

Mystiria: An Intergenerational Game for Climate Literacy and Collaborative Action

Joana Spínola
University of Madeira
Funchal, Portugal
ITI/LARSyS - Interactive
Technologies Institute
Funchal, Portugal
joannagomees00@gmail.com

Pedro Campos
Wow!Systems
Funchal, Portugal
ITI/LARSyS - Interactive
Technologies Institute
Funchal, Portugal
pedro.campos@iti.larsys.pt

Lígia Gonçalves
WalkMe
Funchal, Portugal
ligiagoncalves@walkme.pt

Mara Dionísio
University of Madeira
Funchal, Portugal
ITI/LARSyS - Interactive
Technologies Institute
Funchal, Portugal
mara.dionisio@staff.uma.pt

Paulo Bala
ITI / LARSyS - Interactive
Technologies Institute
Funchal, Portugal
paulo.bala@tecnico.ulisboa.pt

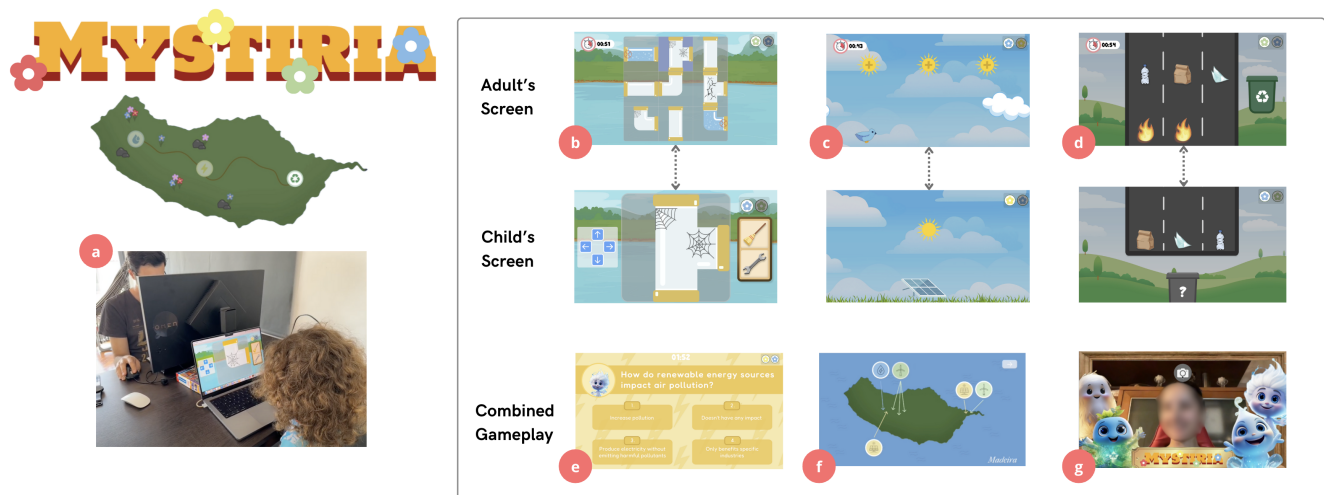


Figure 1: Collaborative Gameplay Structure of Mystiria: (a) Adult Child Layout - Each of the players has their own screen, which the other player is not allowed to see. The goal is for both players to communicate with each other through 3 mini-games (b) Aqua's Mini-game; (c) Electro's Mini-game; (d) Verdis' Mini-game. For (b), (c) and (d), the top screen represents the adult's view, while the screen on the bottom is what the child will see. In addition, players can also experience (e) Quiz Example; (f) Exploring Madeira Island; (g) Picture with Characters

Abstract

Current interventions for climate literacy are fragmented, as they target adults or children, rather than fostering collaboration and

intergenerational dialogue. To foster climate change awareness among adults and children, we have designed and developed Mystiria, an intergenerational collaborative game integrating asymmetric mini-games that address real-world sustainability challenges. Additionally, Mystiria integrates educational quizzes and tasks to promote critical thinking and knowledge transfer between players. This demonstration aims to illustrate the potential of intergenerational serious games for climate change awareness and sustainability through a hands-on multiplayer interactive session, while potentially creating a safe environment for learning and collaboration.

