

GaGEN

State-of-the-art of games

Transnational report



Partners

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1. Introduction

1.1. Background and context

“GaGEN – Using serious Games to engage cross-GENerations into awareness on climate change” is a project that aims to increase awareness on the impact of climate change in everyday living among kids and seniors, especially introducing the concept of circular economy in everyday life, as well as to increase self-awareness on the potential role kids and seniors have as change agents in climate change.

The motivation of GaGEN relies on the vision and desire to contribute to the protection of the environment, while recognising the value of intergenerational learning as a key factor in Europe’s value of solidarity. Partners aim to valorise the role that seniors play in society, by bringing them together with kids, and by providing them with a creative game and relaxed atmosphere of collaboration and learning.

Environmental education has been targeting mostly younger generations and leaving older ones aside (Liu & Kaplan, Essays in Urban Environmental Education 2016). Not only educating seniors can be a powerful tool for behavioral change and greater impact in climate change, but also the interaction between kids and seniors seems to gain a greater added value, when compared to stand-alone interventions.

“An ideal intergenerational program creates opportunities for people of different age groups to learn about each other’s knowledge, experiences, skills, and perceptions. As participants learn about the impact of the environment in each other’s lives, they gain an awareness of common concerns. This contributes to an understanding of the interrelationships among people and the environment and a sense of how to work collaboratively to influence environmental policies and practices”.

According to existing theories of the lifespan development, people aged 50+ may pass through a period of ‘generativity’, in which they gain procreativity and relate to the generation of new ideas and concepts, thus seniors shall be engaged and incorporated in initiatives focusing on climate change, while making references to healthy aging as strengthening “the narrative of older people as agents of change, community leaders and influences on climate action”.

“GaGEN – Using serious Games to engage cross-GENerations into awareness on climate change” aims to offer an intergenerational learning approach to environmental education, by using serious games in a digital format. The goal is to increase awareness on the impact of climate changes in everyday living among kids and seniors, especially introducing the concept of circular economy in everyday life, as well as to increase self-awareness on the potential role kids and seniors have as change agents in climate change.

1.2. Objectives

In this report, we delve into the significance of serious games and explore its potential to offer an intergenerational learning approach to environmental education.

The purpose of this report is to examine the current landscape of intergenerational environmental games, assess its strengths and limitations, and identify areas for improvement and further development.

By thoroughly examining the existing content and methodologies in this field, we aim to lay the foundation for subsequent advancements and refinements in GaGEN's design and implementation.

The content generated through this report will serve as a valuable resource in the ongoing development of GaGEN. It will provide crucial insights into the effectiveness of the current serious game format, its impact on intergenerational learning, and the overall user experience. By analyzing these findings, we can identify areas where GaGEN excels and areas that require attention, enabling us to enhance the project's effectiveness and maximize its impact.

The importance of GaGEN lies in its unique approach to environmental education. With the rapid advancement of technology and the pressing need to address global environmental challenges, traditional teaching methods have proven insufficient in engaging and inspiring learners of all ages. GaGEN bridges this gap by leveraging the immersive and interactive nature of serious games to create a dynamic learning environment that appeals to both younger and older generations.

By promoting intergenerational learning, GaGEN encourages the exchange of knowledge, experiences, and perspectives between different age groups. This approach fosters collaboration, empathy, and a shared sense of responsibility towards the environment. Through the digital format, GaGEN ensures accessibility, scalability, and adaptability, making it a powerful tool in reaching a wider audience and creating lasting positive change.

In conclusion, the GaGEN state-of-the-art report marks an important milestone in the project's journey towards transforming environmental education. By critically assessing its current state, identifying areas for improvement, and recognizing its significance, we lay the groundwork for future advancements. With GaGEN's intergenerational learning approach and serious games in a digital format, we envision a world where environmental education becomes engaging, inclusive, and impactful for learners of all ages.

2. Literature review

2.1. Serious games

2.1.1. Definition of serious games

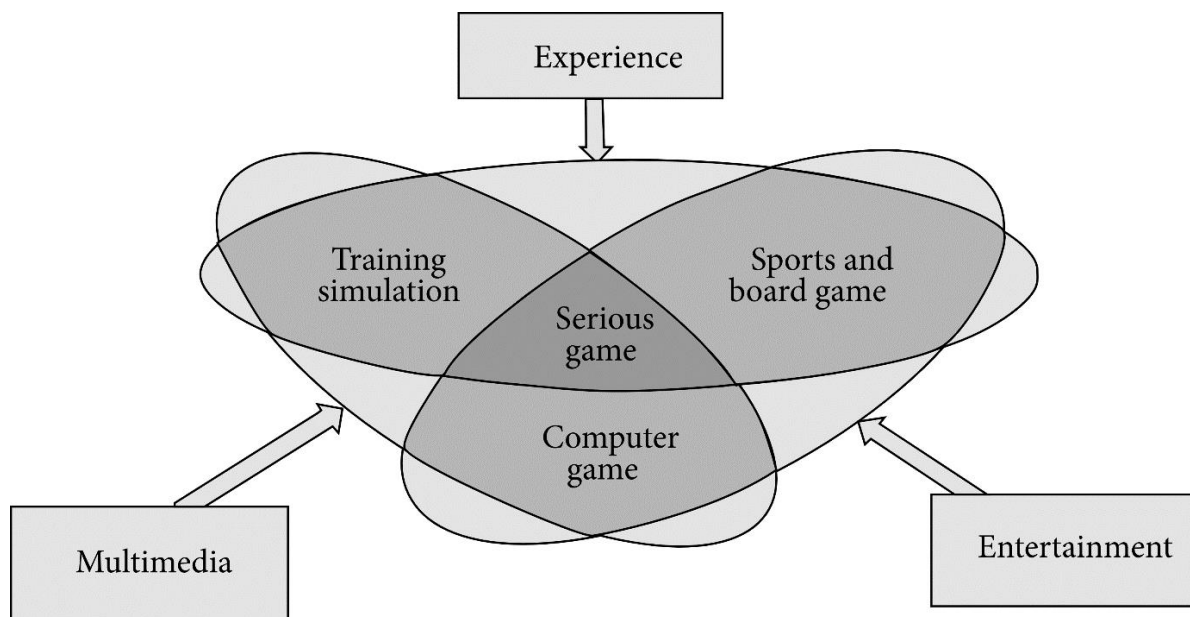
Games are characterized as a structured framework in which participants engage in simulated competition under the control of a set of rules, culminating in a quantifiable outcome, according to Salen and Zimmerman's (2004) conceptualization. The definition of a game is further refined when it is digital, as it necessitates the integration of technology into the game system (Mcclarty et al., 2012). The definition of games encompasses simulations, augmented reality, and traditional video games (Sarigöz, 2019).

Serious games are created with an educational goal instead of entertainment, unlike games intended for entertainment (M. Nazry & Romano, 2017). Games for behaviour change, persuasive games, and other terms are frequently used equally when referring to serious games (Antle et al., 2014). Serious games are primarily used for game-based learning but can also be used for other things like altering behaviour (Bogost, 2010). In the abovementioned information, serious games are "games whose primary purpose is not entertainment, enjoyment, or fun." (Michael and Sande Chen, 2011). At the same time, serious games also have an entertainment component. (Jantke, 2010). Serious games should be distinguished from simulations that depict reality as accurately as possible because serious games give a greater degree of freedom by simplifying reality in the game model. (Freese et al., 2019).

Following the abovementioned definition, serious games' main design goal is something other than entertainment, which sets them apart from video games (Laamarti, Eid and El Saddik, 2014). However, there is an issue with basing the definition of a serious game on its design goal (Jantke, 2010). To determine whether a particular game is serious, one would need to know the game designer's goals or plans when creating that particular game, which could be more practical (Laamarti, Eid and El Saddik, 2014).

Briefly, through multimodal engagement, a serious game may also improve the user's experience (de Freitas and Liarokapis, 2011). A serious games occur in a variety of settings, such as in the realms of interpersonal communication, education, and training (Dörner et al., 2016). Digital serious games have a variety of media that can include text, visuals, animations, audio, haptics, and more (Caserman et al., 2020) The phrase "serious" refers to games that are intended to teach players a lesson or impart information, such as knowledge, skills, or general content (Ritterfeld, Cody and Vorderer, 2009). This implies that the player is exposed to a setting that presents content derived from knowledge or experience (Domínguez et al., 2013). Therefore, as indicated in the diagram of Figure 3, serious games are described as an application with three components: experience, entertainment, and multimedia (Laamarti et al., 2014).

Figure 1. Components of significant games application (Laamarti et al., 2014)



Characteristics of Serious Games

Activity

The purpose of an activity is for the player to do it as a response or input to the game (Laamarti et al., 2014). Activity types can include physical activity, like games for well-being (Buttussi & Chittaro, 2010) or games for health that help fight youth obesity (Scarle et al., 2011). The type of exercise can also be physiological, like in games that help people get better, or that look for specific health problems (McKanna et al., 2009). It can also be mental, like in games that educate (Shin et al., 2011) or help people talk to each other (Hill et al., 2006).

Modality

The way that information gets from the computer to the people playing the game is called the "modality" (Laamarti et al., 2014). The player's sensory modes in the game are characterised by a modality such as visual, auditory, and haptic (Laamarti et al., 2014). Utilising methods to advance the game's goal is crucial (Laamarti et al., 2014). Additionally, it is essential to use suitable methods to improve the user experience and, in turn, make the game more successful (Laamarti et al., 2014).

Interaction Style

The interaction style determines whether a player interacts with a game using conventional controls like a computer, mouse, or joystick or more advanced ones like a brain interface, eye gaze tracking, movement tracking, and tangible interfaces. The game's success may be impacted by selecting the appropriate interface during the serious game creation process (Laamarti et al., 2014).

Environment

This criterion, which may combine several others, describes the setting of the computer game.

- A 2D (two-dimensional) or 3D (three-dimensional) environment, or a mix of the two, can be found in a serious game.
- Virtual or mixed-reality environments are entirely artificial. Computers have developed an immersive setting that can show the real world or be entirely made up. The use of virtual reality is common in important titles (Sporrel et al., 2019). According to Almurashi et al. (2022), mixed reality includes augmented reality and improved virtuality. It depicts a situation in which components from the physical and digital worlds can communicate and cooperate in real-time.
- Location awareness depends on the game, where the player may be unable to identify their current location (Licoppe and Inada, 2006).
- Mobility determines the portability of the game.
- Online determines if the game is playable over a computer network, typically the Internet.
- Social presence determines whether a game is for one person or more than one person. Computer-aided exercise (2008) shows that games with more than one player are more motivating and interesting than games with only one person.

2.1.2. Success factors for serious games

Digital games have been shown to develop a variety of personal and social skills and competencies (Wiemeyer & Hardy, 2013). So, serious games, according to Corti (2006), "leverage the power of computer games to captivate and engage end-users for a specific purpose, such as to develop new knowledge and skills.". While serious games are most commonly used in education and training (also known as educational games or game-based learning/training), they can also serve other purposes, as detailed by Sawyer and Smith's (2008) taxonomy. In particular, they can also be used to change behaviors, to raise the awareness about social, political or health issues, promote brands, products or healthy habits, etc.

The success of a serious game depends on several factors that contribute to its effectiveness in achieving its intended outcomes while still being interpreted as a game by the users:

- **Relevance:** The serious game must be relevant to the intended audience and address their specific needs, challenges, or learning objectives. The embedded content should be accurate, up-to-date, and aligned with the goals of the game.
- **Engagement:** The game must be engaging and captivating to keep the players motivated and interested in playing. It should have an appealing storyline, attractive graphics, and interactive gameplay to keep the players immersed in the game (Boyle et al, 2012).
- **Feedback and assessment:** The serious game should provide immediate feedback and assessment to the players to help them learn from their mistakes and improve their performance. This feedback should be tailored to the player's individual needs and progress (Sitzmann, 2011).

- **Adaptability:** The game should be adaptable to different learning styles, preferences, and skill levels of the players. It should offer multiple paths to achieve the learning objectives and allow the players to choose their own pace and level of challenge.
- **Motivation:** The game should motivate the players to apply the knowledge or skills they learn in the game to real-world situations. It should also create a sense of achievement and progress to encourage the players to continue playing and learning (Rigby & Ryan, 2011).
- **Evaluation:** The game should be evaluated regularly to measure its effectiveness in achieving the intended outcomes. This evaluation should be based on valid and reliable measures of learning, behavior change, or other performance related to the serious objective (Garris, Ahlers, & Driskell, 2002).

