Evaluating *Tiaki* as an Educational Board Game

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1. Introduction

Introducing invasive species into an ecosystem poses a significant threat to biodiversity worldwide, endangering native species and disrupting natural ecosystems. These pests, populated accidentally or intentionally through human activities, prey upon local species which can lead to population decline or extinction. Additional consequences include threats to food security for other species and costly, time-consuming efforts to manage these species.

Pests ranging from insects to rodents and larger mammals pose a significant threat to the native species of Aotearoa New Zealand. Conservation agencies have therefore taken bold action to create awareness initiatives and to deploy methods eliminating non-native species. Trapping and reporting practices have been partially successful, but policy attention has turned to more effective solutions that require public buy-in. Genetic modification, for example, can reduce pest populations through gene editing, potentially offering a more sustainable, targeted, and long-term outcome. However, the use of this technology raises important questions about environmental safety, ethical frameworks, and the balance between technological interventions and natural ecosystems.

The Biological Heritage research program has brought pest control campaigns to the forefront of public education and debate to support New Zealand's native species. This program, in alignment with the work of principal investigator Dr. Ocean Mercier, conservation advocate Pat van Berkel, and others at Victoria University of Wellington, strives to protect the biodiversity and biosecurity of native species through promoting aggressive pest control. To amplify the work that includes pest trapping programs and prevention, an extensive portion of this effort aims to educate and spark conversation among the public ("Public Perceptions of New Pest Control Methods," 2024). A range of tools can promote civil and respectful dialog about complex decisions. Among them, the use of serious games can enable players to interact with scenarios facing scientists on the ground.

Game developers for serious games design with a purpose beyond entertainment, aimed at educating players, encouraging discussion, and promoting awareness of community issues. Creating accessible entry points for education is essential, especially when the subject matter is context-specific or introduces new scientific vocabulary. Serious games promote face-to-face interaction and enable players to experience real time consequences based on their choices.

Tiaki (meaning to protect) is a serious game designed to be a new tool in pest control education. Dr. Mercier, Pan van Berkel, and other experts developed the game in collaboration with the Biological Heritage research program. Third Studio, a design firm focused on exploring design processes within community groups, worked with them to create the game. These designers hope that *Tiaki* players will become aware of methods of genetic modification for pest control and learn more about the implications of their choices, but the game needs testing and further evaluation in order to move forward towards use in formal education settings.

The goal of this project is to assess the viability of the *Tiaki Board Game* as an effective tool for coordinated pest management in Aotearoa. To achieve this goal, we have identified three objectives. The first objective is to enhance *Tiaki*'s game design mechanics and components. Our second objective is to evaluate user experience, including playability and enjoyment. Finally, we will assess the impact of the *Tiaki* game on participants. The outcome of the project will be a set of recommendations to improve the effectiveness of *Tiaki.*

2. Literature Review

Tiaki is the Māori concept of caring for people, place, or culture, and is a core principle for many in Aotearoa New Zealand (*About Tiaki*, n.d.), This sentiment reflects Māori values of guardianship, emphasizing the preservation of natural ecosystems and heritage. These ideals have been challenged as Māori and the English Crown have engaged in a shared history of colonization, land disputes, and struggles to honor principles outlined in the Treaty of Waitangi. This difficult historical and cultural context amplifies the unease and sometimes distrust that surrounds the use of genetic modification (GM) as a tool for pest control.

For many, particularly within Māori communities, genetic modification is seen as a direct disruption of tiaki, raising concerns about the long-term consequences to the culture's natural heritage. Altering ecosystems through genetic intervention is sometimes at odds with traditional understandings of stability and respect for nature, complicating discussion on the subject. Consequently, conversations in Aotearoa New Zealand about GM and its role in pest control are riddled with tension and require a culturally sensitive approach. To successfully engage in these concerns, a balanced level of scientific clarity as well as respect for historical understandings are paramount.

2.1 Historical and Ethical Context of Pest Management in New Zealand

Human colonization, beginning approximately 1,000 years ago, has caused extensive loss of native bird species in Aotearoa New Zealand. European and Polynesian settlers to New Zealand intentionally brought species for the agricultural industries and recreational activities they created (Russell, 2014). However, with these arrivals, over 90 hitch-hiking species unintentionally entered the country (Pimental, 2011). The introduction of these species threatens native fauna, destroys habitats for bird species, and decimates hatchlings in their nests (Holdaway, 1989).

Figure 2.1 A brush-tailed possum preying on the eggs of a native bird nest in New Zealand (*Possums. East Taranaki Environmental Collective*, n.d.)

A combination of ecological, historical, and government-sparked factors deeply influence local views on pest control, specifically that of non-native species. Predator Free 2050 is an initiative from the New Zealand Department of Conservation that focuses on the eradication of pests that pose a threat to native birds, frogs, lizards, and plant life. Invasive predators kill an estimated 25 million native birds each year, as New Zealand wildlife evolved separately on its two islands and some species lack an ability to defend themselves. (*Predator Free 2050*, n.d.). Thus, Predator Free 2050 works to mobilize citizens by informing them of the dangers of pests, innovating tools for pest control, and engaging individuals in pest trapping measures.

Finding an ethical, widely supported method for pest management in Aotearoa is difficult, as there are conflicting attitudes towards different methods.. The Department of Conservation's Dr. Edy MacDonald conducted a study surveying attitudes of New Zealanders surrounding pests and their control, finding that 84% agree that "pest species are a significant

conservation problem" and 61% "are aware of New Zealand's goal to become Predator Free by 2050. ("Public Perceptions of New Pest Control Methods", 2024).

There have also been changes in attitude towards control methods recorded from 1994 to 2012. In 1994, traditional control strategies drove the views on pest management, like the use of poison and physical trapping. Although it remains a government priority, public opinion has shifted away from the use of poisoning methods (for example 1080 poison) and more people are in favor of trapping and hunting methods for elimination, suggesting an ethical and cultural shift towards a more humane treatment of pests (Russell, 2014).