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CCS Concepts

• **Human-centered computing** → **Collaborative interaction**; • **Applied computing** → *Collaborative learning*.

Keywords

Serious Games, Climate Change, Sustainability, Asymmetric Play, Adult-Child Interactions

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1 Introduction

Climate change is one of the most urgent global challenges, with rising global temperatures, sea levels, and extreme weather events threatening ecosystems, human lives and economic stability [23, 26, 29]. The United Nations' 2030 Agenda for Sustainable Development [18], specifically Goal 13 [4], calls for urgent action. Despite frequent discussions on climate change and sustainability [3, 6, 17], current approaches lack engagement across generations, missing the chance of creating a shared learning experience between adults and children. While adults hold current decision-making power, children are future sustainability ambassadors, making their joint engagement crucial.

Mystiria addresses this gap through asymmetric mini-games and collaborative gameplay, fostering teamwork, communication and shared responsibility. Through this work, we aim to unify the fields of HCI, serious games, climate change education, and intergenerational knowledge transfer by showcasing how adult-child interactions can enhance learning, collaboration and sustainable behaviours. Beyond its contributions to serious games, Mystiria is relevant to the IDC community as it exemplifies how play-based learning and intergenerational collaboration can be leveraged to engage children in complex real-world issues that affect their lives. Moreover, Mystiria aligns with this year's theme of hope, by immersing players in a journey towards a sustainable future, and instilling a sense of bravery and optimism. Through its emphasis on water conservation, renewable energy sources and the power of recycling, Mystiria encourages children to see themselves as capable of making a real difference in the trajectory of the world.

2 Related Work

Alvarez [1] defines serious games as those that "*invite the user to interact with a data-processing application whose intention is to combine at the same time teaching, training, communication, or information aspects, with ludic mechanisms based on video game*". The positive learning outcome achieved with serious games makes them promising in an educational context [27], as they include all aspects of education and can be used at all ages [20]. Serious games do not have entertainment as their main purpose [19], so they offer unique opportunities for learning about climate change and sustainability. Serious games have demonstrated significant potential in education, as previous research highlights the effectiveness of these games in teaching about sustainability and raising environmental awareness

[5, 7, 16]. However, most serious games focus on solo play, and few studies have explored collaborative environmental games designed for mixed audiences, such as children and adults.

Intergenerational learning represents a dynamic exchange of knowledge, values and skills between different generations [22]. Serious games have increasingly been recognized for their potential to facilitate this way of learning, as highlighted in preceding studies [12, 31]. Previous research in the field of intergenerational interaction has explored multiple contexts, such as museum-based musical play installations [15], remote communication between adult children and their parents in China [33], adult-child tablet-based play [11], exploring the benefits of parents and children cooking together [21], and other contexts [13, 14, 30, 32]. To the best of our knowledge, there have been few designs of this type of interaction for sustainability and climate change.

Asymmetric play has proven to encourage collaboration and engagement between players with varying skill levels, abilities and roles [8]. As demonstrated by Harris et al. [10], asymmetric play increases social presence, perceptions of connectedness, immersion, behavioural engagement and understanding. Pais et al. [24] developed an asynchronous asymmetric game for family play, in which the players had two very distinct roles. By assigning different roles to players, the game promotes interdependence by requiring participants to work together to achieve a common goal, despite having different responsibilities. Similarly, Chen et al. [2] investigate how varying control mechanisms in an asymmetric collaborative game can prompt social interactions amongst users. Nonetheless, these works have primarily focused on generalized topics rather than serious games tackling climate change.

Mystiria builds upon this foundation by integrating asymmetrical mechanics to foster dialogue and knowledge transfer between adults and children, regarding climate change and sustainability. By combining these elements, Mystiria offers a novel approach to asymmetric play, serious games and intergenerational learning.

