Interactive Game Intervention to Educate Youth Environmentalists about the Adverse Health Effects of Climate Change

Cary Choo, Simon Fraser University

Keywords: environmental health education, youth, climate change, research

SFU Health Sciences Undergraduate Journal

Purpose

As a health scientist, I have always been fascinated by the physical and environmental factors affecting our health. Topics can range from air pollution and cardiovascular health to nutritional intake and metabolic diseases. As a teenager, I was fortunate enough to work for Ocean Wise as a Children and Youth Educator, where I taught children and young adults about ocean conservation and environmental health. Through that position, I developed an interest in learning more about climate change and began to form a strong passion for educating peers about the health consequences of climate change. As someone who believes that experiential learning is more empowering than formal education settings, I wanted to create an activity that allows others to learn about this critical topic in a fun and engaging way. Thus, I drafted a game and refined it for this research project.

Colonization and Globalization Effects

Due to the rise of the Anthropogenic era, the increasing severity of climate crisis effects and the increase in human health consequences have been a long time coming, starting from the colonization of Indigenous lands. Canada is a colonized country where colonizers have suppressed Indigenous Peoples' rights and knowledge through a wide range of methods, such as residential schools, laws, and regulations of child welfare (Matheson et al., 2022). Without their freedom to speak their traditional languages and share stories, lessons, and land stewardship orally within nations, Western colonialism disrespected and ignored Indigenous Peoples' knowledge (Matheson et al., 2022). Additionally, colonialism has shifted fundamental aspects of anthropogenic climate change to intensify the consequences on Indigenous Peoples, where the invasion disrupted their ability to connect with their traditional territories (Whyte, 2017). Various actions such as deforestation, pollution, and the creation of urban infrastructures have damaged ecosystems that

once flourished under Indigenous care, (Whyte, 2017). This has forced Indigenous Peoples to maintain only a tiny fraction of their original lands or be displaced to a different ecosystem to familiarize themselves with (Whyte, 2017).

Colonization and the following globalization of commodities for human consumption resulted in the rapid decline of the Earth's wellbeing, with colonizers perceiving the Earth as an endless source of resources to extract profitable gains from (Lehtonen et al., 2019). As globalization continues to deter us from feeling deeper connections to the planet, people have fallen for the misbelief that we have the right to exploit the Earth to benefit from its raw materials, furthering our overconsumption of goods (Lehtonen et al., 2019). Technological advances and social media platforms have also contributed to overconsumption by influencing one's purchasing choices. For instance, there was a TikTok trend known as "Material Girl," where the TikToker would share a short clip of their clothing, jewellery, cars, and other commodities to a soundtrack titled "Material Girl." Initially, this trend was meant to show off one's wealth, but adaptations also circulated to include clips of people going to the stores to buy something. Trends like "Material Girl" on social media can overshadow the downside of overconsumption and its role in climate change by influencing younger individuals to purchase something simply for the act of buying something, not for need.

Climate Crisis, Youth, and Educational Games

Climate change describes the climatic variability that changes the natural environment of different ecosystems on Earth (Allen, 2022). This results in numerous adverse effects for the planet and all the living organisms that rely on the resources the Earth provides, including consequences for human health. For example, rising sea levels increase the risk of waterborne diseases and floods (Frumkin, 2016). Floods can displace people from their homes and significantly impact food

production. Crop losses, reduced crop yields, and decreased crop nutrients contribute to food insecurity and malnutrition (Frumkin, 2016). Another extreme weather event influenced by climate change is heat waves. Heat waves directly impact our health, as our body's thermoregulation systems may be unable to withstand the long duration of intense warmth (Frumkin, 2016). As a result of increasing the body temperature outside of the optimal functioning temperature range, heat stroke, heat exhaustion, or death can occur (Frumkin, 2016). The climate crisis further widens the environmental disparities between high-income and low-income countries. High-income countries create the most harm, yet populations in low-income countries are the ones most affected by climate change (Friis, 2019).