There are other specific success factors that can contribute to the effectiveness of serious games:

- **Interactivity:** The game should offer opportunities for the players to interact with the content, other players, or the environment to enhance the engagement and, eventually, peer interaction.
- **Immersion:** The game should create a sense of presence and immersion in the virtual environment to enhance the players' emotional involvement and cognitive processing.
- **Collaboration:** The game should promote collaboration and teamwork among the players to facilitate knowledge sharing, and skill development.
- **Personalization:** The game should offer personalized experiences that adapt to the individual needs, preferences, and progress of the players.
- **Transferability:** The game should support the transfer of learning or skills from the virtual environment to real-world situations. This can enhance the practical value and relevance of the game.
- **Accessibility:** The game should be accessible to diverse learners, including those with disabilities, different cultural backgrounds, or limited resources. This can enhance equity, inclusion, and social impact.

These factors are not mutually exclusive and can interact with each other to influence the success of the serious game.

2.1.3. Games on climate change: main characteristics

There is no commonly agreed typology for environmental games. A 2021 study (Gerber et al., 2021) frames the concept of “climate games”: games tackling topics related to climate change (from climate change itself to water services, the energy sector or transport). Other studies focus on environmental topics that might not be included in “climate game” typology because they focus on other issues: nature conservation for instance (Sandbrook et al., 2014). However, the 2021 climate game studies remain the most recent and exhaustive study of environmental serious games.

Game purpose and goals

According to this study, the stated purpose of the majority (75%) of these games is learning. The aim of these games is for the players to learn about climate change, its causes, impacts and potential solutions. The remaining 25% of games aim to foster discussion between participants or to have a direct impact on climate-change.

Most climate games are “game-based”, as opposed to “play-based”. “Game based” means these games have goals that have to be fulfilled. Thus, these games provide feedback to the players about their performance and can be won or lost. On the contrary, “play-based” games do not have goals and cannot be won or lost.

Player roles

The majority of climate games, especially the ones focused on providing learning, assign a role to the player. These roles vary greatly depending on the “system level” of the game: the scale at which the game is set (individual, household, community, city, country, multiple countries and global level).

Usually, the higher the system level, the more politically and socially important the role: from citizen/consumer to advisors, mayors, governors and other important private or public stakeholders. About a third of climate games are set on the global level, followed by the city and multiple countries levels.

Topics

Whether they are set on an individual or more global level, the vast majority of games focus on climate change mitigation (rather than adaptation). That means that most games tend to be centred around solutions aimed at reducing climate change rather than living with it. In terms of specific topics, games vary but the most represented sector is energy (36% of studied games), followed by transport (13%) while others like health or the financial sector are rarely mentioned.

Games also vary in terms of what type of actors they put forward as the ones that have power to change things, to mitigate climate change. Most often, public institutions are the most put forward by climate games, by, for instance, putting the player in the shoes of a mayor. Another important actor in climate games is the individual. Indeed, a significant number of climate games focus on individual behaviours that can help mitigate climate change. On the other side, private companies and technology are the least mentioned. The study also points that existing climate games only rarely bridge the various system levels and actors. The study recommends that future climate games should link “the different levels of climate related challenges, e.g., by putting individual decisions in a global context.” (Gerber et al., 2021)

Target groups

The target groups of climate games are most often the general public¹ followed by students and then professionals. Other studies (Rossano et al., 2018) do go into more details about

¹ The two GaGEN target groups: children under 12 and adults over 55 fall under the “general public” category of the study. The study does not go into more details for this category, making it impossible to assess the prevalence of those two age ranges.

children under 12 as an age group targeted by environmental games. However, adults over 55, or potential intergenerational aspects of environmental games, are not studied by the academic literature.

Player interaction

In terms of player interaction, the majority of climate games are multi-player. Relatively many games include aspects from both competition and collaboration. This may reflect the nature of climate change mitigation which involves a common goal that requires collaborative action but at the same time must be met under consideration of partial information and often competing interests.

Medium

In terms of medium, among digital serious games², almost half of games are exclusively playable on the computer. The remaining half or so is playable both on mobile and computer, allowing greater access to the games.

Gaming environment

Finally, additional reading conducted for this part highlights the importance of the gaming environment: if the characteristics of the serious game are important, so are the conditions under which it is played. Academics recommend having a debriefing phase after playing. This debriefing allows the player, with the help of a facilitator, to turn the “spontaneous concepts” acquired by playing into “scientific knowledge” through discussion and the sharing of deeper information about the game’s topic. (Harteveld & Drachen, 2015)

2.2. Intergenerational digital games

2.2.1. Characteristics of children and seniors as (potential) gamers – motivation for playing, needs and preferences, challenges.

When developing an intergenerational game, it is essential for creators to have insights into both younger and older adults' motivations to ensure its attractiveness to the players. Overall, the game needs to be meaningful for them (Loos, 2014).

The literature shows that older adults recognise the potential value of games for mental stimulation, so playing for health benefits seems to be a strong motivation for interest in digital games among older adults. However, the experiences of engaging with a meaningful, aesthetic, and enjoyable challenge play a more critical role when choosing to play a game over doing other activities (Khalili-Mahani, et al., 2020). Some of the motivations presented by older people are related to the enjoyment of interaction and communication with family members (Zhang & Kaufman, 2016). Other frequently rewarding aspects mentioned are

² The 2021 study also takes non-digital serious games such as board games into account.

relaxation, fun, distraction/ escape from reality, stimulation, the potential for intergenerational connection, and challenge (Khalili-Mahani et al., 2020; Loos, 2014). The possibility for social interaction seems to be the most important predictor of time invested in playing digital games. Conversely, older people have negative feelings about violence in digital games (Loos, 2014). The literature states that to be meaningful for older people, digital games should include themes associated with elderly life but also foster connections, contribute to society, and cultivate oneself and others (Loos, 2014). In fact, older people also noted the potential usefulness of games for socially isolated people (Khalili-Mahani, et al., 2020). Older players tend to reject reflex-oriented games like fighting, racing, action, and violent games, namely because they find such games more complex, less interesting, and therefore less enjoyable to play due to age-related physical conditions or disabilities. However, older adults seem more adaptable than younger players, which is why it is suggest that when designing intergenerational games, priority should be given to children's preferences (Hera et al., 2017). On the other hand, arousal, challenge, competition, diversion, fantasy, and social interaction appear as the primary motivators for younger adults to play video games (Loos, 2014).

Hera and colleagues (2017) identified three possible patterns of motivation to play digital games shared by younger and older adults: (a) social interaction and connectedness; (b) fun and relaxation; and (c) escaping reality. The authors gauged that older adults who play games for fun, enjoyment and relaxation tend to appreciate strategy games with more straightforward rules that can be played in short sessions, which is similar to the young players' motivation for playing games. Furthermore, older adults seem to play games to escape from their daily life reality (Hera et al., 2017); similar to younger players' motivations for diversion and enjoyment, escaping from reality comes close to fantasy and imaginative immersion (Loos, 2014).

Regarding the elderly preferences, they seem to enjoy playing casual games that allow them to educate themselves, contribute to society and connect with others. In this sense, sports, gardening, and music are frequent topics included in their game concepts. In fact, 'wellness games' designed to train the body and mind are the most purchased and played by older adults (Othlinghaus et al., 2011). Beyond these, problem-solving, storytelling, learning and skill development, and history teaching and creating invigorating social interactions games seem to be the preferences of this age group (Khalili-Mahani et al., 2020). Other studies show a large preference for cognitive stimulation, relaxation, and physical exercise games (Khalili-Mahani et al., 2020). In Havukainen's (2020) study, older adults identified seven elements as essential to make games fun: 1) appearance and aesthetics, 2) competition, 3) manageability of gameplay, 4) social impact, 5) familiarity, 6) unpredictability, and 7) intergenerational gameplay (Havukainen, 2020). Children's gaming preferences show a wide range of games played, from puzzle and dexterity games, racing and soccer games, complex simulations as well as action and strategy games. The most played games are FIFA, Super Mario, The Sims, Singstar, Mariokart, Pokémon, Harry Potter and Wii Sports (Othlinghaus, et al., 2011).

To be able to design intergenerational digital games, it is not only necessary that both groups are interested and motivated to play, but they must also be able to do it (Loos, 2014). Alongside the ageing process, some declines, or age-related limitations due to declining vision, hearing, cognition, and motor functions (Loos, 2014) need to be accounted for. Age-related decline in vision can lead to difficulties seeing and processing cluttered online content

or even reading the text on the screen. The reduction in motor functions might lead to problems using a keyboard and mouse, selecting links, and scrolling pages, especially when targets are small. Furthermore, both generations mainly have limited memory capacity and demonstrate some problems focusing their attention (Othlinghaus et al., 2011). Gerling and colleagues (2012) ascertained that traditional game design methods do not account for these ageing-related needs of older adults (Gerling et al. 2012). Table 1 summarizes some challenges and proposed solutions (adapted from Gerling et al. 2012).

Table 1. Challenges associated with designing games for older adults and respective solutions.

Challenge	Solutions
Attention span and memory	Simple and intuitive screens that decrease memory load.
Auditory processing	Clear auditory feedback; use lower frequency tones and provide information through multiple modalities.
Capturing and maintaining interest	Provide content that is purposeful and interesting to users; use appropriate game variety.
Motor skills (e.g., reaction time, coordination, balance)	Avoid small targets and moving interfaces; adjust the game to decreased sensory acuity and slower responses; provide alternate control mechanisms; simple and intuitive interaction.
Problem solving and reasoning	Adjustable, appropriate cognitive challenges.
Unfamiliarity with gaming	Provide clear information about game restrictions, requirements, and objectives; enable user to experiment with the game system.
Unfamiliarity with technology	Provide immediate, encouraging, and positive feedback on learning goals and enough time to learn basic skills.
Visual processing	Large and well-defined visual symbols; allow the user to control font, colour, and contrast.

Khalili-Mahani and colleagues (2020) mentioned that besides the physical accessibility, intergenerational barriers stemming from the cultural inaccessibility of games should also be addressed.

When pondering existing games, older people refer to several stressful factors, namely the addiction risk, the learning curve, the generational gap regarding interest and technology literacy, but also the lack of personalized aesthetics (Khalili-Mahani et al., 2020). Some studies suggest that gamer culture is not inclusive to older adults by requiring knowledge of how to use a controller or a keyboard (Khalili-Mahani et al., 2020).

Addressing the challenges of both target groups, research suggests they don't have the ability nor the patience to deal with long instructions and need structure and guidance in some way. In the same vein, these groups need a more straightforward interface, easy access, gameplay, and simpler instructions (Khalili-Mahani et al., 2020; Othlinghaus et al., 2011). There is also the need to adapt games and the digital world to accommodate physical, cognitive, and sensory impairments, thus increasing accessibility to services (Havukainen, 2020). These age groups seem to need short sessions that are easy to get in and out of, with an educational component, supporting the various roles of both age groups and considering various

motivational and contextual factors (Zhang & Kaufman, 2016). Concurrently, intergenerational digital games need to be easy to use and understand for older people, as technology anxiety is one reason for older people to avoid using new technology (Zhang & Kaufman, 2016). The current older adult generation did not grow up with computer technologies. Thus, they might not be as familiar and comfortable with technology as children are. Therefore, a digital game that an older player might not understand may be far too simple for a child (Hera et al., 2017). It is important to introduce mechanisms into the game that encourage a mutual exchange of information and/or ideas (Hera et al., 2017).

2.2.2. Success factors for intergenerational digital games

Successful intergenerational games seem to be where meaningful play emerges to unite children and older adults. Commonly, both generations prefer games with meaningful and relevant content referring to everyday situations and age-related interests. Both age groups enjoy collaborative gaming and particularly like the social aspects of games (Othlinghaus et al., 2011). However, to design successful intergenerational digital games, we need to consider the common motivations of children and older adults, age-related factors, and follow a human-centred research procedure (Loos, 2014).

