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Gamification and sustainability education: exploring psycho-educational dynamics with Play It Cool

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ABSTRACT

This paper introduces *Play It Cool*, a gamified digital learning platform designed to foster pro-environmental awareness and engagement within the broader context of sustainability education. Grounded in Self-Determination Theory (SDT), the platform incorporates game elements (e.g., storytelling, progress bars, interactive mini-games, points, badges, real-life scenarios, community challenges) to support learners' needs for autonomy, competence, and relatedness. *Play It Cool* represents a structured gamified experience that embeds sustainability concepts into interactive learning tasks and real-life challenges. The aim is to provide a structured, theoretically grounded overview of the psycho-educational processes through the gamified platform learning *Play It Cool*. The platform adopts a holistic approach aimed at exploring motivation and sustained engagement in environmental education. By providing a clear conceptual framework, *Play It Cool* offers a foundation for future research on the psychological and pedagogical mechanisms underlying gamified approaches to sustainability learning.

Keywords: *Gamified learning; digital game-based learning; Self Determination Theory; environmental education.*

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Introduction

The planet is currently facing a climate crisis that threatens the essential balances for human societies and biodiversity (Poushter & Huang, 2019; IPCC, 2014). Human behaviors have been identified as a direct cause of this emergency, and a transition to a climate-neutral society requires widespread individual and collective engagement (van Valkengoed & Steg, 2019). In this context, sustainability education plays a crucial role in fostering the knowledge, attitudes, and behaviors needed for both personal and collective pro-environmental action (Sailer & Homner, 2020; Patricio et al., 2020). Innovative approaches, such as gamified learning, have shown promise in promoting cognitive, motivational, and behavioral change, as well as collaborative skills and collective agency, which are essential for achieving meaningful societal transformation (Douglas & Brauer, 2021; Sailer & Homner, 2020; Patricio et al., 2020). In particular, gamification and game-based learning have been successfully adopted by a growing number of projects in the context of sustainability education (Douglas & Brauer, 2021; Sailer & Homner, 2020). In recent years, gamification, defined as the incorporation of game design principles and elements – such as points, badges, leaderboards, narratives, challenges, avatars, levels and feedback – into non-gaming context (Denden et al., 2022; Deterding et al., 2011), has become an increasingly prominent strategy to enhance user engagement, motivation, and learning (Deterding et al., 2011). It also aims to create an enjoyable and motivating environment that encourages people to take specific actions and sustain long term commitment (Sailer et al., 2017). Gamification has been used in different areas, such as marketing (Hamari, 2017), health (Jones et al., 2014) and education (Landers & Landers, 2014; Shi et al., 2014). Recently, a few studies have explored the integration of gamification with Game-Based Learning (GBL; Prensky, 2001) to enhance educational outcomes (Camacho-Sánchez et al., 2022; Fonseca et al., 2023). GBL refers to the use of games intentionally designed to achieve specific learning outcomes. The player's interaction with the game involves applying knowledge or skills to progress, thus enabling learning through experience and problem-solving (Prensky, 2001). Game-based learning (GBL) can be implemented through diverse formats, including simulations, quizzes, puzzles, memory tasks, interactive activities, strategic scenarios, and reality-based games (Dimitra et al., 2020), all of which have been shown to enhance learners' motivation, engagement, satisfaction, and academic achievement (Balakrishnan Nair, 2021; Dahalan et al., 2024; Oliveira et al., 2021; Roodt & Ryklief, 2019). Digital Game-Based Learning (DGBL) is an evolution of Game-Based Learning, with implementation of games on digital platforms, as learning tools (Prensky, 2005). In DGBL, the digital aspect introduces interactive and immersive experiences that can simulate real-world challenges and