With the powerful impacts of climate change in full swing, communities need to be supported in identifying mitigation and adaptation strategies to improve public health. More specifically, with the rise of youth action for the climate crisis, many youth groups such as YouthToSea, Sustainabiliteens, and EarthEcho Youth are involved in bringing awareness of climate change into various communities and stressing the importance of taking initiative to reduce the effects for better environmental health. Since the power of youth can motivate and inspire other youths and adults to tackle the climate crisis together, the youth action groups need to know how it affects public health. To grasp such a complex relationship, reading from a textbook and learning about climate change in a traditional classroom setting may seem distant and overwhelming (Frumkin, 2022). Therefore, to engage them in the learning process, games can mimic aspects of reality that can be educational for youth (Lee, 2020).

Additionally, although the current BC education system allows high school students in grades 11 and 12 to choose specialized environmental science courses, this was not the case in previous years (BC Government, 2021). Therefore, thousands of people graduated from high

school with no opportunity to learn about climate science. Integrating climate science and justice in education is crucial and can be done through interactive games.

Method

Study Design and Participants

For my research, I conducted a pre-post study, where a group of YouthToSea (Y2S) participants, ages 15-18, were invited to answer a set of pre-intervention questions, play the game I designed to teach them about the connections between climate change and health consequences, participate in the debrief discussion, and then answer post-intervention questions.

Y2S is a youth environmental group that unites passionate young adults across the lower mainland to develop essential leadership skills through various environmental topics and excursions. Given how complicated and intricate climate-related adverse health effects are, having teenagers play instead of children is more appropriate because they are in the formal-operational stage of psychological development, where they can process abstract thoughts and have critical thinking capacities (Shaffer et al., 2020). Additionally, with the rise of youth groups acting for planetary health, Y2S members are knowledgeable in a breadth of environmental topics, such as water chemistry, marine biology, microplastics, pollution, the importance of biodiverse species, gardening, sustainable fishing, and invasive species. In Y2S, climate change is a crucial topic that is not explored as in-depth as it could be, as it has only been briefly mentioned occasionally as a subtopic of discussions in other activities. It is usually described as a negative consequence of the main topic of conversation. Since Y2S members believe that climate change is real and are aware that it affects our lives, this game would be a meaningful experience for them to participate in and allow them to form more personal connections (Beni et al., 2017). Through this game, they

acquired knowledge about climate change and learned how it personally affects their health via self-realization.

Intervention: Game Design

Before playing the game, each participant was assigned to one of eight health issues that relate to climate change: heat waves, greenhouse gas emissions, air pollution, floods and heavy rains, waterborne diseases, foodborne diseases, vector-borne diseases, and food insecurity. There are many more climate-related health issues but I selected the mentioned eight for the game. They were given a paper bracelet with their name written on the outside and their team identity on the inside, which served as their "name tag." Additionally, participants were asked to complete a short online survey about themselves. Some questions included: *"when is your birthday?"*, "*what pronouns do you use?*", and "*what is your favourite colour?*". Their responses to the questions were used in the intervention for their profiles and the clue cards. Profiles are a single page of each person's responses typed up and available for participants to use in the game.

Clue cards were scattered throughout the facility for participants to find, with select information from the online survey and a health fact written on them, such as: "This heat wave member is 17 years old, has one sibling, would rather be a dolphin, and affects vulnerable populations, such as those with medical conditions that impair the body's ability to dissipate heat—infants, elderly, poor, those who lack air conditioning, and those who are socially isolated." Clue cards cannot be removed from where they found them and are only used for viewing the information. The participant's goal was to find cards hidden throughout the location and check the profiles to see who corresponds with the clue to figure out who is on their team. If they learn the identity of someone not on their team, they can eliminate them by ripping off the opponent's name tag. The game ends when either the time is up, and the team with the greater number of survivors

wins, or all the remaining members are from the same team and have successfully defeated the other teams.

Additionally, to keep the game interesting, there were three special cards: the *immunity card*, the *teammate card*, and the *other team card*. These cards provide an advantage for the person who found them. The *immunity card* allows the person to be resurrected from one elimination, the *teammate card* allows the finder to know who is on their team, and the *other team card* allows the player to know all the members of a team they chose (any team that is not theirs).