Chance-based games with easy-to-master tactile/ physical controls offer diverse opportunities for playful interaction, eliciting high degrees of engagement for both generations. In the same vein, shorter games (especially appealing to older players) featuring light-hearted themes and characters (especially appealing to younger players) are more successful among the target groups (Hera et al., 2017). The literature states that for intergenerational digital games' success, positive interdependence significantly facilitates social interaction between different generations. Thus, collaborative digital games have been found to have a solid potential to facilitate positive interdependence. Accordingly, a cooperative game where both generations share the same goal is a suitable goal-related interaction for intergenerational digital games. The technical prototype of a digital game based on the traditional hide-and-seek game is an example of using fun instead of competition to foster interaction (Hera et al., 2017). To ensure success, the focus should fall on how the games will be designed and used to achieve the established goals (e.g., relationship building, mutual understanding, and knowledge sharing). However, balancing the different needs and competencies between the two age groups is necessary (Zhang & Kaufman, 2016). Game designers should comprehend how age differences could be capitalized as an interactive component of the game and consider how each group's expertise can be used to sustain engagement in the game, enabling both groups to support each other (Zhang & Kaufman, 2016).

3.Examples of meaningful serious games from partner countries and beyond

3.1. France

In France, like in the rest of the world, the serious game market is expanding. This type of games responds to a plurality of ends: advertising, communication, recruitment, training and learning. The French national serious game market is estimated to 200 million dollars (2019), and has multiplied by 7 between 2009 & 2014. Serious games were mainly developed by specialized e-learning or healthcare companies. Nowadays, more and more are developed by the big companies of the entertainment video game industry (Ubisoft, Sony, Nintendo etc.).

A few examples of the main French serious games developers:

- My Serious Game: Founded in 2014, this company is specialized in tailor-made digital learning and is the leader of the serious game French market
- Genious healthcare: specialized in therapeutic video games and other digital medical devices allowing to detect or prevent certain illnesses.
- Daesign: specialized in digital learning for companies in order to help them manage their staff.

Serious games on environmental topics have been developing in France since the late 2000's. Some serious games of this type created during that period, like Ecoville, a city-building serious game released in 2009, are still used by some teachers in middle school or high school.

Espéride et la Forêt de Demain (Espéride and tomorrow's forest)

Espéride is a 2021 card-based management serious game published by the Office National des Forêts (National office of forests) and the Nouvelle-Aquitaine region. The game's topics are climate change's impacts on forests and what can be done to counter or adapt to them.

The game manages to incorporate sensibilisation/informational elements in its gameplay, insuring better engagement from the player than a simple quiz game or an information section in a menu. The game can be challenging, while failing too often might be a deterrent to player engagement, winning too easily can also bore the player (Ravyse et al. 2016). This serious game only tackles environmental issues linked to forests, but its game mechanics can be easily adapted to other environmental topics.

In terms of success, an official document from the Nouvelle-Aquitaine region claims that by June 2022, over 2 500 people had played the game and that feedback was generally very positive. As of March 2023, Google Play indicates 500+ downloads and a 4.8/5 rating (though only out of 13 reviews). However, the Apple Store does not indicate the number of downloads nor the rating of the game. The browser version also does not have a player count nor a review section, making the assessment of the game's success a difficult task.

Table 2. *Espéride* - main characteristics.

Theme	Effects of climate change on forests
Setting	Forests: the game is composed of 8 levels including a tutorial. Depending on the level, the game is set in forests bordering cities, mountainous forests, coastal forests, each with their specificities.
Player's role(s)	The player is the manager of a forest estate.
Game objective	By the end of the game, the player will have created the "Forest of tomorrow": adapted to climate change, with human activities that respect biodiversity and that do not put the forest at risk.
Gameplay	<p>Each level has its specific objectives, but overall, they consist in reaching a certain percentage in one or several of the following criteria represented by gauges.</p> <ul style="list-style-type: none"> ● Public reception ● Biodiversity ● Wood Production <p>As well as filling up an objective bar by playing specific cards. The player must also keep an eye to a risk management factor, which, if not kept in check, can increase the risk of negative events impacting the forest.</p> <p>The player has a set amount of time (in years) to fulfill the level's objectives. Playing cards costs time. If the player runs out of that time resource without having fulfilled the game's objectives, the game is lost.</p> <p>There are three main elements to the game:</p> <p>The gauges: that must be filled according to the level's objectives.</p> <p>The cards: A number (depending on the level) of cards are given to the player at the beginning of the game, and each time the player plays a card, new ones are given. Each card can increase and/or decrease the various gauges' levels. For example, playing a "create a logging operation" card will increase wood production but decrease biodiversity. Each card costs time to play. Cost varies depending on the card.</p> <p>The board: Some cards have global effects on the forest and playing them does not require additional player input. However, other cards require the player to select one or several parts of the forest represented by a board. These cards will modify the part of the forest they will be played on and might allow or prevent the player to take certain actions on that section of the forest later down the line. For example, a card can cut down diseased or at-risk trees in a part of the forest to increase risk management. However, similar cutting actions might not be available again in that area of the forest.</p> <p>So overall, <i>Espéride</i> is a game of balance: usually, public reception and wood production requirements have to be met while managing risks and protecting biodiversity by using plausible (though simplified in the game) strategies. Time is of the essence, so good planning is required to optimize forest management.</p>
Interactions	Collaborative
Aesthetics	Board-game style, hand-drawn looking 2D graphics. Music (one track) and various sound effects depending on player input.
Target audience	9 to 11 (according to information on the Apple Store).

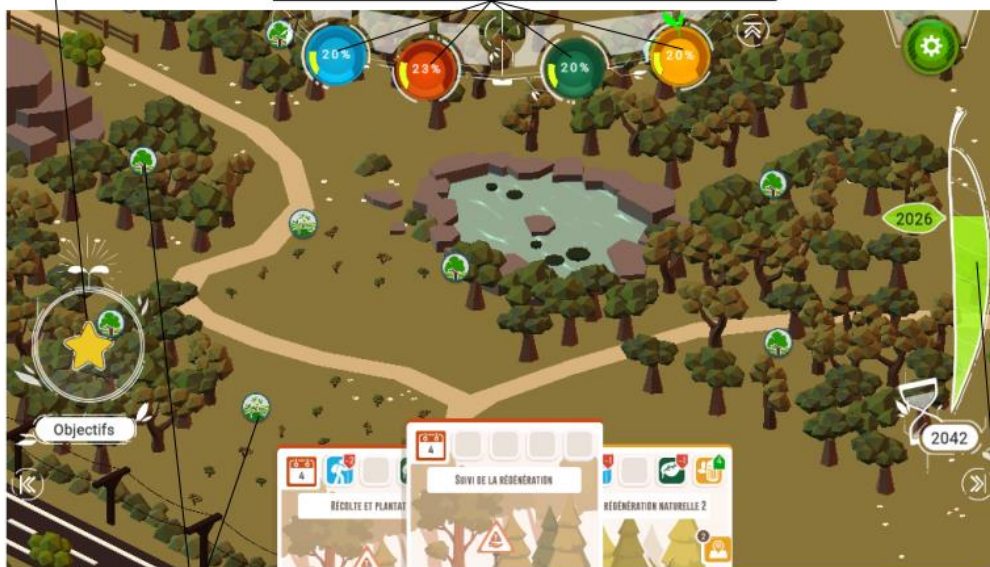
Number of players

Singleplayer with a cooperative multiplayer option (only on PC)

The objective gauge has to be filled up on top of the other requirements of the level, by playing special cards indicated by a star.

From left to right: Public reception, risk management, biodiversity and wood production gauges.

In this level, the wood production gauge must reach 50 (indicated by a leaf).



Each circle on the board represents an area of the forest.

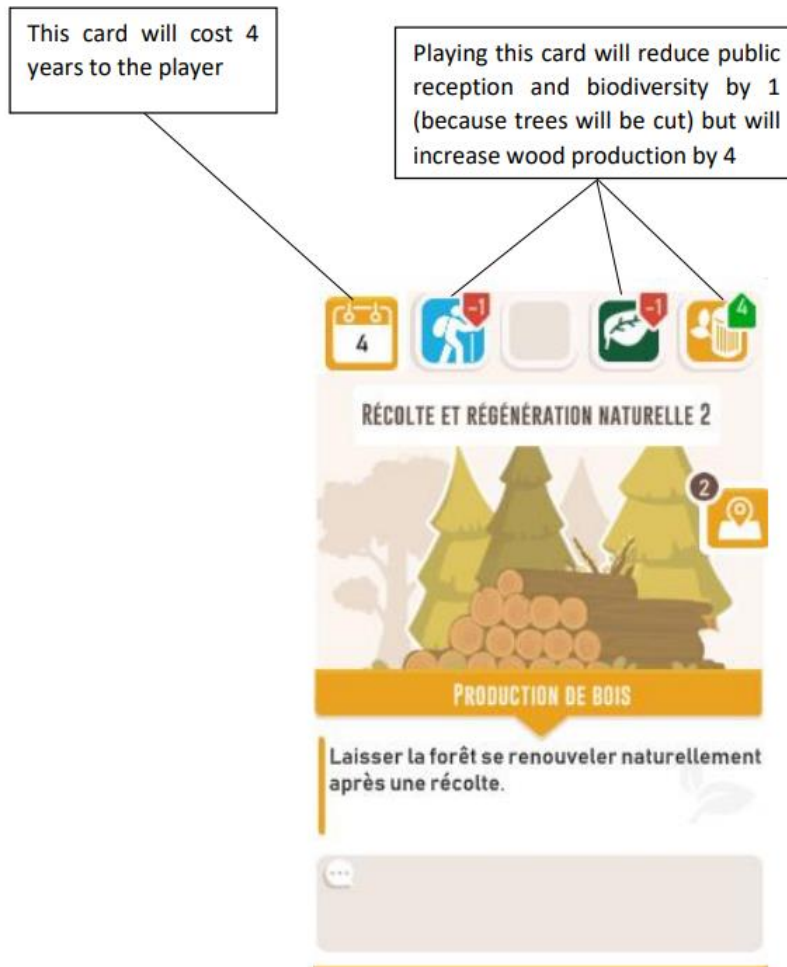


Circles with a tree is a standard part of the forest with adult trees.

Circles with sprouts represent areas where trees have been recently cut. The player has to wait for the trees to grow back to be able to play certain cards idofn these areas again. Other cards might alter areas differently.

The player's cards

Time (in years) remaining



All Screenshots were taken from the PC version of the game: <https://esperide.app/>

Links to the game:

- PC version : <https://esperide.app/>
- Android : <https://play.google.com/store/apps/details?id=com.onf.Esperide&hl=fr&gl=FR>
- IOS: <https://apps.apple.com/fr/app/esp%C3%A9ride-la-for%C3%AAt-de-demain/id1595820960>

References and additional resources:

- COPTec Factsheet (2022). Serious Game “Espéride et la forêt de demain » (in French)
- Ravyse, W., Seugnet Bignau, A., Leendertz, V., & Woolner, A. (2016). Success factors for serious games to enhance learning: A systematic review. *Virtual Reality*, 21, 31-58. DOI:10.1007/s10055-016-0298-4
- Ypsilanti, A., Vivas, A. B., Räisänen, T., Viitala, M., Ijäs, T., & Ropes, D. (2014). Are serious video games something more than a game? A review on the effectiveness of serious games to facilitate intergenerational learning, *Education and Information Technologies*, 19, 515-529. <https://doi.org/10.1007/s10639-014-9325-9>
- Website with information on serious games companies in France (in French): <https://seriousgamer.fr/entreprises-secteur-des-serious-games-en-france/>

Cleanopolis VR

Cleanopolis is an action-oriented, minigame-based serious game published by Electricité de France (EDF, national electricity production and distribution company) in 2015. The game aims to transfer knowledge about the individual-scale causes of greenhouse gas emissions and the potential solutions to reduce them.

For a serious game, Cleanopolis can be deemed to be successful: Google Play reports 50 000+ downloads with an average rating of 4.4/5 (from 634 reviews). The Apple Store does not indicate a download count, but shows an average rating of 4.1/5 (from 36 reviews). The game’s success may be caused by its aesthetics (3D graphics, multiple music tracks and the variety of sound effects).

