

The idea came while the family was living in Japan and the design was said to be based on the architecture of the Imperial Hotel in Tokyo where the foundation had interlocking log beams.[10]

Buckminster Fuller, known as the inventor of geodesic domes, is said to have been inspired as a child playing with Froebel's "peas and sticks," by connecting the nodes and rods to understand how to make strong triangular structures.[11] Fuller later went on to create *World Game* in the 1960's with the intention that it be a tool that "would facilitate a comprehensive, anticipatory, design science approach to the problems of the world."[12] The *World Game* used his *Dymaxion Map* as the board space and was related to his theory of Spaceship Earth in the interconnected relationships between governance, design, and the environment.

In "Design for Change," we seek to find a balance of the hands-on creativity found in Froebel's Gifts and the larger systems thinking related to climate change in Fuller's *World Game*. However, a core difference between these precedents and our project is that students are playing games of their own making. Our role as instructors offers guidance as a framework to further develop the games; similar to Sol Lewitt's drawing instructions with open-ended flexibility. We have found that the development of the game is just as important as playing to develop deep engagement through creative communication and iterative design,

Figure 2. Public Exhibition of Sea Level Rise Board Games at the Exploratorium: The Museum of Science, Art, and Humanities. Gabriel Kaprielian.

especially when considering the complexities of climate change. Next, we will share two courses where we have used game development as a pedagogical tool: (1) "Architecture and Play: The Sea Level Rise Board Game" by Gabriel Kaprielian; (2) "Social Impact Video Games: Ghost Hotel and The Air We Breathe" by Dr. Renee Jackson.

## ARCHITECTURE AND PLAY: THE SEA LEVEL RISE BOARD GAME

The Sea Level Rise Board Game (Figure 1) was designed, developed, and played by students in an intensive 5-week program at UC Berkeley called *Design and Innovation for Sustainable Cities* (DISC) directed by Gabriel Kaprielian. The DISC program explores a multi-disciplinary and multi-scalar approach to design of the built environment. Over the past 8 years, the program has hosted students from 30 countries representing various disciplines at different stages of their university education. Given the diversity of the student body and complex nature of urban systems, the board game as a pedagogical tool offered a platform to apply site analysis, research, and urban theory leading to creative communication and more informed design proposals.

The students in the program were tasked with developing a plan for urban adaptation to issues presented by sea-level rise in various sites around the San Francisco Bay Area. This involves

a complex series of challenges including: regional versus local governance, built versus natural environment, vulnerable local and regional infrastructure, diverse stakeholders with diverging interests, and population growth. Questions to be answered through game development and play included: How can the best policy and design be selected and tested? How will communities learn about different options and strategies for adaptation and be empowered to act? Who will be the winners and losers of different scenarios?

The studio process began first by conducting site analysis, including mapping of the past, present, and potential future risk posed by sea level rise. These maps later created the board game base, reflecting a 'real' rather than hypothetical place. Students developed the board game using a provided framework, adding game pieces, resilience strategies, and chance event cards from precedent research of real and speculative projects that address climate change. The students then play-tested their games acting as the various stakeholders, while further developing them through iterative design conversations. Following game design and play, student groups developed an urban design proposal leading to climate change resilience.

To address the pressing problems for coastal adaptation in response to climate change, ecological degradation, and urban

Figure 3. "Sea-Level Hi-Rise" at the Milwaukee Museum of Art. Gabriel Kaprielian.

growth, the board game sought to reframe the problems as opportunities for design innovation. With an open-end approach to determine potential future outcomes created through the board game, students were more likely to experiment with innovative resilient urban development strategies. For long-term and large-scale planning, this process incorporates a complexity often seen in real-world projects that must consider changing circumstances over time. The final urban designs included knowledge gained through game play, including design for multiple scenarios of events, development strategies over time, and allowed the teams a framework to discuss their ideas.