Conducting the Research

After arriving at the Vancouver Maritime Museum, I set up the clue cards throughout the facility while Y2S attended a workshop with Ocean Wise staff. I taped clue cards in each exhibit and noted how many cards there were to ensure I remembered to remove any after the game. I started the session with a positionality statement and land acknowledgement:

> "My name is Cary Choo and I use she/her pronouns. I am a settler scholar of Chinese-Canadian descent, where I live on the unceded territories of the Qayqayt, Hul'qumi'num Treaty Group, and Traditional Coast Salish Nation Lands, including the Tseil-Waututh, Kwikwetlum, Musqueam, Sto:lo, and Stz'uminus Nations. The term unceded means that the Indigenous Peoples did not sign any documents handing their land to the settlers, nor did they willingly give up the land, regardless of what has been imposed on them,"

They reviewed the information on the consent form to remind them of their rights as a voluntary participant and the withdrawal deadline if they no longer consented to be in the research. Then, I handed out the pre-post intervention question booklets and let them randomly select a letter from a jar to act as their name for the questionnaire (i.e. Participant A, Participant B, Participant C, etc.) and gave them approximately 10 minutes to complete the pre-intervention questions. These questions allowed me to gain an understanding of their current knowledge about what climate change is and its health effects. Afterwards, I introduced climate change and health by highlighting

the eight topics. I asked questions about health and the environment to allow them to reflect on their health stance regarding environmental influences. I explained the game, provided everyone with the name tags and profiles, and clarified questions that arose before allowing everyone to explore the museum to find clue cards. While they were socializing, I walked around to supervise and facilitate the interactions for the safety of Y2S and the public.

Once the game concluded, everyone was given a five-minute bathroom and water break. For the remainder of the afternoon, we had our debriefing session. For the first part of the session, they went around to different pieces of chart papers, each with a climate-related health issue listed on it. The participants were asked to write down the health facts they learned during the game and other relevant information they recently learned of from the news or social media. We then gathered everyone back to discuss climate change and the health effects they found interesting or surprising. I also explained how the health issues relating to climate change are interconnected, the difference between climate change and global warming, and why climate change is generally the more accepted term. Afterwards, Y2S were given time to complete the post-intervention questions and place them in a folder before leaving. The post-intervention questions included the same pre-intervention questions and an additional feedback question. Once everyone had left, I went back into the museum to take down the clue cards and cleaned up the gallery space we used.

Results

Qualitative data was collected, where their responses to the pre-post intervention survey were analyzed to answer the following research questions: (1) What do youth environmentalists (ages 15 -18) know about the adverse effects of climate change on human health, and (2) How are interactive games an effective method to deliver educational content about climate change and its adverse effects on human health to youth (ages 15 -18)? The pre-intervention questions were:

A. What is climate change?

B. What do you know about the health effects of climate change?

The post-intervention questions included:

C. What is climate change?

D. What do you know about the health effects of climate change?

E. Do you have any suggestions for changes to the game? If yes, please write your feedback below.

F. What is your glow and grow? *Please note, a glow is something they enjoyed, and a grow is something they learned.

What Do Youth Environmentalists (Ages 15 – 18) Know About the Adverse Effects of Climate Change on Human Health?

For this research question, I synthesized the data by categorizing the responses of the pre-intervention questions into three groups: accurate, incomplete, and non-descriptive. In total, before playing the game, only one person had responded to A) accurately, and eight could describe their knowledge of climate change and health effects. For B), please see Table 1.

Table 1

Responses to Pre-Intervention Questions.

	Question A)	**Question B)**
Accurate	1	8
Incomplete	7	5
Nondescriptive	5	0

A) What is Climate Change?

Accurate answers contained a clear definition of what climate change is, containing keywords such as "climate variability," "changing ecosystems," or "Earth's systems shifting." In contrast, incomplete answers would be responses that did not state what climate change is or gave false definitions. Non-descriptive answers would state that "climate change is the climate changing" or something similar. Only one of the responses provided a clear definition that was correct and descriptive, with seven responses describing the effects of climate change or providing false definitions of climate change, and five respondents were non-descriptive, with replies of "when there is a change in the climate" (Participant A).