environments (Prensky, 2005) implying full-fledged learning experiences embedded in game narratives (Becker, 2021). It offers students opportunities to experiment, make mistakes, and learn from their actions, making the learning process more fun and motivating (Denden et al., 2022; Deterding et al., 2011; Prensky, 2005). Gamification and GBL are two different game-related approaches that share several commonalities and have multidimensional relationships (Dahalan et al., 2024; Jayasinghe & Dharmaratne, 2013; Krath et al., 2021). Indeed, they share the main idea of “using positive gameful experiences for the sake of a serious purpose, for example, education or behavior change, rather than focusing on entertainment” (Krath et al., 2021, p. 2). Gamification is not necessarily focused on learning but it is applied in educational contexts through the use of game principles, aesthetics, strategic approaches, and design elements to enhance engagement and motivation (Dahalan et al., 2024; Kapp, 2012; Man, 2021), whereas the goal of GBL is to promote learning through the intentional use of full-featured games that facilitate experiential and participatory knowledge acquisition (Becker, 2021; Dahalan et al., 2024). Gamification and GBL, including DGBL, have been shown to significantly enhance learner motivation while also providing immersive environments that promote engagement and active learning (Camacho-Sánchez et al., 2022; Khan et al., 2017; Pesarese et al., 2016). The two approaches have also been represented by some authors as complementary and as positioned along a part-whole continuum rather than as opposing approaches to educational innovation (Hooshyar & Mirkhezri, 2020). According to previous research, the adoption of these approaches in the field of sustainability and environmental education can increase climate change engagement, which is not limited to understanding or recognizing the relevance of climate actions, but rather involves individuals’ cognitive, affective, and behavioral connection to climate issues (Fernández Galeote et al., 2021). Moreover, it can increase a sense of responsibility and urgency toward transformative social changes to achieve climate mitigation (Rajanen & Rajanen, 2019). Specifically, climate change engagement could be facilitated by several game characteristics including active experimentation, which allows players to test knowledge and make decisions in simulated scenarios, collecting badges and points; social interaction, through collaborative or multiplayer modes; visual representation and immersive simulations, which help players experience climate issues interactively; motivational, engaging experiences, which capture attention, foster immersion, and create a sense of flow (Fernández Galeote et al., 2021) and collaborative gamified experiences that can be more effective than individual and competitive activities (Sailer & Homner, 2020). These processes can foster a sense of collective efficacy, encouraging learners to consider not only personal but also shared environmental actions and civic

participation (Kranz et al., 2022), emphasizing individuals' perceived capacity to act and their belief in the group's ability to achieve shared environmental goals.

To explore the underlying psychological processes that may elucidate the efficacy of the inclusion of game-oriented techniques to enhance sustainability education, several scholars (Sailer et al., 2017; Sailer & Sailer, 2021; Zhao et al., 2021) have sought to employ Self-Determination Theory (SDT; Deci & Ryan, 2017; Ryan, 2023) as a theoretical framework. SDT (Deci & Ryan, 2017; Ryan, 2023) is a psychological theory that focuses on human motivation and posits the existence of three essential basic psychological needs – autonomy, competence, and relatedness – whose satisfaction is essential to foster autonomous motivation. Specifically, the need for autonomy refers to the sense of control and choice over actions; that in educational design could be provided learners with meaningful choices (Deci & Ryan, 2000; Martin et al., 2018; Sheldon & Filak, 2008) and opportunities for self-direction, thereby enhancing their sense of autonomy during learning (Martin et al., 2018). Supporting the need for competence in educational settings involves structuring tasks with clear expectations and providing timely, informative feedback (Deci & Ryan, 2000; Martin et al., 2018), to evolve the feeling of effectiveness and success while engaging in activities. In addition, the need for relatedness pertains to feelings of social connection and belonging with others, which in an educational design could be provided by promoting social interaction, collaboration, and a sense of belonging among learners (Martin et al., 2018; Niemiec & Ryan, 2009). Learning environments that facilitate cooperative activities and provide opportunities for peer feedback and shared goals can enhance learners' motivation (Martin et al., 2018). When these needs are fulfilled, individuals are more likely to experience autonomous motivation – that is, engaging in an activity out of genuine interest or personal value, rather than external pressure (Deci & Ryan, 2017; Ryan, 2023). Drawing upon SDT, several authors have proposed that gamified learning can facilitate the internalization of learning objectives. Research has demonstrated that the incorporation of game elements can effectively capture users' attention, motivate them toward achieving goals and enhance performance (Wee et al., 2019), especially when their basic psychological needs are met (Deterding, 2012; Li et al., 2024; Przybylski et al., 2010). For instance, Sailer and Sailer (2021) implemented a gamified quiz in a flipped classroom setting, and their results indicated that the inclusion of points and team leaderboards, as game design elements, contributed to an increase in students' autonomous motivation and need satisfaction (Sailer & Sailer, 2021). Another study (Zhao et al., 2021) implemented a gamified interactive e-book designed based on SDT, revealing a positive impact on students' motivation and performance.