The board game serves as a platform for creative discourse, bringing people together to discuss the problems, opinions, and develop a more robust and inclusive process of design. In the case of the Sea Level Rise Board Game, students were able to incorporate their site analysis and sea level rise adaptation research with the complexities of time and changing events. The board game helped students from diverse backgrounds come together to create a shared vision of a more resilient future and in turn share their experience and develop 'design empathy.'

A public event was held at the Exploratorium: Museum of Art, Science, and Technology, where students displayed their board games and posters of final urban design proposals (Figure 2). This public presentation illustrated another important aspect of the board game, which was not only a tool to describe the design proposal, but also served to actively engage community members young and old through play. This led to heightened interest

by the students and public alike, generating open discussions and co-creating new scenarios of speculative futures. This was a demonstration of how the board game created a framework not only for internal design discussion, but also external communication in a way that was more participatory and democratic than traditional "static" architectural design representation.

The board game as architecture pedagogy was found to have been successful on a variety of levels. It offers a platform for interdisciplinary conversations. It simplifies urban complexity through abstraction of the game board and pieces, allowing non-design students to more easily engage in design development including digital modeling, fabrication, and representation. During the game, students consider multiple perspectives and develop design empathy by role playing as the stakeholders. It creates an opportunity to directly incorporate site analysis that the students learn in mapping and fieldwork exercises as a key part of the urban design process. Students developed the rules of game play through an iterative process of testing out the interaction of player goals, potential development, coastal adaptation strategies, and chance events that lead to conversations. The board game serves as an interactive model that allows the student groups to test out and discuss multiple scenarios of sea level rise adaptation.

## BOARD GAME STRUCTURE
It is important to have a structure to the board game so that the students can have a place to begin from. This reflects Froebel's Gifts, which begin first with structured grids and set geometric

pieces and only end much later with clay as the last gift that can be manipulated into any form. The pedagogy for the board game structure was informed by "Sea-Level Hi-Rise" a hybrid board game and art installation designed by Gabriel Kaprielian for an exhibition at the Milwaukee Museum of Art (Figure 3).

In the "Sea Level Rise Board Game," players represent local stakeholders tasked with adapting the city to rising tides and a changing shoreline. As sea levels rise, will the players choose to collaborate and create a shared vision for a resilient waterfront community, or will they follow their own divergent interests? This presents an opportunity of choice for players to actively communicate their goals, collectively work together, and develop empathy for different perspectives. Or, perhaps a more sinister approach might involve finding ways to manipulate other players to achieve their goals. In this way, the "Sea Level Rise Board Game" is both a collaborative and competitive game. All players lose if any development is flooded at the end of the game and if shared sustainability goals are not met. Multiple players can win, if they achieve their individual goals.

Unlike most board games, the game does not start with a blank slate, but rather a playing board incorporating a real site, populated with the present built and natural environment. Underneath the game board, are maps from the Past, Present, and Future of the site. These maps become 'characters' in the game, influencing and informing game play. As sea levels rise, they threaten to reclaim the land that was built on the historic baylands. In one site example, the Past Map from 1857 shows the historic shoreline, the Present Map illustrates the current city built on reclaimed land, and a new Future Map is placed each lap or decade and shows the inundation for that level of sea level rise; water pieces are placed on the board accordingly. Similarly, in the game and in real life, Earthquakes and Floods more directly affect areas built on reclaimed land. These maps teach players that underneath each city street and building, lies a story that describes the historical ecology and urban transformations that can help inform resilient future development. The Board Game Grid represents a translation from the 'real' world to the 'game' world through a pixelization of the urban fabric. The game pieces include Buildings, Transportation and Public Space, Adaptation Strategies, and the Environment.