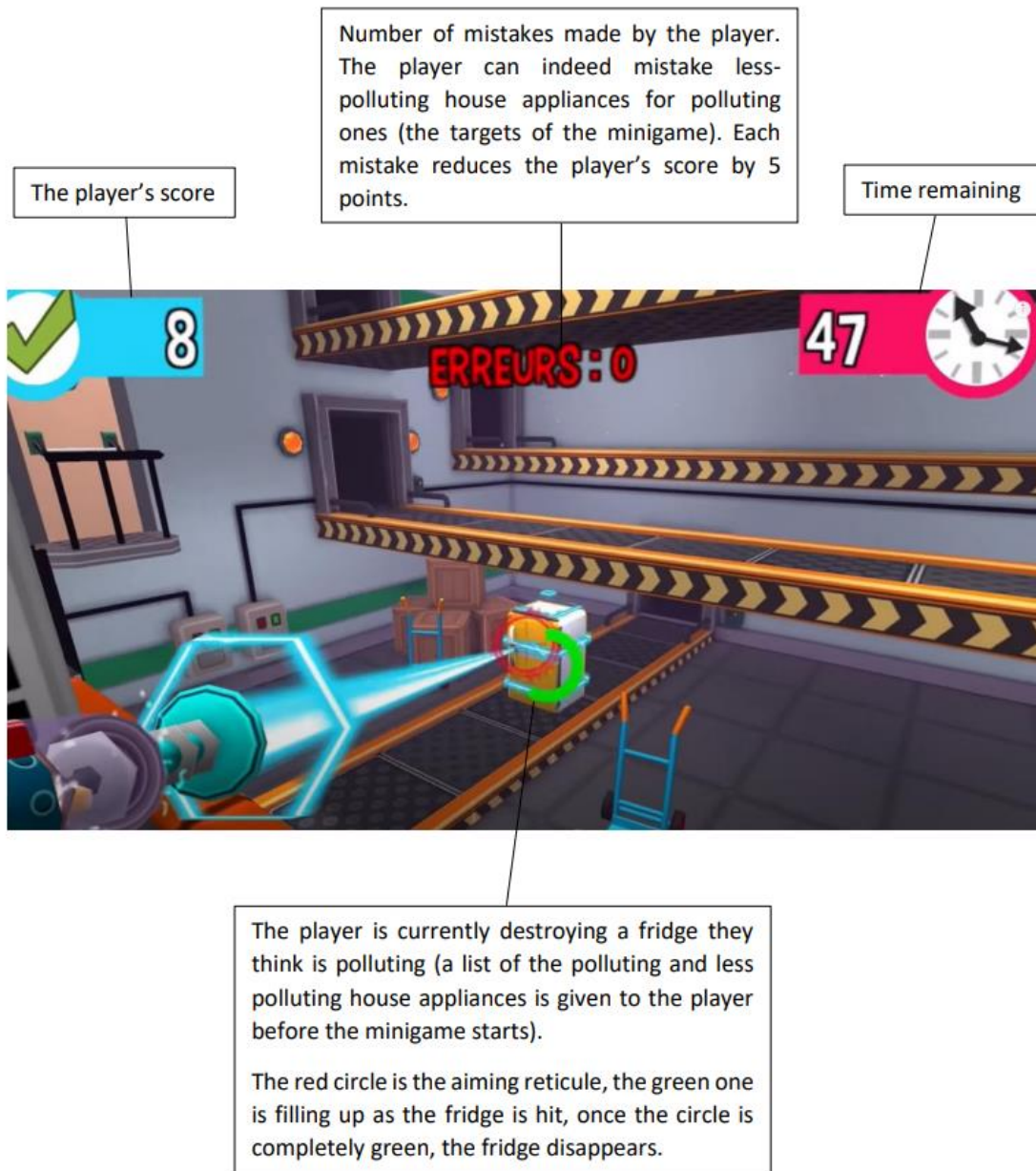
Furthermore, the game is VR compatible but not exclusive. VR can be used with cardboard glasses with the phone strapped on it. VR favours a more immersive experience, a more intuitive handling of the game, and some studies have shown that it also led to higher user-satisfaction than 2D serious games (Checa 2020). However, VR can be disorientating/nausea inducing for first time users.

Table 3. Cleanopolis VR - main characteristics.

Theme	Greenhouse gas emissions
Setting	The fictional city of Cleanopolis
Player’s role(s)	The player helps Captain Clean and Toby, a superhero and his dog, tasked to save Cleanopolis from greenhouse gas emissions.
Game objective	By the end of the game, the player will have saved Cleanopolis from a CO ₂ “cloud” looming over the city.
Gameplay	<p>The game is composed of 8 action-oriented minigames, each related to possible solutions to reduce greenhouse gas emissions.</p> <p>Cleanopolis is also composed of quizzes about environmental issues and a short 3d animated movie on climate change.</p> <p>Minigames are usually based on a precision/reflex action the player must perform (for instance, drive a truck to houses in order to deliver heat pumps, or use a special tool on houses to insulate them). Minigames are time based, player speed is important to reach the highest score possible in the limited amount of time the game grants. Some actions can be failed, for instance, one minigame tasks the player with destroying household appliances that are too polluting, the player can make mistakes by destroying ones that are non or less-polluting, reducing their score.</p> <p>Depending on the player’s score, finishing a minigame grants up to three stars; which can be used to unlock cosmetic modifications to the city.</p> <p>The game also offers an “investigation” activity asking the player if they or their family members have implemented ecological solutions in their house (low consumption light bulbs, heat pump, etc...) and about good practices (turning off the light after leaving a room, etc.)</p>

Interactions	None
Aesthetics	3D graphics, point of view depends on the minigame (usually 1st person or 3rd person). Music (various tracks), multiple sound effects depending on player input and the game's reaction.
Target audience	4+ (according to the Apple Store), general public
Number of players	singleplayer





Screenshots are from the game's trailer, <https://www.youtube.com/watch?v=HRLMjjGIM3I>

Links to the game:

- Android: <https://play.google.com/store/apps/details?id=com.bulkypix.cleanopolis&hl=fr&gl=US>
- IOS: <https://apps.apple.com/fr/app/cleanopolis-vr/id1045463085>

References and additional resources:

- Checa, D., Bustillo, A. (2020) A review of immersive virtual reality serious games to enhance learning and training, *Multimedia Tools and Applications*, 79, 5501-5527. <https://doi.org/10.1007/s11042-019-08348-9>
- Khalili-Mahani ,N., De Schutter ,B., Mirgholami, M., Holowka, E. M., Goodine ,R., DeJong, S., McGaw, R., Meyer, S., & Sawchuk, K. (2020). For Whom the Games Toll: A Qualitative and

Intergenerational Evaluation of What is Serious in Games for Older Adults, *The Computer Games Journal*, 9, 221-244, <https://doi.org/10.1007/s40869-020-00103-7>

- Zhang, F., Kaufman, D. (2016) A review of intergenerational play for facilitating interactions and learning, *Gerontechnology*, 14 (3), 127-138. DOI:10.4017/GT.2016.14.3.002.00
- The short 3D animated movie on climate change included in the game can be accessed on YouTube: <https://www.youtube.com/watch?v=lf6XQVFjLro>

Conclusions

Both games tackle environmental issues and aim to transfer knowledge to their audience on the impact of climate change and possible ways to reduce them or adapt to them. Both games are quite easily accessible in terms of technical requirements: *Epéride* is available as a browser game on PC and as an app on IOS and Android, *Cleanopolis* is available on IOS and Android. Both games do not have high requirements, almost any smartphone or PC can run them.

The knowledge that the games want to transfer is integrated into their gameplay. Other serious games encountered during the research conducted for this part often have external (as in external to the gameplay, this could be either a pdf document separated from the game or an informational section) informational documents detailing the concepts it tries to share with its audience. Though more detailed, this kind of information is disconnected from the gameplay, which might hinder player engagement and learning quality (Ravyse et al. 2016).

Another key point in common between these two serious games is the type of publisher that got involved in the projects. Both are linked to the French state. The ONF (is a governmental Agency and EDF a state-owned company). The environmental message that these serious games want to share can thus be limited by national policy. For example, one of *Cleanopolis*' minigames ask the player to transform combustion engine cars into electric cars, without mentioning the possible ecological problems linked to the latter, or alternative solutions. This highlights the need to carefully choose which information should be transferred through serious games. There is a need to strike a balance between nuanced, complete, factual and op-to-date information and simplicity of understanding for the target groups.

In terms of differences, *Cleanopolis* is simpler than *Epéride* gameplay-wise and may be more aesthetically pleasing: 3D environments, VR-compatibility, multiple music tracks and a bigger variety of sound effects make for a more vivid experience. (Ravyse et al. 2016, Ypsilanti 2014) The simplicity of *Cleanopolis*'s gameplay, as well as the fact that most of the minigames are dynamic and action-oriented, might also make the game more (or at least more quickly) engaging for the players. The gameplay is faster-paced, more dynamic and requires less reading. This could, at least partly, explain the game's success (50 000+ downloads on Google Play and high ratings).

On the other side, *Epéride*'s complexity might mean that players have to take more time to assimilate game mechanics, but it gives more freedom for them to establish their strategy and play around with concepts linked to environmental issues, making the learning experience feel less linear/limited in terms of player choices.

In terms of intergenerational play, some aspects of the two games are suited for such practice, while some may hinder it. A 2020 study (Khalili-Mahani et al. 2020) showed the various potential stress factors of elderly (60+) people when playing serious games. Among others, one recurring factor is the game's learning curve. Most participants of the study were afraid to be unable to learn the game. This, however, does not mean that the game's difficulty should be trivial. An important part of the participants also felt that challenge was a rewarding/satisfactory element of serious gaming. This means the game should be "easy to learn, hard to master". This can be done through the implementation of a tutorial and an incremental increase of difficulty throughout the game. Espéride has both, the first level players have to complete before being allowed to access the others. However, level difficulty could be more clearly indicated in their description with, for example, a difficulty rating system. Cleanopolis does explain each minigame before the player can start it, but explanation is quick and only written: the player cannot play a simplified version with explanatory pop-ups to learn the minigame. On the other side, the minigames are simple enough to not require more explanation.

Espéride has a cooperative multiplayer mode. This favours intergenerational play by encouraging interactions between players in order to achieve a common goal. Cleanopolis is a singleplayer experience, and the fast-paced nature of the game is not optimal for exchanges between players in a group session, or for the intervention of a facilitator that might help players understand the game.

Finally, one question raised during the research was the question of the longevity/sustainability of serious games. Indeed, many games that might have been chosen to be analysed were not available to play anymore. Some games' websites were simply not accessible, while some required the use of browser plugins (usually Adobe Flash Player) that are no longer available. Cleanopolis itself cannot be downloaded on mobile phones that have a recent version of the Android OS. Furthermore, even in the case they can still be played, some functionalities of serious games can become unavailable to players after a certain period of time. For instance, when tried in mid-March of 2023, Espéride's cooperative multiplayer mode did not work.

3.2. Germany

Computer and video games are very popular in Germany. According to the Association of the German Games Industry, around sixty percent of the people in Germany engage in gaming, at least sometimes.

According to the "Games Industry in Germany 2021" report published by game - the German Games Industry Association, the German games market generated a revenue of €8.5 billion in 2020, with around 34 million active gamers in the country. By 2023, the market volume in Germany is expected to reach 370 million US dollars. While the majority of revenue is generated by entertainment games, the report highlights that serious games are gaining popularity in Germany, particularly in the fields of education, health, and sustainability.

Germany has a growing serious games industry, and there are several games developed in the country that address climate change and related environmental issues. The German Federal Environment Agency has developed several web-based games and apps that aim to educate and engage the public on environmental issues, including climate change.

EnerCities

“Project EnerCities” offers an online e-learning game for young people to experience energy-related implications. The goal of the game is to create and expand virtual cities dealing with pollution, energy shortages, renewable energy etc. The game is web-based and suitable to play on low-budget computers.

Table 4. EnerCities- Climate change game.