B) What Do You Know About the Health Effects of Climate Change?

For this question, respondents needed to state at least one health consequence *and* the climate change factor that caused it to be an accurate response. Incomplete responses would be answers that mentioned climate change effects but did not make any correlations to health, did not correctly link climate change to health, or vice versa. For example, Participant M wrote, "… more fires, which leads to poor air quality," but did not mention increased asthma attacks or concerns for respiratory diseases. Some other responses include "changes in precipitation patterns" (Participant G), "increasing smog levels" (Participant L) and "species extinction" (Participant E). Eight people could accurately connect the climate crisis with a health issue, and five did not completely respond to the question.

How Are Interactive Games Effective in Delivering Educational Content About Climate Change and Its Adverse Effects on Human Health to Youth (Ages 15 -18)?

To answer the second research question, I used the same grading criteria for questions C) and D) as I did for A) and B) to compare the individual's results to see if those who responded

accurately to A) and/or B) were able to provide accurate responses to C) and/or D). After playing the game, no one's definition of climate change was non-descriptive, and two more people were able to connect climate change to health issues. There was also an increase in the number of people who could define climate change. Additionally, of the seven members who gave incomplete definitions of climate change before playing the game, three gave correct responses for C), and three of the five non-descriptive responses presented a clear definition of climate change for C). It is important to note that youth who answered accurately the first time still answered accurately this time, as demonstrated in Table 2.

Table 2

Responses to Post-Intervention Questions C) and D).

	Question C)	**Question D)**
Accurate	7	10
Incomplete	6	3
Nondescriptive	0	0

Discussion

Based on the results above, youth environmentalists did not completely understand the climate crisis before playing the game, as only one member could explain what climate change is, and others provided false definitions or misunderstood the question by describing climate change's effects. It was not until after we played the game that we received more accurate definitions of climate crisis in their responses. As for the health consequences, we noticed that eight people could link climate change with health before playing the game, with two more people joining that group after the game. For example, some of the responses were: "Parasitic outbreaks could increase …

after heavy rainfall" (Participant N), "air pollution = respiratory illness" (Participant Y) and "higher chance of getting bug-borne diseases" (Participant H), among others. Another point I noticed was that the eight pre-intervention responses for question B) were more focused on heat-related health and climate issues, such as "poorer air quality" (Participant K) and an increase in climate anxiety (Participants H and N). This could be because British Columbia has been experiencing increasingly intense forest fires for the past few years. Therefore, it may have been a more prominent health concern in their minds.

From the feedback portion of the post-intervention questionnaire, responses to question F), what is your glow and grow, indicated that using an active game as an educational medium to teach youth about climate change and health is beneficial. Over half the participants' (7/13) responses were about socializing, making new friends, and reflecting on learning climate change and health facts. There was one response about enjoying the game's competitive aspect, with five talking about having fun playing the game. This correlates with the literature review done by Beni et al. (2017), in which young adults had fun, learned relevant information they could connect to, interacted with friends, and engaged in friendly competition to create meaningful and memorable experiences.

Challenges

Timeline

The major challenge I faced was the time restraint. My research was conducted in the second part of the day, with Y2S spent the morning working on their environmental projects and then playing the game after lunch. Within two hours, I had an outline of the afternoon drafted, with different amounts of time allocated for each section of the day. However, I did not allocate enough time to get name tags for each player. As I had to ensure that no one would know a fellow

participant's identity, I had to give the name tags out one at a time. There was also not enough time allocated for sharing accessibility to the PDF of profiles on the Google Drive folder. Some still had no access after inputting their emails into my laptop to share the document with them. Thus, more troubleshooting was needed before allowing everyone into the museum exhibits to find clue cards. Due to the delay, the schedule shifted back, which shortened the debrief session. From the original 45 minutes allocated, we only had 20 minutes to reflect on climate change and health information, form connections, discuss current actions, and complete the post-intervention questions. Feeling rushed, we had to skip the discussion about current actions and plans.