Recently, advancements in science and technology have brought the option of GM to the potential methods of pest control for scientists (Dearden, 2018). The application of gene drive technology for pest management faces social, cultural, and ethical challenges. The push for public acceptance of the technology itself has further posed a challenge, as New Zealand has a history of public hesitation towards the use of genetically modified organisms. Aotearoa holds a unique socio-political framework due to its history with the Treaty of Waitangi, an agreement between European settlers and native Māori (Burns, 2024). This treaty created an expectation of respect between the two populations, mainly in protecting the rights of the Māori. However, governmental policy has historically tended to disregard these rights and oppose honoring the treaty, bringing to light the need for initiatives for its restoration. Because of Aotearoa's distinctive socio-political structure, there are contested opinions surrounding GM as a pest control method, with some being directly related to the traditional values of Māori people. Māori perspectives on gene editing reflect a balance between cultural values, ethical concerns, and potential benefits (Clark, 2023). Key values relevant to biotechnology in Māori culture include *whakapapa* (genealogy), *mana* (power), and *kaitiakitanga* (guardship) and these highlight the importance of tradition and the respect of indigenous knowledge. Those in favor recognize benefits like environmental conservation and improved agriculture but stress the importance of transparency and collaborative decision making among lawmakers, scientists, and citizens. This complicated and nuanced perspective emphasizes the need for a framework that keeps the Māori community in the conversation so that measures affecting their biosystem also reflect their historically rooted values (Clark, 2023).

Efforts at the heart of encouraging the public to accept GM include proper education, public engagement, and ethical advancements in gene-editing techniques. With an absence of

evidence-based engagement, public support for informed technological decisions will remain a barrier in pest control initiatives. Achieving this support begins with new tools and strategies in educating the public through civil, productive discussions surrounding the complex topic of GM (Dearden, 2018).

2.2 Genetic Modification: A Powerful Tool

Properly understanding the potential consequences and differing opinions of technology such as GM is essential in defining them and exploring their applications. There are two common methods associated with GM in pest control: Ribonucleic Acid Interference (RNAi) and gene drives (CRISPR/Cas9). RNAi therapy silences protein synthesis in an RNA strand. This is a temporary process that is only effective with continuous therapy (Palmer, 2021). When using GM for pest control, the specific method described is called gene drives. Gene drives use CRISPR/Cas9 to insert or delete inherited genetic information causing a permanent edit in an organism and affecting its future generations (Palmer, 2021). Environmental scientists studying GM methods claim that introduction of gene drives in 1% of a species' wild population can lead to a marker gene present in 99% of the species within nine generations, highlighting the permanence of this technology's effect (Dearden, 2018). Common modifications target genes related to reproduction, specifically female fertility. This ultimately decreases the health of organisms and, over time, the size and well-being of the population (Dearden, 2018). Targeting pests with GM is a chemically safe alternative to using pesticides, but there are potential consequences of this technology.

While researchers have not yet implemented this technology outside laboratory practice, they put extensive thought into what negative effects might occur from introducing GM into the wild. European colonizers introduced the Brush Tailed Possum to New Zealand in the 19th century to introduce the fur industry. This possum is invasive to the ecosystem and has become a pest to many New Zealand native species, disrupting the flora and fauna. If researchers released GM possums into the New Zealand wild, there is a possibility of further migration to Australia, where these same possums are a protected species. GM possums in this region, therefore, may negatively affect the Australian biodiversity of such species (Dearden, 2018).

As in Aotearoa New Zealand, countries around the globe analyzing and driving pest management are looking towards GM as a solution. In the United States, researchers conducted

studies with mosquitoes due to an increasing problem of the insect's disease-transmitting characteristic. This technology is only gaining interest internationally and *Tiaki* was developed to educate on such topics.

2.3 Mapping the Stakeholders of *Tiaki*

Third Studio developed the collaborative board game *Tiaki* in collaboration with Biological Heritage Research Program as an innovative educational tool to inspire and facilitate discussions around GM as a pest control method in Aotearoa. With its aim to foster in-depth dialogue and a holistic understanding of this complex concept, *Tiaki* bonds stakeholders who contribute to the game's goals, development, and educational impact. These individuals and groups create an environment for players to promote a shared understanding of the implications of GM's role in pest control methods.

Our partners, Dr. Ocean Mercier, an Associate Professor at Victoria University of Wellington, and conservation advocate Pat van Berkel collaborated with other professionals in the Te Kawa a Māui (School of Māori Studies) to serve as visionaries for the *Tiaki* game. Dr. Mercier's research focuses on biotechnology and pest control methods in New Zealand, especially in the context of Māori co-governance. Her contributions to the project are essential in maintaining the game's educational value while also working with game developers to make it engaging and accessible to local communities. She and Pat van Berkel have collaborated with the Biological Heritage Research Program, a New Zealand-based initiative focused on education for environmental preservation, stressing alignment between scientific research and public engagement ("Public Perceptions of New Pest Control Methods.", 2024). Our partners and Biological Heritage have supported their mission through science communication and interactive education. Through the *Tiaki* game, scientific and ethical considerations can become more accessible to the general public and conceivably engage communities on pest control methods and emerging solutions.

The game developing team, Third Studio, involved in the creation of *Tiaki* translated scientific and ethical concepts into engaging gameplay. The designers built a serious game to serve as an educational tool and a source of enjoyment for participants. In designing this game to be collaborative, the game encourages teamwork and thoughtful dialogue about *Tiaki*'s prompts,

creating interactions between players that promote reevaluation and redefined values concerning GM and its impact.

The game has implications for educators who serve as a significant stakeholder in *Tiaki*. The game is an interactive tool that can transfer concepts from the classroom into a more dynamic physical experience. With growing interest in environmental sustainability and preservation of native species, educators may have an effective tool to broker difficult conversations with their students and the broader public.

Individuals with an informed view of environmental issues and solutions serve as the desired players of *Tiaki*, however the general public can participate successfully as well. These populations bring differing personal perspectives, knowledge, and questions into discussions throughout the game, allowing for collaborative exploration into GM as a pest control method. As players participate in *Tiaki*, they are encouraged to develop insightful analyses about ethical, scientific, and ecological branches of pest management. Participants gain the opportunity to widen their knowledge, contribute to broader dialogue, and have an open mind to differing views on the topic. Their contribution is significant as they develop into individuals who have a confident voice in policy decision-making.