3 Design and Development of Mystiria

Mystiria is an intergenerational collaborative game for one adult and one child (6-10 years old). Players will learn about Mystiria's climate crisis and embark on a journey led by different characters to help restore its balance: (1) Perla – the heart of Mystiria, informs players about the role of climate change in forcing humans to abandon the island; (2) Aqua – guardian of water, emphasizes the importance of water conservation, by teaching players practical ways to avoid wasting water; (3) Electro – the guardian of energy, focusing on renewable energy sources, and reminding players how significant sustainable energy sources are; and (4) Verdis – guardian of recycling.

The game features three asymmetric mini-games, each with a tutorial and an educational quiz at the end. The inclusion of asymmetric gameplay was based on previous research, which shows how this mechanic helps collaborative learning, engagement and immersion [10, 24]. For a visual representation of the gameplay progression see Fig. 2. The mini-games were developed considering the cognitive abilities of children in this age group, though older children can also participate. Mystiria was modelled after Madeira Island in Portugal, as its where it was developed and tested. This

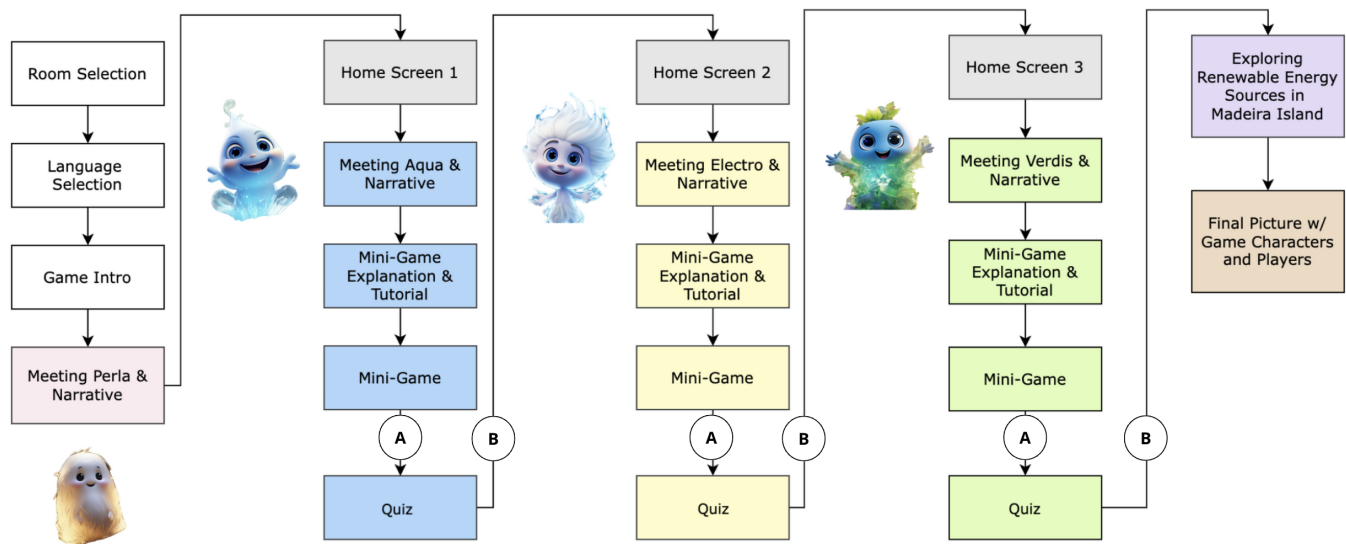


Figure 2: Flow Diagram Illustrating Game Scene Progression. (A) represents a short narrative scene. (B) encompasses two scenes, a short narrative followed by the score scene.

design choice follows Rowntree et al. [25], who suggest a localized context may offer the greatest potential for changing beliefs and behaviours. Since teaching about global climate change and global warming can be didactically ineffective [28], *Mystiria* emphasises players' local environment, in hopes that it will have a lasting and meaningful impact.

The narrative features prompts to inspire adult-child discussions and knowledge transfer, in the form of embedded questions. For example, in *Verdis' narrative*, the character asks players, "*Do you know how long it takes for glass to decompose?*". This approach not only engages players in the gameplay, but also promotes critical thinking and collaborative learning about sustainability topics.