Post-Game Exhaustion

Additionally, I did not consider Y2S's energy level after playing the game. I am glad that a physically active game helped convey my teachings and was a successful educational tool. However, the post-game fatigue did interfere with the debriefing session. Although the chart papers were written and drawn on, there was a lack of engagement during the group discussion about the connections between climate change and health issues, which I noticed was due to exhaustion. Signs of fatigue included visible sweat, limp limbs from sitting upright, and facial expressions, among others.

Future Improvements

From the feedback portion of the post-intervention questionnaire, responses to question E) were mainly left blank (7/13), possibly indicating they could not think of anything to improve or that they enjoyed the game and educational aspects, among others. Participant H would have liked more advantage cards to be present, and 4/13 participants' feedback suggested they would have liked to have the climate-related health facts more intertwined with the game, as they shared that they would skim the facts and were more focused on the member's information for the game. This

was slightly upsetting to read, as I thought I had integrated the health facts on the cards. However, I am glad they had written their honest opinion about the facts on the cards. Other than brainstorming a better way to incorporate the facts in the game, I also need to brainstorm how to ensure that all the players find and read the cards. Since each card contains a different health fact, it would be beneficial if each player found every card.

For the future, I would plan this to be a day-long workshop with plenty of time allocated, including buffer time in between. The morning would consist of set up, introduction, and time to play for the game, with the entire debrief session in the afternoon. This would allow ample time for participants to have a better grasp of the concepts and how everything is interconnected with each other. This scheduling would also be timed perfectly for the post-game lunch break, where they will have sufficient time to rest and refuel their energy for the debrief.

Another factor I should have considered was the various learning conditions that a participant may have. Throughout my time with the Y2S cohort, I noticed that some members have diverse learning needs, although I did not inquire about these. My data collection method heavily relied on a certain level of literacy. It was not until I read the responses that I realized how excluding the game may be for individuals with specific learning needs. Participant A's questionnaire booklet had a few sentences with some misspelled words and drawings, which is acceptable, as sketch notes are a form of communication. On the last page, they apologized for their illegible writing and stated they have dyslexia. As someone who had taken the course *EDUC 422: Learning Disabilities,* I am ashamed and baffled as to why it did not occur to me to brainstorm a way to make the research more inclusive for those with learning differences. For future research and game development, I will actively try to design activities that are more inclusive of learning diversity.

Conclusion

Overall, the active game educated youth about climate change and its adverse health effects. Some adjustments need to be made to incorporate the facts better and to be more inclusive for the learning diverse community. However, the game itself is effective at delivering educational content for youth.

Ongoing Actions

Youth's Quiet Activism Projects

Youths' passion for a cleaner and healthier future can transform climate change by creating local projects. These efforts are a form of quiet activism, where youth socialize with people of various ages with differing knowledge about climate change to inspire them to act (Steele et al., 2021). Ocean Wise, for example, provides support and guidance for Y2S members as they build and create their projects. Through Y2S, an ambassador created an organization called "Stones 4 Seas," where she sells hand-painted rocks and donates 50% of the profits to ocean conservation. She also engages in the community by partnering with schools to host workshops for children to learn about the environment and paint rocks. The project connects her hobby of rock painting with educating others about the environmental issues we are currently facing. Not only is this a meaningful passion project, but by engaging the children with a socially creative outlet, she is also reaching out to another generation that needs hope for the future (Steele et al., 2021). This is a crucial step towards transforming climate change, as the climate crisis is an intergenerational justice issue (Gislason et al., 2022). With the long building of climate change since colonization to the intensified effects of globalization, climate change worsens as the years go by, forcing the younger generations to face the eco-anxiety and consequences brought upon them. Hope is needed in a time of a climate crisis, where it can motivate us to set goals and identify a pathway to achieve

that goal (Frumkin, 2022). Hope benefits our mental well-being and can empower others to act now (Frumkin, 2022). Accordingly, “Stones 4 Seas” is based on the ambassador’s personal choice of craft that advocates for various environmental solutions and provides hope for peers to take the initiative for the planet.