Environmental advocacy groups and policymakers serve as important stakeholders for *Tiaki*. *Tiaki* offers a way for advocacy groups to engage the public with their core values for environmental sustainment and protection of native species. This allows the public to bring their opinions to policymakers, helping to shape future policies.

Finally at stake is the wellbeing of native species. Being an island, Aotearoa has a fragile, isolated, and biodiverse ecosystem. Consequently, valuable native birds are at risk of becoming extinct due to the threats posed by non-native mammals and rodents. Among these are large populations of rats, stoats, and possums (Dearden, 2018). These species have no common predators in New Zealand, making them the primary source of harm for native species.

The presence of pests in New Zealand is a topic of great concern. There is significant funding for pest control reduction. The Department of Conservation (DOC) spends more than 70 million NZD each year on pest control initiatives and corrective actions (Dearden, 2018). The New Zealand Predator Free 2050 Initiative promotes pest control trapping and poisoning. However, government policy discourages pesticides due to concerns of their chemical components and their contraindications with the environment (Dearden, 2018). Programs like the

Biological Heritage Research Program are turning to technology to find effective and safe methods of pest control.

2.4 Serious Gaming as a Tool for Education

Serious games provide an engaging and educationally rich environment for players, offering more than just entertainment. Unlike traditional educational tools, serious board games engage players in dynamic, hands-on learning experiences that foster critical thinking, teamwork, and problem-solving. In the classroom, board games are particularly effective at increasing student engagement and motivation, transforming learning into an interactive and enjoyable activity while still achieving specific educational objectives. Serious board games are set apart by their ability to make learning fun, immersive, and sometimes even reflective of real-world challenges. For example, collaborative board games not only encourage strategic thinking but also promote discussions about complex, real-world issues in a light-hearted, low-pressure environment. Additionally, they often provide opportunities for the "examination of collective decision-making", where players must collaborate to navigate challenges and make decisions as a group (Young, 2012).

An example of a collaborative, serious board game is the card game *Oregon Trail*. In this educational game surrounding U.S. history, players work together toward a common goal: reaching Willamette Valley in Oregon. The game's mechanics emphasize teamwork and cooperation, as players must collectively manage their resources, make decisions, and navigate through various challenges. If at least one player survives the journey, the game considers the entire party to have succeeded. However, if all players die before reaching the destination, the game ends in failure. The game's cooperative nature forces players to adapt to team dynamics and manage conflicts as a group, encouraging collaborative problem-solving and communication skills. Furthermore, the series of calamity cards players draw—representing challenges like illness, weather, or accidents—mirror real-world obstacles, creating an opportunity for players to discuss risk management and decision-making in a group setting. By working together to navigate these challenges, players develop a deeper understanding of the importance of collaboration, adaptability, and perseverance in achieving a shared goal (Hutton, 2024).

2.5 Designing and Testing Educational Board Games

To effectively use board games for educational purposes, educators must thoughtfully implement them in public spaces, such as classrooms or other learning environments so that participants are engaged. When designing a serious game, it is essential to consider how the game mechanics will immerse players while simultaneously reinforcing the intended learning goals. Another point is that providing the best experience requires presenting these games "in concert with good teaching" (Young, 2012). Designers should craft the game's mechanics in a way that encourages participation, stimulates critical thinking, and deepens understanding of the subject matter. One of the first steps in developing educational board games is playtesting, where developers trial the game with a target audience to evaluate its effectiveness. Playtesting can provide valuable insights into whether the game engages the players as intended and whether it promotes the desired learning outcomes.

A crucial aspect of playtesting is identifying the demographic that will best benefit from the game, as different age groups or educational levels may respond differently to various game characteristics (mechanics, visuals, rules, etc.). Additionally, playtesting helps identify any gaps in knowledge or behavior of the target player audience (Nabong, 2024). Understanding these gaps allows designers to tailor the game's challenges and content to address the specific needs of the players, ensuring the game is both educational and engaging for an overall meaningful experience.

2.6 Learning from ExpandED and Simulation-Based Games

We explored the value and potential pitfalls of serious games in a case study evaluating ExpandED. This game was an expansion to the serious board game GridlockED, which a team at McMaster University created. The designers created the game to teach the value of interdisciplinary collaboration within a hospital emergency department (ED). This game expansion, aimed at college medical students, reflects the modern-day ED by simulating the pressure of working and managing an ED shift with a variety of medical professionals (social workers, nurse practitioners, and occupational therapists). Patient cards and event cards force the players to consider multiple points of view when making decisions about patient and caregiver management (Fiala, 2024).

To test the effectiveness and educational value of the game, the research team, including a mix of medical students and faculty, used a mixed-methods approach to conduct an evaluation with 45 participants from various health and medical programs at McMaster University. This research team conducted playtesting sessions in small groups of students to simulate a team of medical professionals in an ED unit. The evaluation integrated multiple methods of data collection, drawn from different designs, into a single evaluation. This approach results in a more complete evaluation when compared to traditional approaches that rely on a single assessment point. The team utilized pre- and post-game surveys to map changes in viewpoint regarding ED workflow, perceptions of roles in healthcare, and value of interprofessional collaboration. The pre-game survey collected information about the players prior exposure to interprofessional education and perceived value of individual professionals providing care through a series of seven point Likert scales (1=not familiar and 7=extremely familiar) and yes/maybe/no questions. Post-game surveys focused on the game's playability, player's enjoyment, and educational effectiveness through open response questions and similar Likert scale surveying.

Using pre- and post-game Likert scale surveys enabled the researchers to determine a significant increase in the players understanding of ED workflow (see Figure 1). Prior to playing, the mean Likert rating in relation to understanding of ED workflow was 3.1, while the post-game Likert rating average was 5.2. Using a p-value approach to hypothesis testing, this data indicated a statistically significant improvement in understanding ($p < 0.001$), which along with qualitative information based on the players' written responses, provides a quantitative metric of the increase in knowledge of ED workflow.