In this article, we discuss “*Play It Cool*”, a gamified digital platform developed to explore the role of gamification in the educational and motivational processes described by Self-Determination Theory (Deci & Ryan, 2017; Ryan, 2023) within sustainability education. *Play It Cool* could be defined as an interactive educational experience that combines principles of gamification and DGBL (Becker, 2021; Deterding et al., 2011; Prensky, 2005). While it is not a fully immersive game, it integrates elements such as points, badges, and narrative-driven challenges to make learning about environmental issues and sustainability engaging and motivating. This approach could be embedded within a broader educational pathway to enhance learning of some knowledge, skills and attitudes (Becker, 2021) in sustainability education. Unlike fully open-ended DGBL experiences, the platform provides a learning experience in which mini-games constitute an integral part of the learning content, which can be considered as a form of DGBL. Indeed, as Deterding and colleagues (2011, p. 11) argued, the boundary between a game and an “artifact with game elements” is often blurry and it can involve subjective judgements and socially constructed meanings. Based on this premise, gamified learning activities, including a coherent set of gamification elements, might be perceived by (some) learners as games. Accordingly, while *Play It Cool* might not be considered in its entirety as a fully-fledged DGBL tool, it could be defined as a platform that incorporates, as part of a gamified learning experience, a variety of mini-games, including puzzles, quizzes, and hangman, that are designed as interactive learning tools reflecting the core principles of game-based learning. Overall, *Play It Cool* aims at enabling students to acquire knowledge and develop skills through a gameful design that enriches the online learning experience with both a series of mini-games and a set of gamification elements chosen and implemented according to the SDT framework.

Although gamification shows considerable promise, several studies have reported mixed results regarding its effectiveness in education (Dah et al., 2025; Van Roy & Zaman, 2017), with gamified learning environments not consistently leading to improved student outcomes (Koivisto & Hamari, 2019). Indeed, gamification can sometimes be counterproductive, potentially eliciting negative emotions and undermining learning outcomes (Hanus & Fox, 2015; Mekler et al., 2017; Mitchell et al., 2017; Park & Yap, 2025) by creating perceptions of control or pressure that reduce autonomous engagement (Rigby, 2023). Consequently, while gamification has the potential to foster autonomous motivation by satisfying basic psychological needs, the processes underlying these effects remain insufficiently understood (Li et al., 2024; Park & Yap, 2025). Given the growing use of gamified learning in sustainability education and its potential to enhance individuals’

motivation toward long-term pro-environmental behaviors, understanding these mechanisms is increasingly important (Wee & Choong, 2019). Research investigating how gamification influences motivation and learning is still at an early stage (Jahn et al., 2021), and scholars have called for more theory-driven empirical work to establish a coherent framework linking gamified designs to learning outcomes and motivational processes (Sailer & Homner, 2020). Although various theoretical perspectives have been applied in studies of gamification for sustainable behavior, SDT has emerged as the most widely used framework in research on sustainable consumption, gamification and GBL (Krath et al., 2021; Lim et al., 2025). SDT provides a robust foundation for such investigations, guiding both the analysis and design of effective gamified learning environments (Gao, 2024). However, previous studies (Alberts et al., 2024; Tyack & Mekler, 2020) have noted that its application in games research is often superficial, overly simplified, or inconsistent with the original theoretical framework. The continued exploration of applying SDT within game-oriented techniques is crucial for advancing sustainability education.