Decolonizing Climate Change by Incoming Indigenous Knowledge

Climate change itself is a result of colonization and globalization, where Indigenous Peoples’ land was exploited for resources, and the Indigenous Peoples’ voices of concern and advice were ignored. However, to tackle the climate emergency, we need to center Indigenous Peoples’ knowledge into our action plans (Whyte, 2017). With centuries worth of experience in maintaining and preserving the lands, they are also the ones who will know how to restore the ecosystems. For instance, with the raging wildfires in Australia in 2020, environmental decision-makers sought solutions from local Aboriginal peoples to prevent the wildfires from happening again while mitigating the effects of forest fires that already exist (King, 2022). Known as controlled burns, they would intentionally start small fires to burn lands from April to July because smaller, cooler fires would decrease the severity of seasonal fires, significantly reducing greenhouse gas emissions (King, 2022). Adopting Indigenous land management techniques into our policies and practices can help mitigate the effects of the climate crisis.

References

Allen, R. (2022). HSCI 204 lecture notes.

BC Government. (2021, December 10). K-12 Climate Change Education in B.C. https://www2.gov.bc.ca/gov/content/education-training/k-12/administration/program-management/climatechangeeducation

Beni, S., Fletcher, T., & Ní Chróinín, D. (2017). Meaningful Experiences in Physical Education and Youth Sport: A Review of the Literature. *Quest (National Association for Kinesiology in Higher Education)*, *69*(3), 291–312. https://doi.org/10.1080/00336297.2016.1224192

Friis, R. (2019). *Essentials of Environmental Health* (3rd Edition). Jones and Bartlett Learning.

Frumkin, H. (2022). Hope, Health, and the Climate Crisis. *The Journal of Climate Change and Health*, 100115. https://doi.org/10.1016/j.joclim.2022.110115

Frumkin, H. (Ed.). (2016). *Environmental health: From global to local*. John Wiley & Sons, Incorporated.

Gislason, M. & Kennedy, A. (2022). How to teach children about climate change, inspire hope and take action to change the future. The Conversation. https://theconversation.com/howto-teach-children-about-climate-change-inspire-hope-and-take-action-to-change-thefuture-174036

King, A. (Narrator and researcher). (2022, May 25). Landback + Aboriginal Australian Land Management. (Season 1, Episode 4). [Podcast]. The Joy Report, Intersectional Environmentalist. Intersectionalenvironmentalist.com/the-joy-report/landback-aboriginal-australian-land-management

Lee, J. (2020, January 29). Games Can Teach About Climate Change and Motivate Ecofriendly Actions. https://www.slj.com/story/games-teach-about-climate-change-and-can-alter-behavior

Lehtonen, A., Salonen, A., & Cantell, H. (2019). Climate Change Education: A New Approach for a World of Wicked Problems. *Sustainability, Human Well-Being, and the Future of Education*. Springer. https://doi.org/10.1007/978-3-319-78580-6

Matheson, K., Seymour, A., Landry, J., Ventura, K., Arsenault, E. & Anisman, H. (2022 May 26). Canada's Colonial Genocide of Indigenous Peoples: A Review of the Psychosocial and Neurobiological Processes Linking Trauma and Intergenerational Outcomes. *International Journal of Environmental Research and Public Health, 19*(11). doi: 10.3390/ijerph19116455

Shaffer, D., Kipp, K., Wood, E., Willoughby, T., Roberts, K., Gottardo., A., Krettenauer, T., Lee, J., & Newton, N. (2020). *Developmental Psychology: Infancy and Childhood.* (5th Canadian Edition). Nelson.

Steele, W., Hillier, J., MacCallum, D., Byrne, J., & Houston, D. (2021). Quiet Activism *in* Climate Change. Quiet Activism: *Climate action at the local scale.* Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-030-78727-1_7

Whyte, K. (2017). Indigenous Climate Change Studies: Indigenizing Futures, Decolonizing the Anthropocene.