With each round, players roll the dice and traverse the outside track, representing time and chance. A lap around the track represents a decade in time, with sea levels rising at least one foot. The Game Track is a timeline that also contains Event Cards, which introduce an element of chance that can help or hinder individual and shared goals. These represent Environmental, Governmental, and Economic factors. Players must choose from various game pieces to be placed on the grid, representing collective and individual interests. For example: The Developer wants to make as much money as possible with new high density development; the Mayor is trying to raise enough tax money to pay for resilient infrastructure, but must first create Transit

Oriented Development and public amenities to attract Tech Companies; the Resident wants to increase quality of life by adding bike and pedestrian friendly roads and public parks, while maintaining low density development and has the special power to delay some undesirable development; the Environmentalist seeks to increase tidal wetlands and protect native species and has the special power to remove parcels at risk of flooding from sea level rise.

## SOCIAL JUSTICE VIDEO GAMES: GHOST HOTEL AND THE AIR WE BREATHE

The video game project developed by Dr. Renee Jackson is called Arcade our Way (AoW). There have been three iterations of this project with the Academy for Middle Years (AMY) Northwest in Philadelphia and The Linden School in Toronto. The first case-study led to the development of a video game prototype called Ghost Hotel (AoW, 2016). This was a feminist game designed in collaboration with girls in grade seven. This game provided the opportunity for the participants to articulate ideas about what it means to stand up for yourself as a young female in society.

The most recent case-studies, "Girls with Ideas" and "Proudly Untitled," demonstrated the power of collaborative knowledge sharing about climate change within the context of building the narratives of the games. Both projects took place within an after-school context at AMY Northwest in Philadelphia, with a small group of 4 girls in grade 7, and 4 boys in grade 8, with occasional contributions by a female and male peer. AMY Northwest is an urban middle school that consists of a student body that is 88% African American or Black and 100% of the student body is eligible for free lunch (Public School Review, 2017 – 2018).[13] "Girls with Ideas" took place over 12 weeks, and "Proudly Untitled" took place over 5 weeks due to the novel caronavirus. Though our time was cut short, 5 weeks of collaboration with the student-participants provided a rich collective learning experience. Throughout both projects, each 1-hour after school session was audio recorded, transcribed and coded for knowledge sharing based on various themes: "climate change learning"; "social justice understanding", and "video game knowledge". The most significant learning about climate change happened within the co-construction of the narrative of the game.

Past research has revealed that the most motivating element for students when they design games for learning, is the construction of the game narrative.[14] What often happens within the context of math and science when students design their own games for learning is that they become fully engrossed in the story-building and are less inclined to incorporate the learning elements into the game. Given the collaborative nature of these projects, significant learning took place as the narrative of the story was excitedly being discussed by the student-participants, most often the adults, but at times the students, would suggest details within the context of the story more specifically related to the climate crisis. Student-participants would then choose to weave it into the story, or leave it out. In this sense, the students

Figure 4: "The Air We Breath" - Video Game Interface. Renee Jackson.

were not told what to think or incorporate, but instead chose for themselves. This approach which emerged through the creative design process, supports a critical pedagogy framework wherein students learn collectively through what critical pedagogy Paulo Freire refers to as praxis: reflection and action upon the world in order to transform.[15] From a critical pedagogy perspective, the teacher/facilitator and students are co-learners and co-teachers. Within the context of collaborative social impact game-design, I have come to refer to this idea of collective story building with the incorporation of knowledge based on the topic at hand as "knowledge weaving."

## VIDEO GAME STRUCTURE: CLIMATE-FICTIONS

The "Girls with Ideas" case-study led to the design of 2 choose your own adventure type climate-fiction games that were planned out and partially developed using a free application called *Twine*. The data gathered during the creation of these games supports the concept of knowledge weaving, however, for this section I will focus on the game "The Air we Breathe" (AoW3, 2020), created through the "Proudly Untitled" case-study, because it was completed. In this game, you win by throwing knowledge about climate change at minions (agents of the state), transforming them into activists. You win against lumber and oil corporate bosses by overwhelming them with powerful statistics about their industries. You lose if you suffocate by running out of oxygen and not managing to plant enough trees, clean enough ponds, and help scientists in order to improve the air quality. In our game we share real statistics and everyday strategies for working against climate change (such

as eating less meat and not wasting paper), and the player gathers them in a journal. Several of these statistics are localized to Philadelphia, as this is our context.