In gamified learning environments, autonomy can be supported by allowing learners to select missions, customize avatars, or choose the sequence of challenges, giving them perceived control over their progress in alignment with SDT's emphasis on autonomy (Sailer et al., 2017). Need for competence can be enhanced through mechanisms such as levels, points, badges, progress bars, and immediate feedback on performance, which allow learners to monitor their improvement and experience mastery (Hamari et al., 2016; Sailer et al., 2017). While the need for relatedness can be supported by incorporating social elements such as teamwork, leaderboards, cooperative missions, and communication channels that allow learners to connect and collaborate (Sailer et al., 2017) in a gamified learning environment.

For this reason, the platform presented in this paper, *Play It Cool*, adopts a holistic gamified design that draws on principles from SDT (Deci & Ryan, 2017; Ryan, 2023), aiming to explore the motivation and engagement through the overall support of basic psychological needs for autonomy, competence, and relatedness. The development of *Play It Cool* could serve as a research-grounded environment for a holistic investigation of psycho-educational processes in sustainability education. As follows, we describe the platform illustrating the principles of SDT that guided the design of *Play It Cool*, providing theoretical grounding for the choice of the gamification elements that have been included in the platform and that will be discussed in the subsequent section of the article.

***Play It Cool*: design elements and theoretical principles**

Technical development and definition of game mechanics was conducted by a co-design phase involving a group of researchers in developmental and educational psychology (Torre et al., 2025) and a team of developers and game designers from Grifo Multimedia, an ICT company from Italy with experience in gamification and DGBL. The game was made available as a web app.

Play It Cool consists of a gamified platform that incorporates a series of game design elements that previous studies (Kam & Umar, 2018; Oliveira et al., 2025; Sailer et al., 2017; Wee, & Choong, 2019) suggested could enhance engagement and motivation through the satisfaction of psychological basic needs (Table 1).

Table 1. Associations between basic psychological needs (autonomy, competence and relatedness) and game elements in *Play It Cool*.

Basic Psychological Needs	Game Elements	Expected Effect
Autonomy	Choice of region and tasks, multiple paths, storytelling	Increased sense of volition and control
Competence	Immediate feedback, progress bars, quizzes, points, badges	Enhanced perceived mastery and motivation
Relatedness	Community challenges, collaborative tasks, narrative interactions, avatar	Strengthened sense of community and engagement

The first game design element integrated in *Play It Cool* is storytelling (Figure 1), which does not directly influence player performance but plays a crucial role in providing context and meaning to the gamified experience (Kapp, 2012). Presence refers to the feeling of being psychologically “inside” the game world, rather than simply controlling characters from the outside (Ryan et al., 2006). Moreover, Frost and colleagues (2015) found that a gamified course, which included storytelling, promoted greater satisfaction of the need for relatedness in students compared to a condition in which the course did not include any game design elements.



Figure 1: An example of storytelling.