Aqua's Mini-Game - *Connect the Pipes*: This mini-game focuses on water management and highlights the importance of maintaining an efficient and clean water distribution system. The gameplay is divided into three progressively challenging phases: a 3x3 grid (see Fig. 1-b), then 4x3 and finally 4x4. The game is designed to foster adult-child collaboration, as the adult has a complete view of the puzzles and is responsible for solving them (leading water from one location to another). The child, in turn, must clean or fix the pipes with the available tools and move around the puzzle guided by the adult.

Electro's Mini-Game - *Sunshine Savers*: In the second mini-game, the focus shifts to renewable energies, particularly solar. In phase 1 (see Fig. 1-c), the adult spawns suns for the child to catch using a solar panel. Suns can be lost to the passing "enemies" (clouds and birds), requiring strategic timing and placement from the adult. In phase 2, the adult must place solar panels across *Mystiria* to fill a light meter, while the child clears the clouds obstructing sunlight. A dynamic grid system changes where the sunlight is shining and also its intensity, which is based on how many clouds are on the child's screen. Without the adult placing the solar panels in the correct places, players will not earn any points, but the adult will

not be able to see the correct locations to place the panels if the child does not clear the clouds. These mechanics promote sustained engagement, communication and cooperation to achieve success.

Verdis' Mini-Game - *Recycle Fest*: In the final mini-game of *Mystiria*, players will focus on proper waste sorting. The child's role is to catch the falling trash in the correct recycling bin (indicated by the adult). The adult has two main responsibilities: first, informing the child what the current recycling bin is; and second, extinguishing the fires that sporadically spawn on screen, to prevent trash from being burnt and possible points lost (see Fig. 1-d). The need for the adult to inform the child of the current recycling bin increases the collaboration aspect, and ensures that both parties have to be alert and communicating to achieve the highest score possible. The knowledge transfer we are hoping to achieve by burning the trash is to highlight the negative consequences of improper waste management, such as pollution and loss of recyclable materials.

After each mini-game, players collaborate on three quiz questions (see Fig. 1-e) based on the character's topic. For each correct answer, the score will increase by 10%, with no penalty for incorrect answers, for a positive learning experience [9]. Towards the end of the game, players will explore different sustainable initiatives that are taking place in Madeira Island (see Fig. 1-f), which include the use of solar panels, wind turbines and a storage dam. To wrap up this experience, players will get a chance to take a picture with the game's characters (see Fig. 1-g), creating a keepsake, reminding players of their participation and the key lessons learnt.

Mystiria was developed using Unity¹ and designed for computer-based gameplay, supporting multiple languages. The game characters were made using Midjourney², an AI-powered generation art tool. The final character designs were achieved through variations

¹<https://unity.com/>

²<https://www.midjourney.com/home>

of carefully curated prompts, tailored to reflect the theme of each character, while appealing to both adults and children.

4 Summary of Demonstration

The original game, in which players go through all of the mini-games and narrative scenes, takes around 45 minutes, but for this demonstration, players would be able to pick which of three mini-games they would like to play, making the experience much shorter and ideally timed for a demonstration. As such, each mini-game takes on average 6 minutes. Setup for the demo is minimal, as only a stable Wi-Fi connection is needed and two computers, with mouse or trackpad support. A video demonstration of Mystiria can be consulted online³.

5 Conclusion and Future Work

There are multiple key areas that, in the future, should be explored to enhance Mystiria's impact and broaden its reach. First, the game's map should reflect the player's current regional location, as it will have higher chances of engaging participants. Additionally, refining Verdis' game mechanics is important to create a more balanced game experience. Finally, the game difficulty could dynamically adapt to players' varying skill levels.

Mystiria represents a promising alternative in using serious games to facilitate intergenerational climate change education. Through collaborative gameplay, we hope to effectively bridge generational divides, enabling adults and children to exchange knowledge and perspectives on sustainability. Further refinements in game mechanics and different localization contexts could position Mystiria as a model for cultivating cross-generational climate change responsibility.

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³<https://www.youtube.com/watch?v=ttlno9THyRg>

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