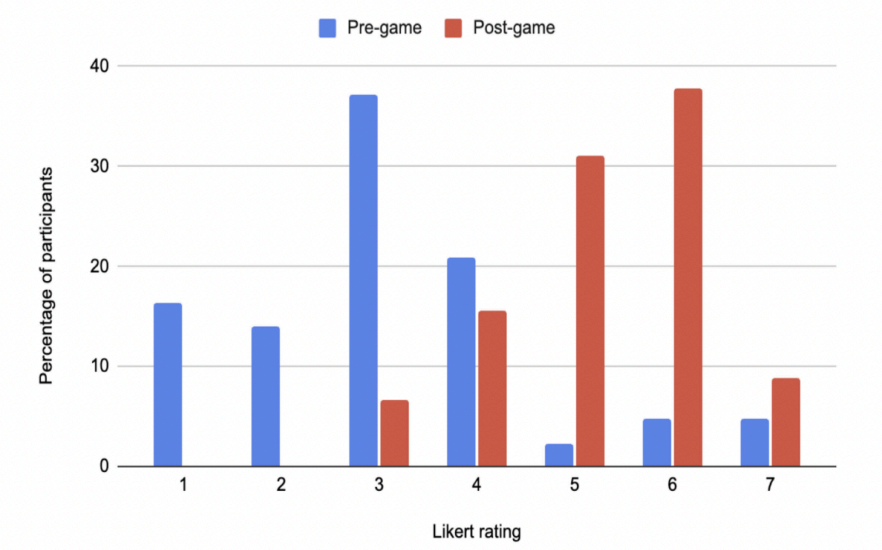

Figure 2.2 Graph displaying survey results of pre- and post-game understanding of emergency department workflow on a Likert scale from 1-7 (1=not familiar and 7=extremely familiar) (Fiala, 2024).

The study found a possible “ceiling effect” when it came to the players’ views on interprofessional collaboration, as views on the subject only increased from 6.2 to 6.4 on the Likert scale survey. In this context, the ceiling effect refers to the phenomenon where the participants’ initial attitude towards a concept is already at such a high level that new experiences will not significantly increase outlooks in a post-game survey. This suggests that while ExpandED may have reinforced players’ positive views, it could not further elevate them.

As a part of the post-game study, the research group gave the players open-ended surveys. These surveys consisted of basic prompts that asked them to elaborate on the game’s playability, realism, and educational value. The team organized this qualitative feedback into primary themes like “player roles” and "satisfaction.” The analysis of this data allowed for more in depth understanding of the players’ main takeaways and direct comparison to the quantitative data found in the Likert surveying.

This study reinforces the importance of simulation-based learning, specifically in the field of medicine, as a tool for equipping students with experience prior to entering a professional field. By using a mixed-methods approach for evaluation, the researchers uncovered measurable changes in knowledge and player satisfaction.

2.7 The *Tiaki* Game

Tiaki is a collaborative board game that invites players to work together to strengthen the mauri (life force) of Aotearoa by protecting the balance of taonga (treasures) and managing pests. The game presents different scenarios, with each player receiving method cards to help address the challenges. When players complete the scenarios they receive taonga tokens, which strengthen the mauri; however, if the players do not control the challenges, they place a pest token on the board. The game ends when the players win as a team and receive six taonga tokens or lose when they receive six pest tokens.

Method cards display different forms of pest control and players use them to complete scenarios and challenges. Pest control methods include trapping, mātauranga (Māori knowledge), poison, te ira tangata (the human element), and gene-tech. Scenario and challenge cards provide different pest-related problems that players must solve using their method cards.

Figure 2.3 The layout of *Tiaki* during gameplay, including components of method cards, challenge cards, scenario cards, taonga tokens, and pest tokens.

When creating *Tiaki,* game developers aimed to give people a voice and provide them with the knowledge to allow them to participate in conversations about the biological heritage of Aotearoa. The game hopes to provide a comfortable environment for discussions about complex topics like pest control and genetic modification. Refer to Appendix A for game components and instructions.

2.8 Summary

Serious games can be an effective tool to inspire a community to be more knowledgeable about pest control efforts and methods. Understanding, adapting, and catering to the complex viewpoints of the stakeholders is important in creating the initiative that is accessible and educational. *Tiaki* creates conversations that have the potential to broaden the views of any stakeholder. By engaging the community in learning efforts of *Tiaki*, residents can participate in discussions about emergent technologies that policymakers may integrate into their communities.

3. Methodology

This chapter outlines how the project's objectives connect with methodology while working towards completing the goal. Our primary goal is to evaluate the *Tiaki* game's effectiveness as an educational tool on the topic of genetic modification as a method for pest control. By gathering feedback from stakeholders and players, we will assess how well this serious game can serve as a tool for sharing information and promoting discussion. To achieve this goal, our team has identified three key objectives as outlined in Figure 3.1:

1. Enhance *Tiaki*'s game design mechanics and components
2. Assess user experience, including playability and enjoyment
3. Assess the impact of the *Tiaki* game on participants.

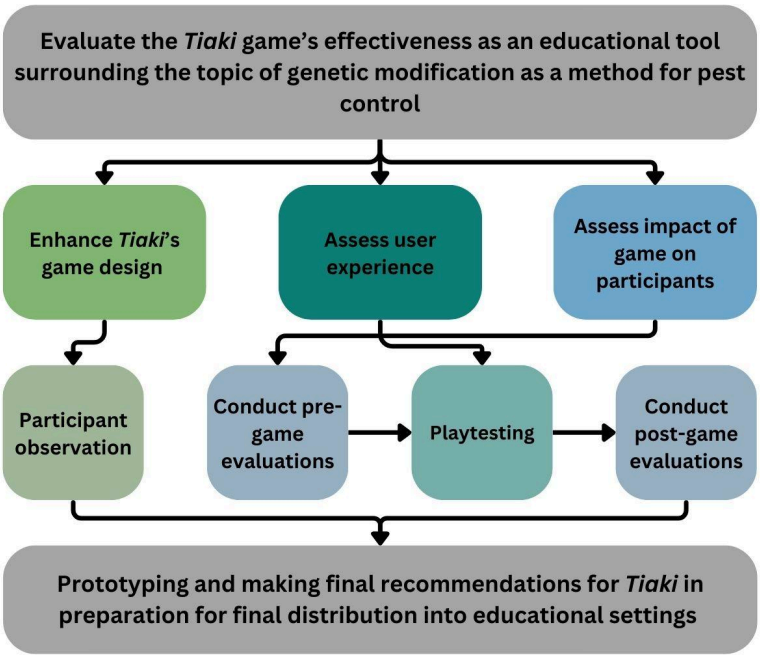

Figure 3.1 A flowchart displaying the project's goal, objectives, and intended corresponding actions.