Note: The text in the figure is in Italian¹

The narrative framework of a gamified application includes a specific title, a setting and a plot that shape the activities and characters within the game, giving them a specific significance that enhances player engagement and immersion (Grasse et al., 2022; Plass et al., 2015), a distinct motivational construct that enhances engagement, even though it is not a direct source of psychological need satisfaction (Ryan & Deci, 2017) it may be associated with the need for autonomy, as indicated in Table 1. This is due to the presence of characters and avatars, which foster a sense of agency through the personalization of the avatar within the game (Landers et al., 2018). In *Play It Cool*, the storyline is set in Utopia, a twin planet similar to Earth where inhabitants strive to make better choices for the environment to avoid the same environmental issues. Within the map of Utopia, there are five regions, each addressing a specific environmental sustainability issue of the Earth. One region, called *Hydronis*, focuses on water usage and pollution, particularly the contamination of freshwater sources. The second region, *Thermadra*, tackles climate change and global warming and their consequences, while the third, *Nubira*, deals with air pollution, specifically the problem of carbon dioxide emissions. The fourth region, *Toxalon*, is dedicated to soil pollution and the five R's of sustainability (Reduce,

¹ Hello, let me introduce myself, I am an activist scientist in the environmental field. You are in 2055. The Earth is on the brink of environmental disaster, over half the people on Earth have been in insoluble conditions for decades. The scientific community, thanks to increasingly precise mathematical models, has highlighted how the Earth's climate has changed in an alarming way and has attributed these changes mainly to human activities, particularly the intensive use of fossil fuels. Today we are facing increasingly extreme, frequent, and devastating climatic phenomena and it is now indisputable that the Earth's climate is undergoing important mutations and that human beings are the main culprits.

Reuse, Recycle, Retrieve, Regenerate), and the final region, called *Energetia*, centres on energy consumption, exploring both renewable and non-renewable energy sources and their environmental impact. The table below (Table 2) shows the various regions of Utopia, detailing the environmental themes and issues addressed.

Table 2. Description of the different regions of Utopia and the specific environmental themes and issues addressed in each.

UTOPIA’S REGIONS	ENVIRONMENTAL THEMES
Hydronis	<ul style="list-style-type: none"> ● Water pollution ● Polluting and non-polluting sources ● Water as a right ● Goal 6 of the 2030 Agenda ● Water consumption and waste ● Various types of marine pollution
Thermodra	<ul style="list-style-type: none"> ● Climate change and global warming ● Carbon neutrality ● Sources that accelerate or slow down global warming ● Greenhouse effect and greenhouse gases ● Deforestation and melting of glaciers ● Green Deal
Nubira	<ul style="list-style-type: none"> ● Air pollution ● Sources of air pollution ● Air pollutants (Particulate matter, lead, carbon monoxide) ● Smog ● Household pollution ● CO₂ equivalent
Toxalon	<ul style="list-style-type: none"> ● Soil pollution ● 5 R’s of sustainability ● Circular economy ● Waste separation and management

<p>Energetia</p>	<ul style="list-style-type: none"> ● Chemical fertilizers' risks ● Aquifers pollution ● Energy consumption ● Renewable and non-renewable energy sources ● Carbon dioxide emissions ● Ecological footprint ● Green Economy ● Benefits of energy communities
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As soon as the game begins, the player will see a map of the planet Utopia. The map shows a landscape with dry and scattered garbage everywhere, and air filled with smog and pollution. Additionally, many animal species are on the brink of extinction due to global warming and there is no electricity. Once all the tasks in a region are completed successfully, the environment gradually transforms into a greener landscape, visually representing their progress toward sustainability goals (Figure 2).



Figure 2. An example of visual progression of world changes during task completion of the region *Hydronis*.

This progression is visible to the player with a percentage bar (Figure 3), a game element chosen because it is associated with achievement and that could be useful to the satisfaction of the need for competence, as reported in Table 1. Moreover, players can autonomously choose which region to explore and which task to start with, facilitating some experiences of freedom and

volition in completing challenges, cultivating a sense of control and personal agency. In the context of sustainability education, additional psychological constructs, such as agency — defined as the ability of individuals to deliberately influence their life trajectory through their actions — are particularly relevant (Cunha et al., 2025). In *Play It Cool*, learners can choose which region to explore first, providing autonomy in navigating the platform and allowing them to follow their own interests, as illustrated in Table 1. Within each selected region, tasks are presented in a recommended sequence, designed to follow a coherent pedagogical progression of information about the chosen environmental issue. Importantly, this sequence is not mandatory, allowing learners to deviate from the suggested order if they wish. This design could reflect a balance between structured guidance and autonomy support, in line with a circumplex model in the Self Determination Theory framework (Aelterman et al., 2019), offering learners both choice and guidance in the progressive acquisition of knowledge, skills and attitudes relevant to sustainability education.