Theme	simulation for environment and energy management
Setting	A fictional city
Player’s role(s)	the player starts with a small village and a bit of land, and grows their own town to a level 5 metropolis
Game objective	The goal of the game is to create and expand virtual cities dealing with pollution, energy shortages, renewable energy etc.
Gameplay	The game has four levels. Each level unlocks new buildings. Start with simple suburban plots, light industrial buildings and the choice between windmills or a small coal plant. Further levels introduce heavy industry, commercial district, forests, urban district, and new energy buildings. The last level unlocks the powerful Super Structures, like the Nuclear Fusion plant.
Interactions	cooperative-competitive
Aesthetics	The game is fully web-based, 3D perspective (via Unity3D plug-in) and is suitable to play on low-budget computers. The game offers a semi-realistic simulation with game-like visual styles (cartoony) and low entry barriers (easy to understand; multiple levels in order to bring-in more complexity).
Target audience	anyone from 15 years old
Number of players	single-player



Source: [enercities game - Bing images](#)

References and additional resources:

- [ENERCITIES \(inforse.org\)](#)
- [Enercities - Paladin Studios](#)
- [EnerCities - Serious Games Society](#)

Keep Cool Mobil

In [KEEP COOL mobile](#), young people guide the fortunes of global metropolises: they decide on the path of their economy, their strategies for climate protection and exert political influence on the international stage. Skillful diplomacy, a sense of responsibility and committed communication are required and decide on victory - and on the future of the global climate.

Table 5. Keep Cool Mobil- main characteristics.

Theme	Climate, environment, sustainability
Setting	A virtual planet
Player's role(s)	Players take on the role of a citizen trying to reduce their carbon footprint and combat climate change.
Game objective	The main objective of KEEP COOL is to teach the players how to deal with environmental problems on different scales and raise awareness around climate change, global warming, the importance of sustainability..etc.

expand their virtual cities. Whereas in KEEP COOL, players set out their economic strategies and present them to their governments WHILE keeping in mind the global warming issue.

The success factors of these two games are their accessibility first and foremost; both games can be easily played on any browser or mobile phone. Second, the games tackle environmental issues like climate change, global warming, deforestation and others in a highly competitive frame while maintaining realistic numbers and outcomes of environmental actions. This helps players to easily identify the problems their immediate regions or cities are facing and it incites them to find solutions accordingly.

Finally, both games can be played in groups and targets people from all ages starting from 14 years old which makes it highly suitable for intergenerational play.

3.3. Poland

Currently, on the Polish market there are available few types of serious games concerning climate changes. At first, there are board games, which are very successful lately and can be treated as intergenerational because everyone above 4 years old can play. On the other hand, there are few digital games. However, digital games are not so intergenerational as we can observe that they are too easy or too complicated for either children or seniors. Games for seniors should be quite easy to understand and give a chance to coordinate easily. These should be intellectual and multi-player games that involve knowledge. On the other hand, for children, arcade games are more suitable, which will not cause children to get bored quickly. Combining these two expectations can be a challenge.

EkoEksperymentarium

EkoEksperymentarium is a digital game which is a part of a project concerning eco-education. In addition to the game, there are also further materials and an exhibition that are designed by the initiators of the project. The game is free of charge as it was made with business partners.

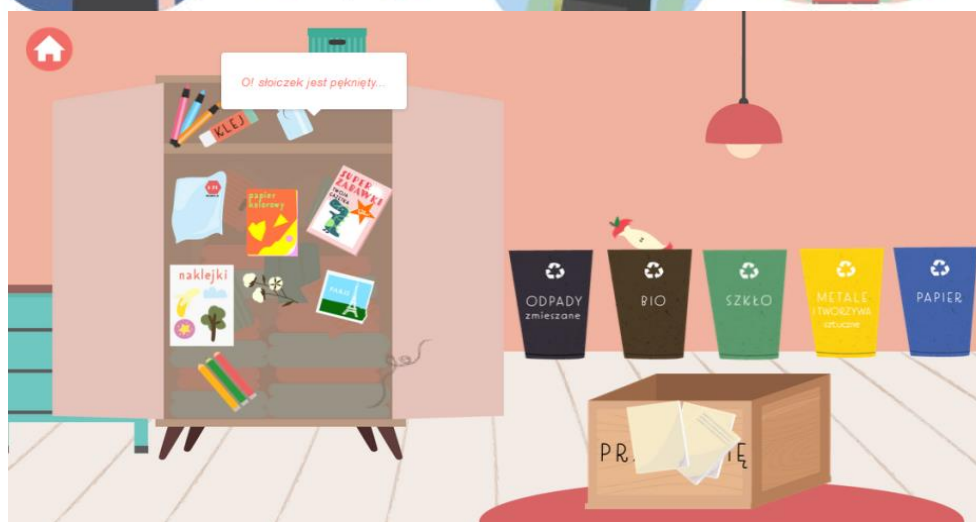
This game allows to play at home, but also at school. It can be used by teachers during lessons, as it equips them with materials and scenarios for lessons. There are provided contests and certificates of participation for teachers and classes. This game is prepared for children, however because it is quite easy to coordinate it can be played by seniors as well.

Table 6. EkoEksperymentarium - main characteristics.

Theme	The main motive of the game are the habits and behaviors of the family that affect the surrounding natural environment.
Setting	The game takes place in the house of the Łaskotki family, where by entering individual rooms we get to know the next members of the family and their everyday life. There is also an extra setting – the forest.

Player's role(s)	<p>Each room, is a separate character. There is mom Karolina, father Karol and kids: Romek and Róża.</p> <p>Mother shows what we can do to protect environment by our habits in living room – she shows how to wisely use electricity and heat.</p> <p>Father shows the kitchen and how we should behave to be more eco-friendly.</p> <p>Romek shows the bathroom and gives some advices on saving water.</p> <p>And Róża plays at her room and gives a good example to reduce waste and separate them, and it the effect to reduce carbon footprint.</p>
Game objective	<p>Each setting is a riddle room where points are collected by solving tasks. Each task gives some points which should be put into the score board.</p>
Gameplay	<p>In each of the rooms there is a guide, i.e. a person who tells about the successive riddles. By solving riddles player gets points. It also shows how the decision made by the player influenced the environment. For example, in the Róża's room we have to help her to separate her belongings, throw out those which were used, but we have to remember about the rules of waste segregation. Some of the materials can be re-used to do the eco-notebook. After each task, we collect points by which we reduce the carbon footprint. Points should be put into the scoreboard, so it is easy to remember them.</p>
Interactions	None
Aesthetics	<p>Graphics is 2D. There is also a lector who reads what also appears in the comments on the screen.</p>
Target audience	<p>Game was prepared for kids age 5-11.</p>
Number of players	single-player





ZA DUŻO RZECZY

Staram się kupować i wyrzucać mniej, bo wyprodukowanie każdego przedmiotu zwiększa nasz ślad węglowy. W mojej szafie nazbierało się sporo rzeczy - czas je posegregować. Pomożesz mi?

START →

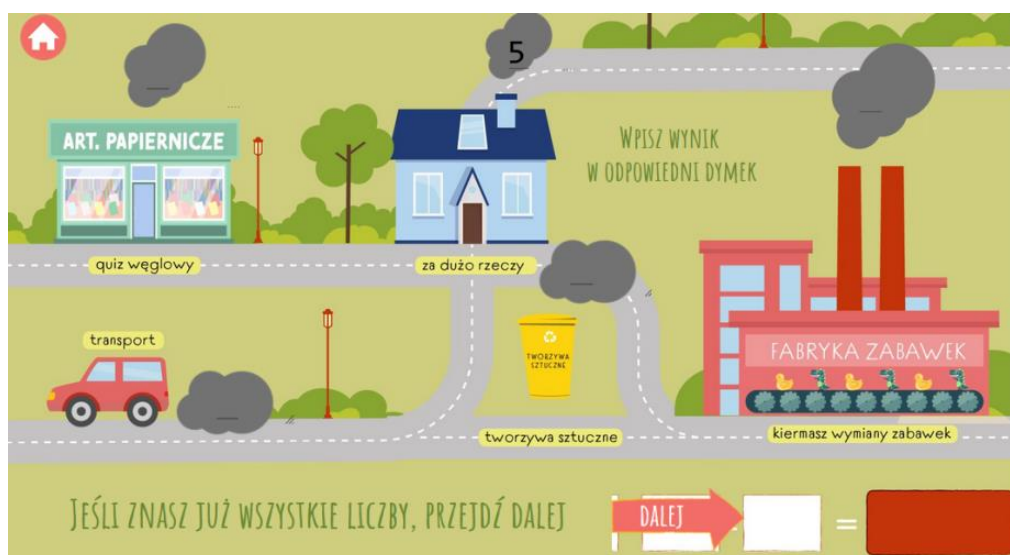
Source: <https://view.genial.ly/5fbd6eaa3646b80d18b1488e?idSlide=c90ec5b0-0b85-470e-a78f-293b9319366f>

References and additional resources:

- The project website where the game can be accessed: <https://ekoeksperymentarium.pl/>

Gra Z Klimatem 2.0

Gra z Klimatem 2.0 is an online game for group of players. In this game, first you have to moderate the group, then you can start playing. The game is about interacting with other players who co-create the society that inhabits the island. To play this game there is needed



at least 5 people and someone who will moderate the game for the group. Players can use computers or tablets to play. The game is free of charge. It was prepared for kids, however adults can play it as well.

Table 7. Gra z Klimatem 2.0 - main characteristics.

Theme	The inhabitants of the island have to face problems related to the development of the island and the cutting down of forests for this development. An important issue is the decisions of fellow inhabitants, which affect the fate of the entire island and all its inhabitants. The game does not reflect the real climate-changing processes, but it shows analogies, so it allows you to understand their causes.
Setting	The setting is an island where inhabitants built society and cut down forests for the development of civilization.
Player's role(s)	There is needed a moderator who sets the game and a group of players, at least 5. Each player is an inhabitant who cares for its own life and business.

Game objective	The goal is to survive as long as possible on the island, which will continue to be a source of income for the inhabitants in the future. Each of the inhabitants can build buildings, harvest crops and cut down the forest. The whole group should speak to each other to avoid natural disasters caused by changes in the environment.
Gameplay	The inhabitants get possession of a forested island, on which they begin to build a civilization. They get rich through successive activities, but at the same time it brings social, economic, natural and individual effects, e.g. activities may cause more frequent hurricanes and floods. Sustainable management of the island is essential, while taking into account the interests of the inhabitants. An important issue is relations with neighbors in order to achieve a compromise between the wealth of the inhabitants and the well-being of the environment.
Interactions	Collaborative, conflict, leadership, competitive
Aesthetics	Graphics in 2D. Very simple, maybe even too much.
Target audience	Age 10+, pupils or students
Number of players	multi-player – at least 5 give the best effects; needed a moderator



Source: <https://zielonegry.crs.org.pl/gry/gra-z-klimatem/>

References and additional resources:

- The project website where the game can be accessed: <https://zielonegry.crs.org.pl/gry/gra-z-klimatem/>

Conclusions

Both games are online and concern the same topic of being more aware about ecological processes. First game (EkoEksperymentarium) is a single-player game with an easy access. Player can start the game at any time. Game has very simple rules and the player is constantly guided by a lector what should be done to observe the progress in the game. At the end, player can observe what actions lead to improving situation in the environment. The second game (Gra z Klimatem 2.0) is a multi-player game and there is also needed a moderator who will lead the game of the whole group. At the end of the game, group can discuss the actions taken and what were the effects of them. During the game there is a chat where a group can communicate and also moderator can give some advices.

First game is simpler and is more suitable for younger kids. The second game gives a chance to work in a group so there are needed some social interactions. Both games cover the topic of climate change. In the first one, player can observe simple everyday situations and how those influence the environment changes. The second one, shows the implications of the whole society life and the consequences of social and economic decisions.

Both games can be used as an intergenerational, however the second one is quite complicated and it can be too difficult to understand in the beginning. It requires someone who will explain the rules and show how to play. On the other hand, first one can be too simple to older people and quite boring because there are no interactions. The best solution would be a game that uses the experience of both described games - a simple interface and rules of the game using interaction with other players.

3.4. Portugal

Over the last few years, the video game industry in Portugal has become professionalised, national projects have become truly entrepreneurial, and the quality of human resources attracts international investment (Ferreira, 2022).