3.1 Enhance *Tiaki*'s Game Design Mechanics and Components

The first objective of the *Tiaki* project is to enhance *Tiaki*'s game design mechanics, such as rules and dynamics, along with components specifically through participant observation, preliminary playtesting, and iterative prototyping. This process should yield recommendations for our team to communicate with our sponsors and Third Studio to refine the game's mechanics

and components before testing with the broader community. Our team will participate in structured gameplay session(s) following the background research of this topic for our project. These sessions will simulate realistic gameplay scenarios while evaluating how the game functions in its current state. We will record observations on a pre-written observation worksheet throughout gameplay to identify areas for improvement. We will note components that caused confusion, disrupted gameplay, or failed to contribute meaningfully to the educational objectives, along with any gaps where additional enhancements will be valuable to players' experience. Insights gained from our participant observation will aid in playtesting with a sample of the target audience (Maanen, 1980). Appendix B includes a guide for verifying components and testing game quality and design during participant observation.

3.2 Evaluate User Experience, Including Playability and Enjoyment

The second project objective is to assess user experience, including playability and enjoyment, focusing on its clarity, content, and educational value. For this objective, we have designed an observational-based testing approach. Our team and sponsors Ocean Mercier and Pat van Berkel will host playtesting sessions in classrooms at Victoria University of Wellington or local community centers. This ensures space for the set-up of a tripod with a mobile phone mount and audio-recording device and allows space for participants to complete pre- and post-game surveys.

Our observations during gameplay will document user interactions, decision-making processes within playtesting groups, and collaborative engagement levels. Visual and audio recording, loaned from the Global Lab of Worcester Polytechnic Institute, will capture the entirety of each session This includes moments of necessary rule clarification by members of our team, strategic debates, and exchanges of knowledge regarding pest control concepts. Participants will need to sign a consent form, showing they are aware and willing to be video recorded, which will also be prefaced in initial outreach. Such a form can be found in Appendix C. One scribe, a member of our team, will record live qualitative data, including player reactions and key points of discussion during gameplay. Another team member will note key moments such as confusion about *Tiaki*'s rules, noteworthy dialogue of pest control concepts, and frustrated or engaging reactions. This method allows for one member to only focus on player enjoyment, while the other focuses on rules and components affecting playability: including

method, challenge, and scenario cards. We will categorize themes of discussion from the transcription to provide an overall understanding and areas for improvement of *Tiaki*'s effectiveness as an educational tool through user experience.

Our sponsors will gather contacts of voluntary participants involved with or interested in environmentalism and pest control. We will contact these participants, including students at Victoria University of Wellington, New Zealand policymakers, Māori community members, and conservation advocates, upon arrival in Wellington. Participant outreach contacts will be gathered from a list provided by our sponsors. In need of further participants, we will post flyers on the Victoria University of Wellington campus along with local community centers with our contact for interest in participation. A participant outreach email example can be found in Appendix D. Each session will range from two to five participants, with a target number of four participants per session, to evaluate the impact of player group size on the overall experience and determine the ideal number of players for *Tiaki*. We will record if player dynamics shift in relation to group size, including communication patterns, efficiency in decision-making, and distribution of individual contributions to group discussions. This data will assist us in determining whether small groups encourage deeper conversation and if larger groups allow for more collaborative discussions and ways to foster a balance between the two mediums for the best user experience.

3.3 Assess the Impact of the *Tiaki* Game on Participants

Our third objective is to assess the impact of the *Tiaki* game on participants. These assessments will evaluate if and/or how each players' knowledge and understanding of genetic modification as a tool for pest control changed throughout a play session of *Tiaki*. Playtesting participants will fill out a pre-game survey (see Appendix E) to gauge their level of understanding and comfort surrounding pest control methods in New Zealand. Following the session, players will fill out a post-game survey (see Appendix F) that consists of five questions identical to the pre-game counterpart and some tailored to knowledge and experience gained throughout gameplay. These surveys will utilize Likert scales, a surveying tool that can measure attitude, perceptions, or opinions by rating participants' level of agreement or satisfaction on a linear, five level scale. To assess the pre-game baseline, the Likert scale would be most useful in

measuring constructs like familiarity of pest control efforts, opinions on genetic modification, and comfortability with implementation of genetic modification in New Zealand.

Pre- and post-game assessment prompts will include questions surrounding views on pest control (Q.E1, Q.E2, Q.E3, Q.E4) and game characteristics (Q.F6, Q.F11, Q.F12): critical points in determining whether the game achieves its aim of educating while entertaining (Gris, 2021). Appendix E includes a draft of the pre-game assessment survey. Appendix F includes a draft of the post-game assessment survey. By comparing pre- and post-game Likert survey results, our team will quantify changes in players' attitudes or knowledge levels with statistical t-tests to compare significant differences between responses (Joshi, 2015). This statistical t-test is only possible with a minimum sample of 20 players, which may not be viable given the time allotted for this project.

To support the Likert data, we will include open-ended response questions in pre- and post-game surveys, specifically for assessing qualitative data. These types of questions explore the user's experience and perceptions in depth, allowing us to gather insights on players' more nuanced thoughts about the game and its educational impact (Gris, 2021). In pre-game surveys, open-response questions prompt players to express their baseline understanding of genetic modification and pest control to identify trends in knowledge levels or preconceived notions. Post-game, this line of questioning enables players to elaborate on specific aspects of the game they found engaging or challenging. This approach is particularly effective for exploring complex cultural topics, as more detailed feedback can reveal patterns not captured by fixed-choice questioning (Gris, 2021). Additionally, open-response questions offer a more flexible way for the player to address areas that are important to them, providing us with potentially overlooked information that is valuable for improving game design and educational strategy. At the end of the post-game survey, we will include an optional question asking for the participants' contact information, allowing us to reach out with follow up questions which will be determined by our team and sponsors following playtesting sessions.