Figure 3. An example of the percentage bar of progression in each region.

Each of the regions includes multiple tasks, including mini-games, quizzes, branching scenarios based on decision making and timed group challenges. As a first task, there is an introductory task, where the player is introduced to the region's specific environmental sustainability issue through a short explanatory text that covers the causes and consequences of each environmental problem (water pollution, climate change and global warming, air pollution, soil pollution, energy consumption). After reading, the player answers a quiz about the content and receives immediate feedback on their responses, whether they're correct or not. Next, there are a series

of tasks where players engage in a variety of mini-games, including a categorization game, a multiple-choice quiz, a matching game, a hangman, three word puzzles and two interactive branching stories, with real-life scenarios and everyday situations, in which players are required to make sustainable choices. These mini-games are described in more detail in the description of the following tasks. The second task is a categorization game with environmental keywords, where the goal is to associate words with categories, in relation to the theme addressed. For example, in the region *Hydronis*, where water pollution and waste is the central theme, the player must decide whether the sources presented are polluting or not. The third task is a multiple-choice quiz where the player answers questions by selecting the correct answer from those presented. To pass, they must reach a threshold of 70% correct answers, simulating an admission test to obtain Utopia citizenship. The following task is a matching game where sustainability concepts are linked to their definitions and the player must match the colour of each concept to the correct definition. Then, there is a sustainability-themed hangman, where the player has to guess a hidden word related to environmental sustainability by selecting letters one at a time. For each incorrect letter, a part of the hangman figure appears. The goal is to guess the word before the figure is completed and before the time ends. After that, there is a word puzzle, where the player must find all the words related to environmental sustainability that are hidden, and they do so by changing the letter until they find the right combination to form the correct word. For example, in the region of *Toxalon*, players are presented with the scrambled word “ncyircelg” and are required to rearrange the letters to form the correct word, “recycling”. These gamified experiences facilitated the exploration of environment-related concepts and provided feedback on responses through interactive mini-games, thereby fostering an understanding of sustainability principles. Immediate feedback is a crucial game design element for supporting motivation and enhancing learning effectiveness (Wee et al., 2019). Specifically, as reported in Table 1 it could foster a sense of competence, helping individuals feel more capable and effective in their actions, which is central to promoting intrinsic motivation (Rigby & Ryan, 2011; Ryan & Deci, 2017). In addition, immediate feedback supports autonomy when it is perceived as informative rather than controlling, allowing individuals to make decisions about how to improve based on their own preferences (Ryan, 2023). In a study by Liu et al. (2021), an engineering course was transformed into an online digital game-based learning (DGBL) experience through the incorporation of feedback as a gamification element. The results showed that the use of appropriate feedback not only increased autonomous motivation, but also enhanced participants’ learning effectiveness (Liu et al., 2021). In particular, a study (Wee et al., 2019) investigated the association between

feedback and the satisfaction of basic psychological needs by incorporating this element into a gamified digital game-based learning (DGBL). Specifically, the authors developed an app aimed at promoting sustainable behaviors related to energy conservation and the results show that receiving immediate feedback allowed students to experience a sense of efficacy and competence during the activity (Wee et al., 2019). By integrating supportive features that enhance competence, learners' motivation can be increased, engagement fostered, and the acquisition of knowledge, skills, and attitudes relevant to sustainability education facilitated. Satisfaction of the need for competence could strengthen learners' sense of effectiveness, further promoting motivation to learn (Reeve & Cheon, 2021).