Serious video games have been steadily increasing in Portugal, representing the majority of the turnover for about 14% of companies and 21% of individual creators. Since 2016, 46 Serious Games have been produced in Portugal, 31 of which by individual creators and the rest by companies. The importance of Serious Games has increased for companies, now representing 15% of the games produced in Portugal and increasing the number of companies involved in creating and developing this type of game. The areas in which Serious Games have been developed have also been diversifying. The companies that produce this type of game produce about half (46%) in the area of education/training (Romeiro, 2020). However, these games are developed in areas as diverse as defence, health, simulation, engineering, and politics (Dias, 2015).

Progressively, educational games have been integrated into Portuguese schools, with programmes already covering around 27 thousand students. There are new national projects oriented to mathematics, Portuguese, and history curricula (Tavares, 2016). In parallel, several resources have been developed in the medical field to support patients in their

recovery processes, help doctors prepare surgeries, promote general well-being, and help patients with mental disorders (Dias, 2015).

AquaQuiz

Aquaquiz is an interactive and educational game comprising questions about water, its characteristics and value regarding different dimensions. The questions have different difficulty levels and are divided into four categories: Water Factories, Blue Planet, Aqua Lab, and Efficient Use. The game is access-free, but players need to register online. It is intended for young students in the second and third cycles but can also be played with family and friends.

In a school environment, the game is available in virtual board format, to be played online on a computer or tablet in sessions organised by teachers in the classroom, integrating the student's education in a playful environment.

In a family environment, young people can count on family members and friends to join in this healthy competition regarding water knowledge. In this context, they can play on the virtual board or carry out "Battles" with a virtual connection between participants.

The Battle version can be played on a computer, tablet, or smartphone. The Board Game can be played on a computer, tablet or smartphone with family and friends face-to-face or in the remote version, where all participants play remotely.

Table 8. AquaQuiz - main characteristics.

Theme	The main focus of the game is water knowledge regarding its characteristics and value.
Setting	Mirrors a board game. However, the circuit is infinite, and there is no finishing place because the end of the game is controlled by playing time (10 minutes).
Player's role(s)	The player answers the questions to advance on the board, or in the "battle" version, answers the questions to defeat the opponent.
Game objective	At the end of the game (games/"battles"), the player will have developed their knowledge on the topic. However, there may be another more macro objective, as teachers and schools can compete in a competition, creating a kind of "Olympics of knowledge" on water.
Gameplay	Each participant has 45 seconds to answer each question. It is not possible to stop the answer time, eliminate answer options or change questions or categories. The correct answer is always presented at the end (after the player's answer or when the time limit is reached). Board Game Version Each participant answers and then passes the turn to the next player (either if the answer is right or wrong). Participants score for each correct answer, and those who complete in the first 3 places receive additional points at the end of the game. The players' list indicates the scores and total time played by each participant. In

	<p>the event of a tie score, the time played determines the winner (the fastest player wins). The round in progress, when the 10 minutes of play are up, is always played until the end (until all participants complete it).</p> <p>Battle Version</p> <p>It is a quiz duel between 2 players, where they take turns answering the same series of 10 questions. Students from grades 5 to 9 can play against classmates in the same years or challenge participants registered with the profile "Other". These participants, who are not students, can play against any player. When creating the Battle, it is possible to choose a specific participant or a mystery player. Who creates the Battle is the first one to answer the quiz. If both players answer the same number of questions correctly, the tiebreaker is based on the time needed to answer. This information is shown on the final Battle Results screen. Only the winner of the Battle receives a score.</p>
Interactions	Competitive
Aesthetics	Board-game style, 2D graphics. No music only interactive sound effects depending on the player's input.
Target audience	10 to 15 years (students from the 5th to 9th grade)
Number of players	single-player / multi-player



REGRAS DO JOGO

MODOS DE JOGO

O Aquaquiz pode ser jogado no computador, tablet ou smartphone. Está disponível online e permite participar em modo **JOGO DE TABULEIRO** ou **BATALHA**.



PERFIS DE ACESSO

Podem participar no Aquaquiz, mediante registo:

- **PROFESSORES** (docentes do 2º e 3º Ciclos)
- **ALUNOS** (estudantes do 2º e 3º Ciclos)
- **OUTROS** (estudantes de outras anos de escolaridade, familiares, outros (os) jogadores(as) interessados(as)).

Quem pode criar Jogos de Tabuleiro? Todos os participantes.
 Quem pode jogar no tabuleiro? Alunos e outros jogadores.
 Quem pode jogar Batalha? Alunos e outros jogadores.

JOGAR EM MODO TABULEIRO

Podem-se optar por disputar o jogo de tabuleiro em conjunto, no mesmo equipamento, ou então podem jogar separados, cada jogador/a a partir do seu computador, tablet ou smartphone.

JOGOS JUNTOS, o/a jogador/a cria o novo jogo e, no mesmo equipamento, todos os restantes participantes indicam a sua password para poderem iniciar.

Em sala de aula, o/a professor/a pode criar os jogos ou até prepará-los com antecédentes, dividir a turma em grupos de 2 a 5 pessoas e lançar o desafio aos/as alunos/as (um jogo de tabuleiro clássico, no máximo, 10 minutos).

A DISTÂNCIA, o/a jogador/a cria o novo jogo e copia o link para o computador ou outros participantes. Cada um dos/ das jogadores/as abre esse link, introduz a sua password no equipamento que vai ter a usar e seleciona o pad. A pessoa que cria o link é quem inicia o jogo, depois de todos os outros participantes estarem registados.



O TABULEIRO DE JOGO

CIRCUNTA infinito, não há uma casa de chegada porque o fim do período é controlado por tempo de jogo (10 minutos).

PARTICIPANTES: mínimo 2, máximo 5.

SEQUÊNCIA DE JOGO: definida pela ordem de inscrição dos participantes, que respondem à vez.

REGRAS: qualitativas, para garantir que cada participante responde ao mesmo número de perguntas que os seus adversários ainda que o tempo de jogo termine.



CRIAÇÃO DE JOGOS PELOS/AS DOCENTES

A opção **JOGAR TABULEIRO** disponibiliza um novo jogo que fica logo disponível para ser iniciado (presencialmente pelos) os estudantes no computador ou tablet e/ou game.

A alternativa de **PREPARAR TABULEIRO** permite criar partidas em que agrupo de jogadores em conjuntos de 2 a 5 participantes, e que ficam guardadas para que os participantes as possam iniciar mais tarde, quando cada grupo se junte presencialmente para jogar.

INICIAR O JOGO DE TABULEIRO

Para se poder dar início ao jogo, cada participante que vai disputar essa partida tem de, individualmente:

- Introduzir o seu nome;
- Seleccionar um dos pedes disponíveis.

Quando todos os jogadores tiverem feito login e escolhido o seu peão é possível **INICIAR O JOGO**.

CATEGORIAS

O tabuleiro tem duas opções distintas para as 4 categorias de perguntas e ainda duas opções, em que o/a participante pode escolher a categoria a que pretende responder.

DIFICULDADE

As perguntas têm sempre 3 níveis de dificuldade e cada participante escolhe o nível a que pretende dar resposta. As mais difíceis permitem obter mais pontos, em caso de resposta correcta.

RESPOSTAS

Cada participante tem 30 segundos para responder. Não é possível parar o tempo de resposta, só clicar opções de resposta ou trocar de pergunta ou categoria.

No final é sempre apresentado a resposta correcta (caso resposta do jogador ou quando é atingido o tempo limite).

RONDAS E PONTUAÇÃO NO JOGO DE TABULEIRO

Cada participante responde e passa a vez ao próximo, caso acerte ou erre a resposta.

No final do jogo, os/as participantes pontuam por cada resposta correcta e os que completarem nos 3 primeiros lugares recebem pontuação adicional.

As pontuações e o tempo total jogado de cada participante está indicado na lista de jogadores/as.

Em caso de empate na pontuação, é o tempo de jogo que determina o/a vencedor/a (vence quem toma o mais vezes).

A ronda que estiver a decorrer quando se atingem os 10 minutos de jogo é sempre jogada até ao fim (caso ser completada por todos os/as participantes).

O MODO BATALHA

Um duelo de quiz entre 2 jogadores, em que respondem à vez a mesma série de 10 questões.

Estudantes do 5º ao 6º ano de escolaridade podem jogar com colegas que frequentam o mesmo ciclo, ou escolher participantes que se encontram inscritos com o perfil Quiz. Estes participantes, que não correspondem a estudantes do 5º ao 6º ano, podem deslamar qualquer jogador.

Ac prior o sistema é possível escolher um/a participante em concreto, procurando-o/a pelo seu username ou optar pelo sorteio de um/a jogador/a misterio. Quem cria a Batalha é quem começa por responder ao quiz.

Caso ambos/as respondam correctamente ao mesmo número de perguntas, o desempate é feito pelo tempo de resposta para responder correctamente. Esta informação é apresentada no ecrã final de resultados da batalha como 'Tempo gasto'.

Apenas recebe pontuação o/a vencedor/a da Batalha.

SOS Terra

The SOS Terra game has arrived at the Portuguese Virtual School and are integrated into all subjects from the 3rd to the 6th grade. The students will be the protagonists of this adventure. The aim is to make the teaching-learning process a more motivating and exciting experience.

The world has been devastated, and climate change has put all living species at risk. A group of scientists and NGOs have built biodomes with the aim of preserving the genetic information of all biodiversity. Through the analysis and mastery of certain information, their tribe has the mission to generate and conserve the energy needed to activate the life support of each of the biodomes located on every continent.

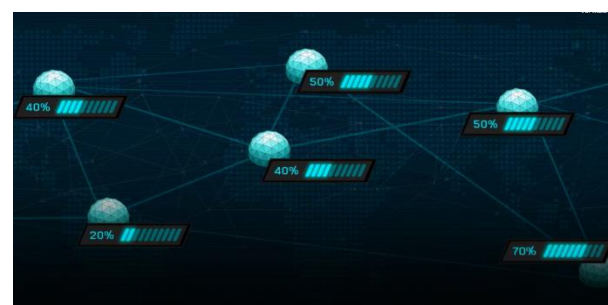
Table 9. SOS Terra - main characteristics.

Theme	General
Setting	Customisable 3D avatars and 2D educational content (e.g., question cards, rewards, etc.).
Player's role(s)	Each student has their own character who can collaborate with other players to achieve common goals.
Game objective	The main goal is for student to save the planet earth. The aim of the game for students is through analysis and mastery of certain information, together with their classmates, to generate and conserve the energy needed to activate the life support of each of the biomaterials located on every continent.
Gameplay	Through gamification of the subjects (corresponding to the school years from 3rd to 6th grade), teachers can monitor student's progress, cooperation and collaboration and award prizes and rewards. Each theme consists of a mission that students must complete to earn rewards. They gain energy by reviewing curriculum concepts and answering the multimedia questions in each mission to activate biodomes that will allow them to save planet Earth from extinction. Each student has an avatar that they can customise to their liking. Professors can assign specific rewards to each student to encourage and motivate learning. They can organise their students into different teams (tribes) and create a capsule with special prizes for the tribe, which students can achieve together by donating part of their rewards. The goal is to encourage teamwork and collaborative learning.
Interactions	Cooperation and collaboration
Aesthetics	Graphics 2D/3D, surrounding and background music
Target audience	8 to 11 years (students from the 3rd to 6th grade)
Number of players	Single-player with collaboration with other players

Environment

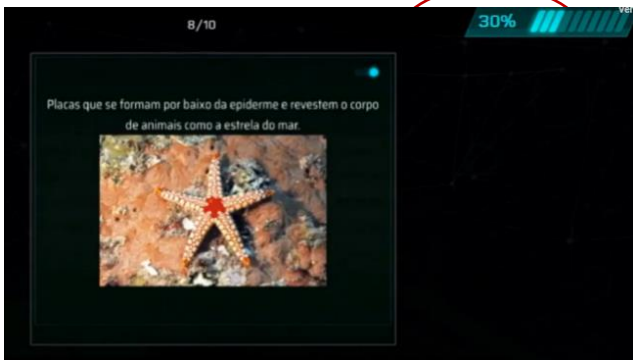


Biodomes - Percentage of energy (that the players accumulate by reviewing the subject/answering questions/solving problems related to the subjects taught).





As players study and answer questions/solve problems, they generate energy to save the planet.