Upon arrival in New Zealand, beginning January 12, 2025, our team will be conducting these outlined methods across a seven-week timeline to provide final recommendations for *Tiaki* in preparation for the game's final distribution into educational settings.

3.4 Estimated Timeline

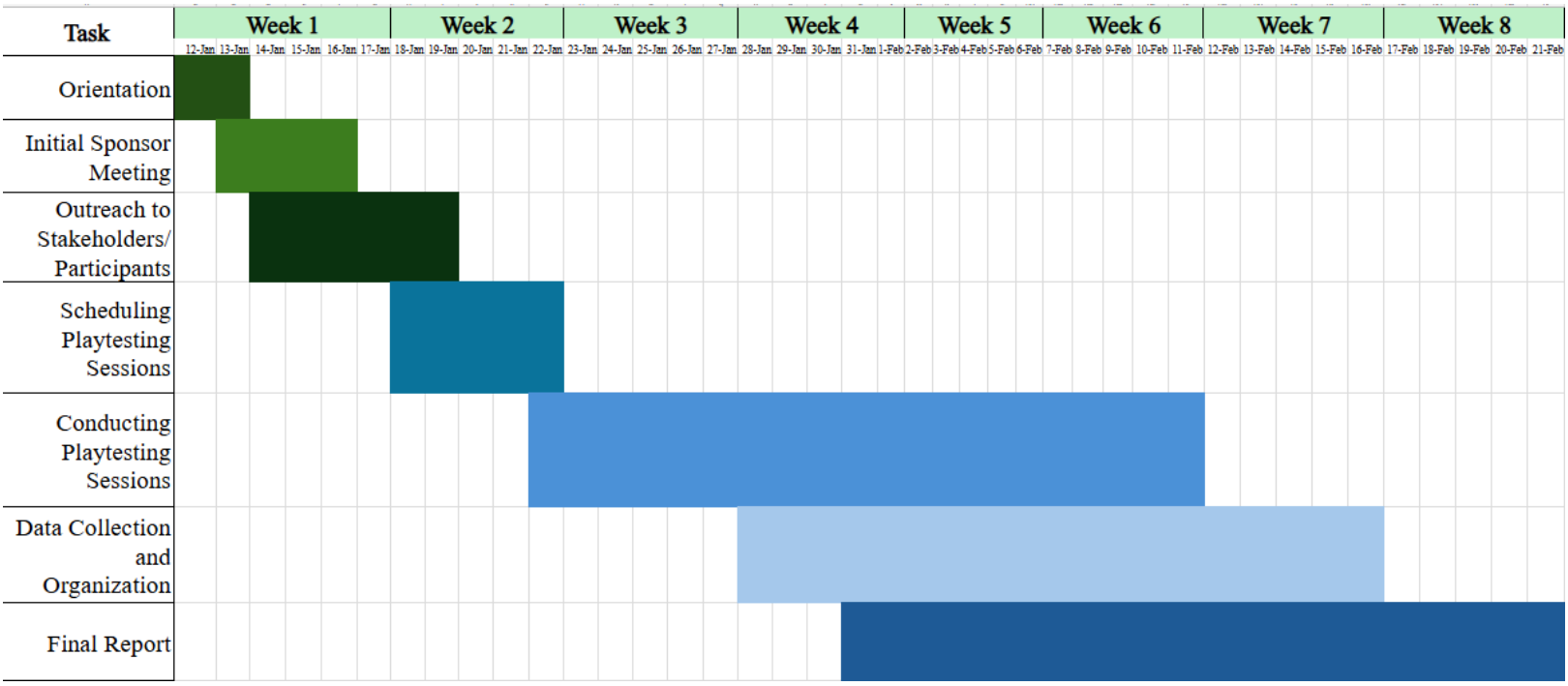

Figure 3.2. A proposed timeline to estimate the completion time of methods to complete objectives. Times are subjective to change.

4. Conclusion

The *Tiaki* game offers a unique opportunity to address New Zealand's critical sustainability challenges, particularly in pest control and the ethical considerations surrounding genetic modification. By creating an educational tool that engages the public with these complex topics, this project supports the UN Sustainable Development Goals 4 (ensuring quality education), and SDG15 (protecting and restoring life on land) The game aims to increase awareness of invasive species management, particularly through genetic modification, and to promote informed discussions about the use of biotechnology in pest control. By fostering collaboration and knowledge-sharing, the game hopefully encourages players to think critically about environmental sustainability and ethical decision-making. This initiative could serve as a model for other regions facing similar challenges, potentially transforming how communities engage with environmental conservation. It also supports inclusive decision-making by ensuring that a broad range of perspectives are integrated into the conversation.

We look forward to working with you and we will present our proposal and open for discussion upon arrival.