Then, there are also two other tasks with mini-games where players are presented with real-life scenarios and everyday situations, in which they are asked to make sustainable choices. The first one is a task where players explore sustainable daily habits through an interactive story where they face everyday environmental dilemmas and choose several options with different levels of eco-friendly. For example, in the climate change-themed mission, the player is asked to choose the more eco-friendly option between keeping the heating on all day at a constant moderate temperature (e.g., 19–20°C) or setting the temperature to 23°C but only for 8 hours a day. This kind of task is designed to raise awareness about the environmental impact of everyday decisions and to show how small actions can lead to meaningful change. This type of gamified activities could promote deeper understanding and internalization of learning by providing meaningful rationales and encouraging the generation of self-relevance (Vansteenkiste et al., 2018). Finally, a community challenge can be activated at specific times, linked to each region of Utopia, to strengthen a sense of community and engagement among players, as illustrated in Table 1. This challenge is an interactive story with a branching scenario, where players must make a collective decision on sustainable solutions that concern public interest issues. For example, in the region where the main problem is soil pollution, each player is called to organize a birthday party for a friend and must make pro-environmental conscious choices throughout the planning process. In the region focused on non-renewable energy consumption, players may be asked to decide on the most sustainable transportation method for going out to dinner, as well as what food options would minimize environmental impact and CO₂ emissions. The outcome of the shared decision alters the map's appearance and affects each player's score.

After each choice or quiz, players earn points (Figure 4) and collect badges (Figure 5) that are tied to story progression, special learning achievements (such as answering all quiz questions correctly), and participation in community challenges (see Table 1). These elements

support engagement and perceived competence and, when combined, contribute to overall autonomous motivation (Ofosu-Ampong et al., 2021; Sailer et al., 2017). Points are a key element of game design that could be perceived as stimulating and encouraging players to continue gamified activities (Brom et al., 2019). In particular, a study (Ofosu-Ampong et al., 2021) implementing a course with gamified elements found that the scoring system contributed to increasing the satisfaction of the need for autonomy, in line with SDT, by providing a greater sense of control and choice over actions. Also badges appear to increase feelings of feeling more competent while performing a task (Ofosu-Ampong et al., 2021; Schürmann et al., 2022). Additionally, results of Sailer and Sailer (2021) revealed that points alone did not show significant effects on any of the three psychological needs. These findings suggest that an approach combining multiple gamification elements may be more effective in fostering overall autonomous motivation. In fact, the use of points combined with badges, leaderboards and graph performance supported the satisfaction of the other two basic psychological needs, competence and relatedness (Sailer et al., 2017).