Though we have not yet had a chance to play-test the game on a large-scale, throughout the game-design process the game was playtested by friends, family and colleagues. Our 14 playtesters ages 8 - 40 completed a feedback form. Beyond the factual learning embedded within the game, wherein some people retained a fact or two and some didn't, what was most striking was the sense of delight that some players felt, including myself, by seeing the built environment of the game transformed aesthetically from a sputtering C02 infested, oil polluted water wasteland to a cleaner, lighter landscape. This element for myself and a few others, had a somewhat visceral, euphoric emotional response.

## GAMES FOR COLLABORATION: FUTURE TRAJECTORIES

Based on these recent examples and from contemporary game designers like Jane McGonigal who apply the affordances of games to "game" various societal systems and address problems, we will be designing further curriculum with the purpose of engaging students at our university in game-design for learning and direct action.[16] McGonigal has created alternate reality games made with the intention of tackling real-world problems. Such games include *World without Oil*, where players come up with, live as if, and share ideas about how they would live without oil.[17] *Evoke* was a game that sent weekly missions to players about real situations in the world such as food security and the

Figure 5. "Arcade Our Way 3: Proudly Untitled" - Student Participants. Renee Jackson.

water crisis.[18] The game teaches the player about the issue and invites them to act in the present and imagine what they can do in the future.

In a similar spirit, using the tools of game-designers, artists, architects and educators, our workshop will mobilize both collaborative learning about the climate crisis through game design, and will involve a public engagement component inviting university and community members to play the games together within the context of a "climate action carnival". Students will be encouraged to create board games and large-scale interactive collaborative games that help others to understand the climate emergency on a deeper level, and to incorporate a component that invites players to "game the climate change system" in some way by taking direct action.

As co-principal investigators, we have been awarded a highly competitive grant in the arts and humanities at Temple University that we will be using to further our collaborative efforts in combining game development and play focused on themes related to climate change. This effort will leverage our individual disciplinary and departmental expertise offering a unique partnership between Art Education and Architecture. We will work together to create an interdisciplinary curriculum that brings the knowledge of pedagogy and participatory engagement from Art Education and knowledge of the design process and built environment factors from Architecture. This will lead to a series of workshops where students of both departments will work together to design, fabricate, and play climate change games

of their own making that aim to tackle the pressing problems related to global warming. The final public event will be part of a symposium around the themes of climate change, interdisciplinary collaboration, and participatory design.

To measure success of the project, we plan to set up various evaluation formats to collect data on the effectiveness of the climate change games, including: pre and post game-design surveys, student evaluations on the pedagogical merits of their collaboration and board game development; game play testing at Temple University's Scholars Studio; and public evaluations on the effectiveness of the board games in conveying information, enabling communication, and developing potential plans to adapt to and mitigate climate change through design and planning of the urban environment.

## REFLECTIONS

We have found that game design about climate change and issues that matter, is an effective way to meet the challenge set for by Madeleine Sclater to develop "creative, collaborative approaches to educational practices and methods, mediated by technology" in order to "deeply engage people and develop their consciousness of sustainability issues." Our most recent projects described within this paper reflect similar goals and findings, attesting to the power of game-design as a powerful learning tool. The results of board game development and game play into the architectural design process indicate that it can be an effective pedagogical tool that is especially useful when students are working in teams and on complex projects with diverse

stakeholders. This was evident from the student feedback evaluations, external invited guest critics, and from the public exhibition. Similarly, the development of video games related to climate change harnessed the potential in students and led to more direct engagement in the learning process. Given this, we plan to harness our efforts through subsequent work, bringing our community together and gathering impact related data.

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