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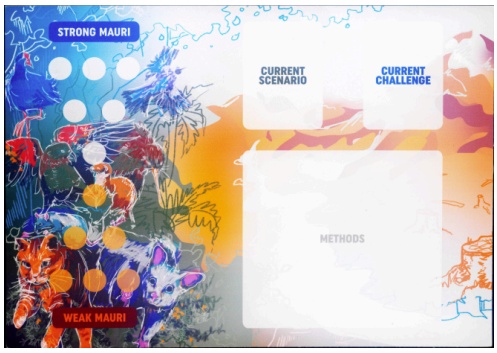
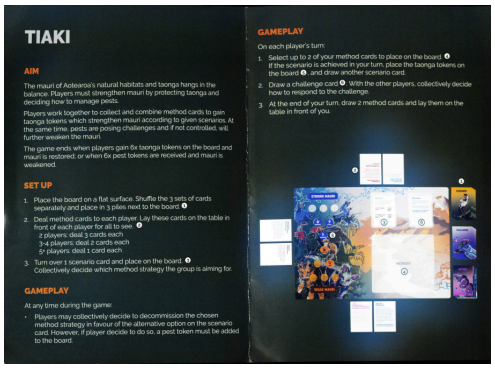
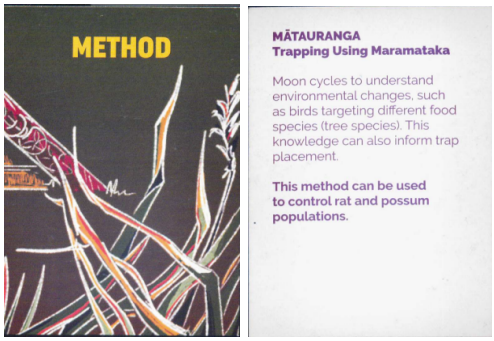
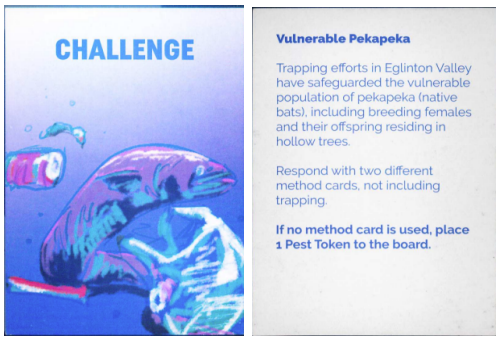
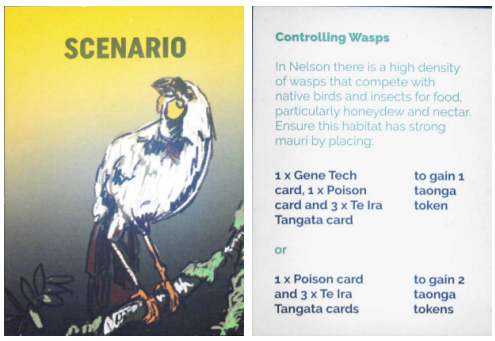
Appendix A: *Tiaki* Game Components

Component Name	Purpose	Image
Tiaki Game Board	The playing field of *Tiaki* where players place their drawn scenario card, challenge card, and desired method cards during gameplay. Taonga and pest tokens are placed on the board to track the game's progress.	
Rule Book	The guidelines for the aim, set-up, and gameplay of *Tiaki* are found here for players to follow.	
Method Card	Strategy cards, distributed to players throughout gameplay aimed to respond to the challenge and scenario cards.	
Challenge Card	A card drawn in alignment with a scenario card, posing a pest challenge that must be controlled throughout gameplay with method cards. If no action is taken, players gain a pest token.	

Scenario Card	A card drawn to strengthen mauri. Upon achievement through method cards, players gain taonga tokens.	
Taonga Token	Tokens gained and placed on the board upon achievement of method cards. The game is complete with a gain of six taonga tokens.	
Pest Token	Tokens gained when method cards are replaced throughout gameplay. The game is complete with a gain of six pest tokens.	

Appendix B: Participant Observation and Component Testing Framework

Evaluation Criteria

Scribe:
Start time:
End time:

1. Rules
    1.1. Are the instructions clear and easy to follow during setup and gameplay?
    1.2. Do any rules cause confusion or stall gameplay?
2. Gameplay Duration
    2.1. How long does a full session take, including set-up?
    2.2. Does the number of players significantly impact game duration?
3. Player Interaction
    3.1. What is the level of enthusiasm throughout gameplay?

        Not enthusiastic at all
        Slightly enthusiastic
        Moderately enthusiastic
        Quite enthusiastic
        Very enthusiastic

4. Component Functionality
    4.1. Do any cards cause confusion or stall gameplay?
    4.2. Are there unclear card instructions that disrupt flow?

Example Observational Notes Template

Category	**Observation**	**Notes/Suggestions**
Rules and Instructions	Players struggled to understand rule two of gameplay.	Clarify rule wording or provide a picture example.
Gameplay Duration	A five-player group exceeded two hours of gameplay to complete.	Suggest alternative rules for faster game progression.
Player Interaction	A five-player game had a conversation flow unrelated to the game.	Suggest a smaller player size for effective communication.

Component Functionality	A scenario card caused repeated confusion during gameplay.	Suggest removal of scenario card from prototype.

Appendix C: Participant Consent Form

Tiaki Playtesting Session Consent Form

Purpose of the Study
Thank you for agreeing to participate in this playtesting session and associated surveys. We are a group of students from Worcester Polytechnic Institute working in collaboration with Associate Professor Dr. Ocean Mercier and conservation advocate Pat van Berkel at the Victoria University of Wellington. The goal of this session, including playtesting and pre- and post-game surveys, is to evaluate *Tiaki*, focusing on its gameplay, mechanics, and user experience, to guide further development and improvements.

Procedures
As part of your participation, you will:

1. Complete a **pre-survey** to share your initial expectations and experiences with similar games or systems.
2. Participate in a **playtesting session** with 1–4 other participants, during which you will review the game's rules and play the game with the group.
3. Complete a **post-survey** to provide detailed feedback about your experience during the session.
4. Be observed during the session, which will include:
    - **Video recording**: A single video camera will record the session to capture gameplay interactions and group dynamics.
    - **Audio recording**: Conversations during the session will be recorded to document feedback and reactions in detail.
    - **A scribe**: A member of the research team will take notes to supplement the recordings and capture observations in real-time.

Confidentiality
Your participation is voluntary, and all data collected, including survey responses, video and audio recordings, and scribe notes, will be used by our team exclusively for research and development purposes. Identifying information, such as your name or image, will be anonymized by our team and sponsors in the analysis and final reports. All data will be stored securely by password protected Victoria University logons, with access restricted to the research team.

Voluntary Participation
Your participation is entirely voluntary. You are free to withdraw at any time without providing a reason. If you choose to withdraw, any data collected up to that point may still be used unless you request its removal.

Consent to Participate
By signing below, you agree to:

1. Participate in the playtesting session and surveys.
2. Allow the session to be recorded via video and audio.
3. Allow your feedback to be documented and used for research and development purposes as outlined above.