Ativa os biodomos



Source: <https://www.escolavirtual.pt/Projetos-EV/sosterra.htm>

References and additional resources:

- Dias, J. (2015). Jogos Sérios para a Saúde. Dissertação de Mestrado em Novos Media e Práticas Web –FCSH
<https://run.unl.pt/bitstream/10362/14923/1/Serious%20Games%20For%20Health%20-%20Miguel%20Dias%20-%20Mar2015.pdf>
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<https://www.dn.pt/portugal/ministerio-poe-alunos-a-aprender-com-videojogos-5119713.html>

Conclusions

We had difficulties finding serious games of Portuguese authorship developed for both target populations of our initiative already existing in Portugal. In this sense, we presented two games designed with younger populations in mind. Both games encompass the climate change theme, and more directly or indirectly, they try to transmit information to the target audience by testing their knowledge. The AquaQuiz focuses solely on the water dimension, its characteristics, how to preserve it and its value as a resource. The SOS Terra addresses the issue of climate change more indirectly while encouraging students to study different themes.

Regarding the accessibility of the games, we can see that AquaQuiz is quite easy to access, being available online on any device (i.e., computer, tablet, or smartphone). It is only necessary to create a simple profile with an e-mail account. However, SOS Terra is only available on the EscolaVirtual platform, requiring children to be students, to have an account on the platform, and their teachers/schools to purchase the game online, requiring subsequent access codes.

One common point between the two games is related to their structure. They are based on a system of questions, in which the player, by getting it right, advances/progresses in the game or gains points to be able to unlock other stages of the game. The games presented are primarily single-player games. However, AquaQuiz can be played in a battle mode challenging other players or in a board game mode with colleagues/ friends or family. While in SOS Terra, each player plays their own role but works (in part) towards common goals with their classmates.

AquaQuiz is a game with much more straightforward rules, while SOS Terra presents more components, different objectives, and tasks in which the player can enrol. Even though this last one entails a more social interaction approach, both games were designed to target younger audiences rather than with an intergenerational approach in mind. Bearing in mind that our objective is to involve different generations, it becomes relevant to understand how age differences could be utilized as an interactive component of the game and consider how

the expertise of each generation can be used to sustain mutual engagement and allow the two age groups to support each other (Zhang & Kaufman, 2016).

3.5. Turkey

Various steps have been taken to expand the place of digital games in the market in Turkey and to train professionals in this field in parallel with the sectoral development in the production process. Digital games are included in Turkey's 11th Development Plan. In the plan, In E-commerce and digital gaming the sector, there are activities aimed at increasing the number of entrepreneurs and increasing their share in foreign markets.

E-Climate Game Project

The overall aim of the game is to prepare primary school children to be climate literate. With the game, the awareness of children and other segments of society is expected to increase in the fight against climate change. Climate change education aims to understand the basic principles in this field, to realize the effects of the crisis, to be informed about what the measures (energy saving, water saving, carbon footprint reduction, cycling, strengthening green space systems, safe waste management, etc.) will be, and to take conscious behaviours for action.

An "e-learning game (fight against climate crisis game)" will be prepared, offering tips for children to learn more efficiently and quickly by looking at the fight against climate change from many perspectives. Awareness will be increased through the scenarios constructed in the game.

The prepared climate change combat game is designed for mobile devices in three dimensions. There is a character selection screen on the first opening screen of the game. This screen has two three-dimensional characters: a girl and a boy. The created mobile game consists of 3 scenarios. These scenarios are in a structure that children can understand the basic principles of climate change. The scenarios discussed topics such as energy saving, recycling and waste management.

The game's informative texts, images and directions are designed according to the target audience. The game also features informative texts before each interactive scene. Children can replay any scenario anytime by clicking the sections button on the game's main page.

In the E-Climate Game:

- The messages in the game do not allow for negative communication.
- The game does not include actions that may lead children to despair.
- The play takes place with scenarios where children can add their positive energies, be an active part of the measures to be taken against the climate crisis, and take on roles that make them the subject, not the object, of the issue.
- The study is designed as one of the essential parts of starting children's access to quality education about the climate crisis.

Table 10. E-Climate Game Project - main characteristics.

Theme	General topics include energy saving, recycling and waste management
Setting	Mobile devices
Player's role(s)	There is a character selection screen on the first opening screen of the game. This screen has two three-dimensional characters: a girl and a boy.
Game objective	Preparation of primary school children to be climate literate
Gameplay	Three scenarios in the mobile game were made. The way these situations are set up makes it easy for kids to understand the basic ideas behind climate change.
Interactions	Competitive
Aesthetics	It is designed in a ready-made game engine with Unity3D technology.
Target audience	Main target individuals aged 7 and over living in Gaziantep
Number of players	Single-Player





References and additional resources:

- Ömer Faruk Eriş. (2022, July 19). Gaziantep - E-İklim Oyunu Projesi. AKILLI ŞEHİRLER. <https://www.akillisehirler.gov.tr/proje-envanteri/gaziantep-e-iklim-oyunu-projesi/>
- Gaziantep Büyükşehir Belediyesi E-İklim oyununu inceliyoruz. (n.d.). Www.youtube.com. Retrieved March 27, 2023, from <https://www.youtube.com/watch?v=x3LzMrdsfQ>

Climate Change Adaptation and Mitigation Game Project for Big Cities

It is aimed at informing the younger generations about the consequences of climate change and providing information about successful mitigation and adaptation actions. The target of

this project, which will determine the activities that can be done to minimize the effects of climate change in environmental conditions and turn them into a game, is high school and university students. The game, which will be developed under CAMAPOLI, can be played on tablets and computers. The game aims to teach young people to create a cleaner environment with visual entertainment that uses cause-and-effect relationships.

Table 11. Climate Change Adaptation and Mitigation Game Project for Big Cities- main characteristics.

Theme	General
Setting	tablets and computers
Player's role(s)	Choosing the character
Game objective	Informing young generations about the consequences of climate change and providing information about successful mitigation and adaptation actions
Gameplay	Scenarios
Interactions	Competitive
Aesthetics	Graphics (2D/3D),
Target audience	high school and university students
Number of players	single-player



References and additional resources:

- Camapoli Gamification. (n.d.). Www.youtube.com. Retrieved March 27, 2023, from <https://www.youtube.com/watch?v=R5NzBJSxMQk>
- Büyük Şehirler için İklim Değişikliği Uyum ve Azaltma Oyunu Projesi. (n.d.). Www.iklimin.org. Retrieved March 27, 2023, from <https://www.iklimin.org/tr/hibe%20projeleri/buyuk-sehirler-icin-iklim-degisikligi-uyum-ve-azaltma-oyunu-projesi/>

Conclusions

The games mentioned above aim to increase the knowledge level of the players and change the behavior by producing a scenario on the common phenomenon climate change. The fact that the scenario in the games is oriented to the needs of the target group and that the level of knowledge on which subjects is increased can be counted among the success factors. All of the games provide information on climate change and use cause-and-effect relationships. Both of game are suitable for intergenerational play when scenario change in line with the needs of target group.

3.6. World

Digital intergenerational games aim to bring people of different ages together to learn and have fun therefore promoting social interaction, knowledge sharing, and understanding between different generations. Unfortunately the availability of such games is quite sparse as it is not easy to design such a game that motivates and attracts different generations. It is particularly difficult to find such games when the focus is to raise the awareness about environmental challenges, to engage players in exploring the complexities of climate change and the potential solutions to address it and to foster the change of life habits. So, although there are many games for this purpose varying in format and style, from simulation games to puzzle games, they were not designed to be intergenerational. But multiplayer games can use that feature to support intergenerational play.

The following examples of digital intergenerational games and games on climate change demonstrate nevertheless that these are important tools for promoting learning and dialogue around critical issues facing society today.

Plasticity

Plasticity is a puzzle-platformer game about a plastic-ridden world (Earth in 2140) and the choices the player makes to save it. Users play as Noa, a curious young girl who leaves her home in search of a better life and embark on an emotional journey as their actions dynamically change both gameplay and the story. While each decision carries consequence, few are irreversible—you may stumble, you may fall, but only you can save the world.

Table 12. Plasticity - main characteristics.

Theme	Overconsumption of plastic products
Setting	Computers with Windows OS

Player's role(s)	Users play as Noa, a curious young girl who leaves her home in search of a better life and embark on an emotional journey as their actions dynamically change both gameplay and the story.
Game objective	To make players realize the dangers of overconsumption of plastic.
Gameplay	Plasticity is a puzzle-platformer game, with the usual game mechanics for this type of games.
Interactions	Competitive
Aesthetics	3D environment of a decrepyt, plastic-ridden world that may turn green following the actions of the player.
Target audience	Children and teenagers
Number of players	Single-Player





References and additional resources:

- Free download: <https://store.steampowered.com/app/1069360/Plasticity/>
- Website: <https://plasticitygame.wixsite.com/about>

Eco

Eco is an online world from Strange Loop Games where players must build a civilization using resources from an ecosystem that can be damaged and destroyed. Eco is a fully simulated ecosystem bustling with thousands of growing plants and animals living their lives. Players harvest, take resources from the environment, construct buildings and towns, tend the farm, hunt wildlife, build infrastructure and transportation, craft clothing, build power plants, and research new technologies. They specialize in a craft and trade goods to other players. Players develop a civilization and sculpt a planet in a reactive manner so whatever a player does in the world it affects the underlying ecosystem.

Table 13. Eco game – main characteristics.

Theme	Environmental challenges
Setting	Computers with Windows OS
Player's role(s)	Develop his/her environment while keeping the ecosystem balanced.
Game objective	Informing about the interdependence of the different factors in an ecosystem.
Gameplay	Eco is a strategy type of game where players have to collect resources to build elements that allow to research new skills and ways of production of resources.
Interactions	Collecting resources, crafting tools and objects, developing skills, communicating and trading with other players.
Aesthetics	3D World with a Minecraft approach.

Target audience	Late teenagers and university students
Number of players	Preferably multi-player (can be played single-player)



References and additional resources:

- Website: <https://play.eco/>
- Game wiki: https://wiki.play.eco/en/Eco_Wiki
- Download: <https://store.steampowered.com/app/382310/Eco/>

Terra Nil

Terra Nil is a reverse city builder about ecosystem reconstruction. In the game, the player transforms a barren, lifeless landscape into a thriving, vibrant ecosystem. He/she turns dead soil into fertile grassland, clean polluted oceans, plant sprawling forests, and creates the ideal habitat for animals to call home. Then recycles the buildings and leaves no trace of presence. The player uses advanced eco-technology to purify the soil, creating plains, wetlands, beaches, rainforests, wildflowers, and more—then efficiently recycle everything that was built, leaving the environment pristine for its new animal inhabitants. Procedurally generated landscapes mean no two playthroughs of Terra Nil will ever be the same. Plan and play around randomized, challenging, and unpredictable terrain, including snaking rivers, mountains, lowlands, and oceans. Each region of Terra Nil progresses through phases, with the ultimate goal being leaving pristine wilderness behind. Levels are not about infinite growth, but rather balancing and nurturing the environment before leaving it in peace. Lush hand-painted environments, relaxing music, and an atmospheric ambient soundscape make Terra Nil a peaceful, meditative experience. Players can use the Appreciate mode to bask in the natural beauty of the ecosystem that was restored.

Table 14. Terra Nil - main characteristics.

Theme	Sustainable ecosystems development
Setting	Windows OS
Player's role(s)	In the game, the player transforms a barren, lifeless landscape into a thriving, vibrant ecosystem. He/she turns dead soil into fertile grassland, clean polluted oceans, plant sprawling forests, and creates the ideal habitat for animals to call home. Then recycles the buildings and leaves no trace of presence.
Game objective	To make players aware of sustainable development.
Gameplay	Turn-based strategy game.
Interactions	Competitive
Aesthetics	2.5D visual approach with a map of the environment.
Target audience	Children and teenagers
Number of players	Single-Player



References and additional resources:

- Download the game: https://store.steampowered.com/app/1593030/Terra_Nil/
- Website: <https://www.terrnil.com/>

Working with Water

Working with Water is a turn-based strategy web game helping teach students about developing and maintaining a sustainable water supply system. The game takes place in the Central Coast of New South Wales, Australia, where the need for clean drinking water increases as the community grows, and the player is responsible for building new infrastructures to meet the increased demand.