Participant's Name (Printed): _____

Participant's Signature: _____

Date: _____

Contact Information
If you have any questions or concerns about this study, please contact:
Abigail Rivers, Emma St Clair, Catherine Sauter & Diego Winsor (in collaboration with Dr. Ocean Mercier and Pat van Berkel)
Worcester Polytechnic Institute Student Research Team
Victoria University of Wellington
gr-tiaki-c25@wpi.edu

Appendix D: Initial Participant Outreach E-mail

Subject: Invitation to Participate in *Tiaki* Board Game Playtesting Session

Dear _____,

My name is _____, and I am part of a group of Worcester Polytechnic Institute (WPI) students—Abigail Rivers, Emma St Clair, Catherine Sauter, and Diego Winsor—working in collaboration with Dr. Ocean Mercier and Pat van Berkel at Victoria University of Wellington. We are excited to invite you to participate in a playtesting session for *Tiaki*, an educational board game centered on pest control in New Zealand.

This session is part of a research initiative to assess the viability of the *Tiaki* Board Game as an effective tool for coordinated pest management in Aotearoa. We believe your scientific expertise would provide valuable insights into its effectiveness in promoting understanding of this topic.

Session Details:

Sessions are to take place in a classroom of Victoria University of Wellington. Session dates are to be coordinated with response, but will occur between [insert date window] during the time frame of [insert time window].

What to Expect:

You will join a group of 1 to 4 other participants to play Tiaki, with the game set up on a table in a classroom environment.

Participants will complete pre- and post-surveys to provide feedback on the game's content and educational value.

The session will be audio and visually recorded to ensure detailed analysis of participant interactions and feedback. All recordings will be treated with strict confidentiality and used only for research purposes.

We would greatly appreciate your participation in this session. Your involvement will help refine *Tiaki* and contribute to its development as an innovative tool for ecological education.

If you are interested or have any questions, please respond by [insert date]. You can reply to this email or contact the team directly at gr-tiaki-c25@wpi.edu.

Thank you for your time.

Warm regards,

[insert name of sender]

gr-tiaki-c25@wpi.edu

On behalf of Abigail Rivers, Emma St Clair, Catherine Sauter, and Diego Winsor

In collaboration with Dr. Ocean Mercier and Pat van Berkel

Victoria University of Wellington

Appendix E: Pre-Game Survey

Demographic Information

Gender

Male

Female

Non-Binary

Prefer not to say

Age Group

Under 18
19-34
35-49
50-64
65+

Ethnicity

Māori

Pākehā (NZ European)

Pasifika

NZ Asian

Q.E1

How familiar are you with pest control methods in Aotearoa New Zealand?

Not familiar at all

Slightly familiar

Moderately familiar

Quite familiar

Very familiar

Q.E2

Have you ever participated in pest control methods? (e.g. trapping, hunting, etc.)

Yes

No

Q.E3

What methods of pest control do you think are currently being used in Aotearoa New Zealand?

_____

_____

Q.E4

Rate your current understanding of genetic technologies.

Not knowledgeable at all

Slightly knowledgeable

Moderately knowledgeable

Quite knowledgeable

Very knowledgeable

Q.E5

Briefly explain what you know about genetic technologies.

_____

_____

Q.E6

How comfortable would you be with Aotearoa New Zealand adopting genetic technologies as a tool for pest control?

Very uncomfortable
Somewhat uncomfortable
Neither comfortable nor uncomfortable
Somewhat comfortable
Very comfortable
Unsure

Q.E7

Please expand upon your answer to the previous question (e.g. key concerns, what your comfort level depends on).

_____

_____

Appendix F: Post-Game Survey

Q.F1

How familiar are you with pest control methods in Aotearoa New Zealand?

Not familiar at all

Slightly familiar

Moderately familiar

Quite familiar

Very familiar

Q.F2

Rate your current understanding of the technology of genetic technologies.

Not knowledgeable at all

Slightly knowledgeable

Moderately knowledgeable

Quite knowledgeable

Very knowledgeable

Q.F3

Briefly explain what you know about genetic technologies.

_____

_____

Q.F4

How comfortable would you be with Aotearoa New Zealand adopting genetic technologies as a tool for pest control?

Very uncomfortable
Somewhat uncomfortable
Neither comfortable nor uncomfortable
Somewhat comfortable
Very comfortable
Unsure

Q.F5

Please expand upon your answer to the previous question (e.g. key concerns, what your comfort level depends on).

_____

_____

Q.F6

Rate the following characteristics:

Visual characteristics

Not interesting at all
Slightly interesting
Moderately interesting
Quite interesting
Very interesting

Written characteristics

Not interesting at all

Slightly interesting

Moderately interesting

Quite interesting

Very interesting

Action characteristics

Not interesting at all

Slightly interesting

Moderately interesting

Quite interesting

Very interesting

Q.F7

How effective were the discussions held during the game?

Not effective at all

Slightly effective

Moderately effective

Quite effective

Very effective

Q.F8

Were your opinions about genetic modification or pest control challenged or changed during the *Tiaki* play session? In what way?

_____

_____

Q.F9

How effective was the game in teaching about pest control?

Not effective at all

Slightly effective

Moderately effective

Quite effective

Very effective

Q.F10

How effective was the game in teaching about genetic modification?

Not effective at all

Slightly effective

Moderately effective

Quite effective

Very effective

Q.F11

Were there any memorable or exciting points? When and why?

_____

_____

Q.F12

Rate your overall enjoyment/engagement while playing *Tiaki*.

Not enjoyable/engaging at all

Slightly enjoyable/engaging

Moderately enjoyable/engaging

Quite enjoyable/engaging

Very enjoyable/engaging

Q.F13

What part of the game was most engaging?

_____

_____

Q.F14

What part of the game was least engaging?

_____

_____

Q.F15

Do you have any additional comments?

_____

_____

Thank you for completing this survey!

If you are open to participating in a follow-up interview online or providing additional insights, we would greatly appreciate your contact information. Participation in an interview is entirely optional and your responses will remain confidential.

Note: We will only use this information to reach out regarding this study.

Please provide your preferred contact details below:

- Name (optional): _____
- Email Address (optional):_____
- Phone Number (optional):_____

Please tick the box if you'd like to be notified about future outputs from the research (e.g. publications, *Tiaki* board game updates)

☐