Working with Water draws on inquiry-based learning, it aims to help students develop their problem solving skills and exercise high-order thinking. Players are presented with Challenges such as drought, or algae blooms that threaten the Central Coast water management system. Players must complete Projects like maintenance, or building infrastructure to overcome the challenges and maintain a sustainable flow of clean drinking water. Each Challenge and Project was targeted at a specific learning outcome.

Table 15. Working with Water - main characteristics.

Theme	Water management
Setting	Web-based (with Unity plugin)
Player's role(s)	In Working with Water, water management infrastructure like dams and weirs, and population centres such as towns are visible and larger than life entities. This helps the player relate to the local areas that they are familiar with, while still providing clear visibility of key elements.
Game objective	To make players realize the dangers of water scarcity.
Gameplay	Turn-based strategy game.
Interactions	Competitive
Aesthetics	2.5D visual approach with a map of the environment.
Target audience	Children and teenagers
Number of players	Single-Player



References and additional resources:

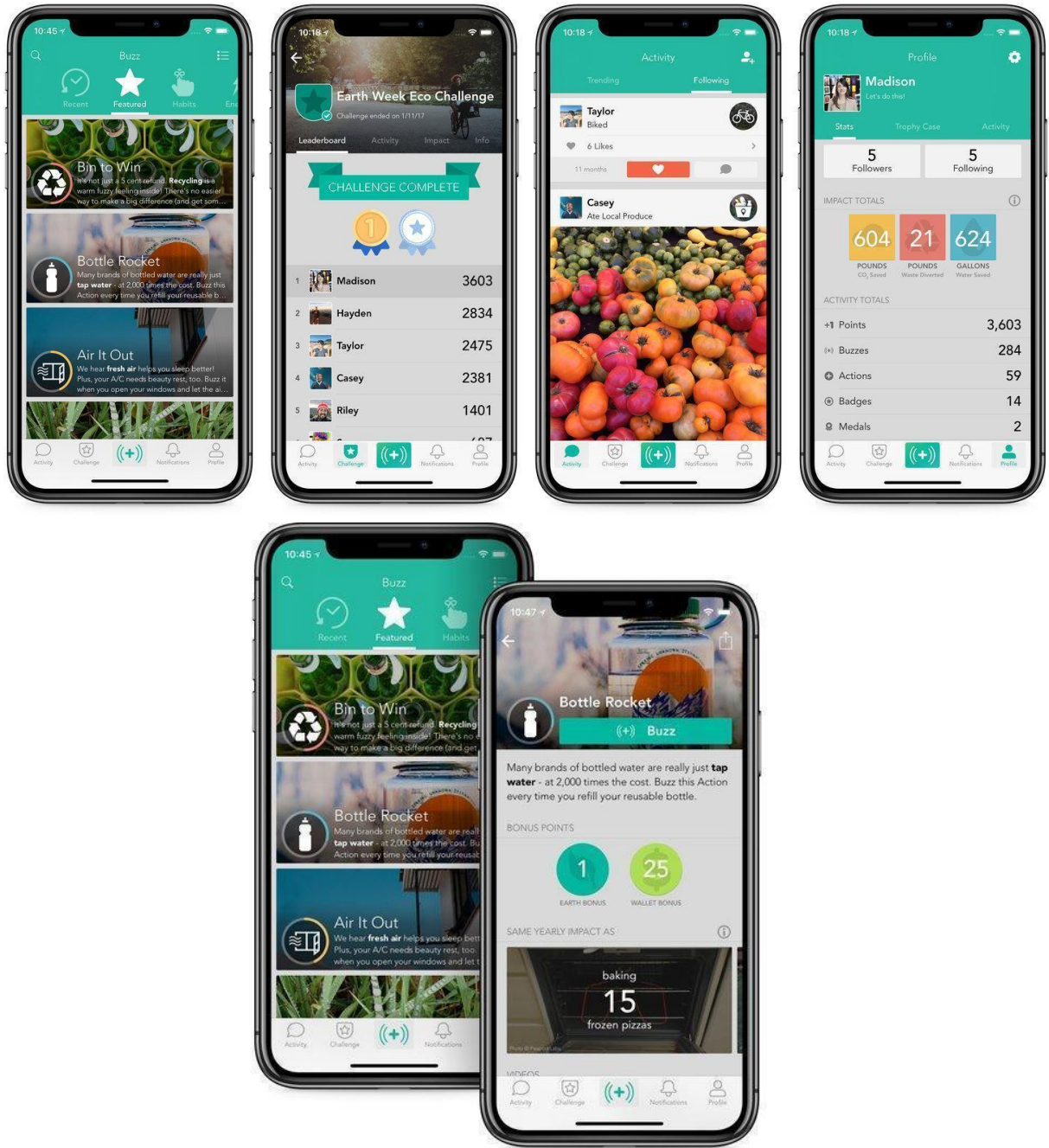
- Play the game: <https://chaostheorygames-dev.s3.amazonaws.com/working-with-water/index.html>
- Website: <https://www.chaostheorygames.com/work/working-with-water>

JouleBug

JouleBug is a gamified app to make everyday habits more sustainable, at home, work, and play. JouleBug organizes sustainability tips into Actions that the player adds to the app in real-life. Users can join local Communities for the latest sustainable news, limited-edition Actions and Badges, plus get access to local Challenges. Players can also track the impact with career stats and fill the Trophy Case.

Table 16. JouleBug - main characteristics.

Theme	Sustainable life habits
Setting	Mobile OSes
Player's role(s)	Players compete with friends, relatives and neighbors to be the most sustainable user.
Game objective	To make players become aware of sustainability challenges.
Gameplay	Gamified app where the player has to complete missions and challenges
Interactions	Competitive
Aesthetics	2D UI with a green approach
Target audience	Intergenerational
Number of players	Single-Player with interactions with other players



References and additional resources:

- Download the game: https://joulebug.com/download/?_branch_match_id=1059565980453156112&_branch_referrer=H4sIAAAAAAAAAA8soKSkottLXz8ovzUINKk3XSywo0MvJzMvWT8kvz8vJT0wBAJ0dEb8IAAAA
- Website: <https://joulebug.com/about/>

GoBeEco

GoBeEco is a gamified web app, which is available in four languages (English, German, Portuguese, Polish). The main goal of GoBeEco Gamification is to encourage adult learners to change their lifestyles to eco-friendly ones. With the gamification users can not only learn what can be done to help the environment on a global scale but also get immediate hints and instructions on what they personally can do here and now and get feedback on their progress. In this game, the player can find 5 doable (but challenging!) missions that address his daily habits and behaviours: in public space (4 challenges, 14 tasks); at home (5 challenges, 28 tasks); when we buy and consume (4 challenges, 18 tasks); at work: Mission (4 challenges, 17 tasks); when we move (4 challenges, 23 tasks). The entire gamification includes a total of 100 tasks, which have different levels of difficulty, where the user can score a different number of points for completing them. In addition, after completing each mission, the player gains access to a short quiz where he can test his eco knowledge.

Although it was designed for adult learners, this gamification is an excellent example of an intergenerational game, as it is perfectly suitable for young people, due to the appealing language and dynamic missions.

Table 17. Gobeeco - main characteristics.

Theme	Adoption of eco-friendly habits
Setting	Web-based application
Player's role(s)	Players have to complete tasks to score and unlock new missions.
Game objective	To make players aware of the importance of adopting more eco-friendly habits in their daily lives.
Gameplay	Gamified web app where the player has to complete missions and challenges
Interactions	Challenging
Aesthetics	2D UI with a green approach
Target audience	Intergenerational
Number of players	Single-Player



[← Back to mission](#)



Challenge

The Way You Move

175 Bonus points

About challenge

Change the way you move around, look for an alternative to a car and discover the advantages of public transport, car sharing, bicycle, scooter or walking.

Tasks 0%

Easy - **Medium** - Hard

10 000 small steps

25

Short riddle: What simultaneously lowers blood pressure, balances glucose levels, reduces stress and body weight, and reduces CO2 emissions to the atmosphere? The...

Easy - Medium - **Hard**

A date on a scooter

50

Are you dreaming of an electric scooter but it is too expensive? You can make this dream come true because you can afford it - in a big city. Rent a city scooter or a city bike an...

Easy - **Medium** - Hard

Gather your local squad

25

Driving a car alone is boring, right? Everyday's way to work can become pretty mundane. There is nobody to talk to and it doesn't feel good to sing your favorite song by yoursel...

Easy - **Medium** - Hard

Bla bla in the car

25

Do you like chatting in the car? Have a look <https://www.blablacar.co.uk/> If you are going on a longer journey, create an account on the BlaBlaCar website and be prepared to...

Easy - Medium - **Hard**

Stinky winky in the traffic jam

50

You say you don't like public transport because it smells bad sometimes? Warm, nice and comfortable in your own car? And are you aware that your car also smells bad - it...

[Privacy policy](#) [FAQ](#)

EN - PL - DE - PT



0 pts  

EN - PL - DE - PT



Mission 3

Getting and using consumer goods



Badge
The Master of Sustainable Goods
for completing the mission

0%

About mission

You'll learn how to make better buying choices and reduce the pollution and waste caused by consumer goods - from food to house supplies.

Challenges



To Buy, Not to Buy or What to Buy: That's the Question!
0 pts



We Are What We Eat. What do You Wanna Be?
0 pts



You vs Pollution - Let's Win the Battle!
0 pts



Let's Turn You Into a No Waste Specialist!
0 pts

Final Quiz

Complete all challenges to take final quiz

[Privacy policy](#) [FAQ](#)

EN - PL - DE - PT

References and additional resources:

- Play the game: <https://game.gobeeco.eu/>
- Website: <https://www.gobeeco.eu/>

4. Conclusions

Serious games are designed with a primary focus on education instead of mere entertainment. In the context of climate games, these educational tools aim to address topics related to climate change. These games typically adopt a goal-oriented approach for learning and assign various roles to players across different system levels, ranging from individuals to the global stage. The primary emphasis in most climate games is on mitigating climate change rather than adapting to it. Public institutions and individuals are often the central actors in these games, and a significant number of climate games involve multiplayer experiences that combine elements of competition and collaboration.

The effectiveness of a serious game in achieving its educational objectives while still being engaging for users depends on several key factors. These include engagement, feedback and assessment, motivation, and collaboration. In the case of intergenerational games accessibility, relevance, and social interaction become essential. Older adults often appreciate games for their potential to provide mental stimulation, social connections, and collaborative experiences while avoiding reflex-oriented games that they may find too complex or unsuitable due to age-related limitations.

For intergenerational games to be successful, it is important to cater to the preferences of both children and older adults. Developers should prioritize children's interests while also incorporating shared motivational factors such as social interaction, fun, relaxation, and escapism. Addressing the unique needs and challenges of both age groups, intergenerational games should offer a user-friendly interface, easy accessibility, uncomplicated gameplay, and clear instructions.

Considering age-related limitations, intergenerational games should feature shorter sessions that are easy to start and exit, with an educational component that supports the distinct roles of both age groups while taking into account various motivational and contextual factors. Short, chance-based games with engaging themes and characters are more likely to succeed among the target audience, as are collaborative digital games that promote positive interdependence and facilitate social interaction between generations.

However, as analysis of game examples available in partner countries showed, finding climate games that meet all these criteria can be challenging. Some of the obstacles faced in developing such games include striking a balance between dynamic, action-oriented and strategy games (so as to appeal to both young and older players), ensuring the longevity and sustainability of serious games, and incorporating cooperative or multiplayer modes in simpler games suitable for younger players. Despite these challenges, there are certain elements that can inspire the creation of successful intergenerational climate games.

For instance, integrating knowledge into gameplay (as opposed to relying on external informational documents) and incorporating cause-and-effect relationships can help provide immediate feedback and assessment. Furthermore, tutorials or a gradual increase in difficulty that adheres to the "easy to learn, hard to master" principle (e.g., as seen in games like *Espéride*, *Cleanopolis*, and *EkoEksperimentatorium*) can contribute to the success of an intergenerational climate game. By focusing on these key elements, developers can create engaging and effective serious games that cater to a diverse audience and promote learning about crucial topics such as climate change.

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