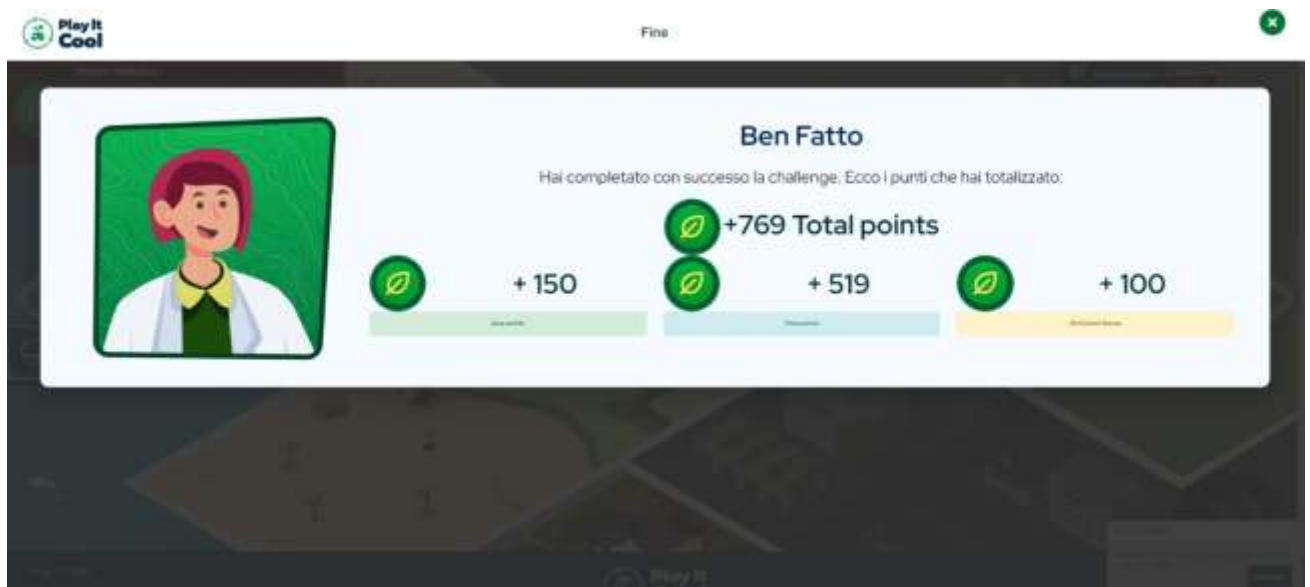


Figure 4. An example of points.

Note: The text in the figure is in Italian²

At the end of the game, after completing all tasks and making the most eco-friendly choices, each is officially welcomed as a “Responsible Citizen of Utopia”, symbolizing their commitment to sustainability. Before “returning” to Earth, players are encouraged to carry this

² Well Done. You have successfully completed the challenge. Here are the points you've scored.

awareness with them and to take real-life actions that are environmentally conscious and mindful of their ecological impact.

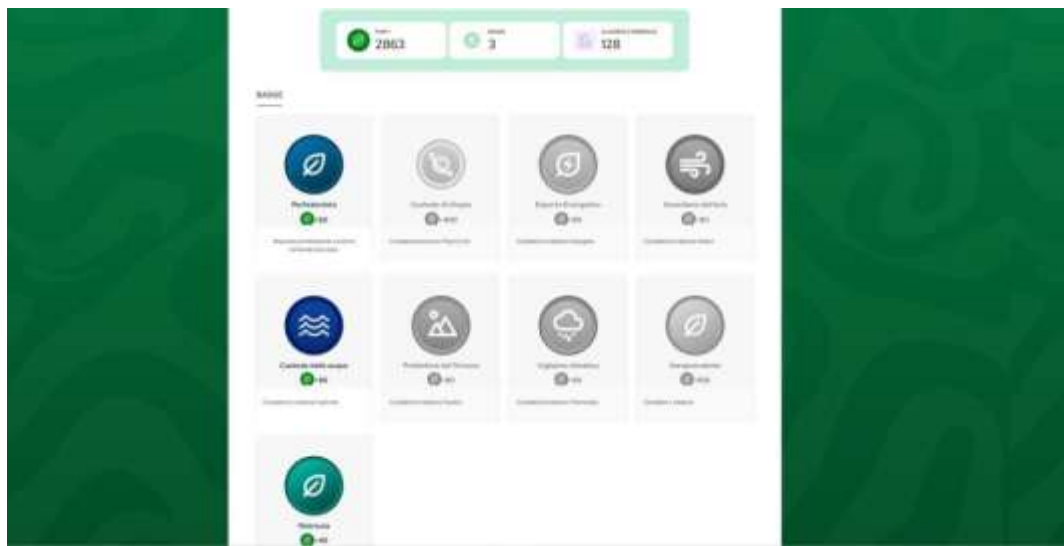


Figure 5. An example of badges.

Discussion

Play It Cool is a gamified platform developed to support environmental education and promote pro-environmental intentions through an engaging and interactive digital experience targeted at students. Sustainability education requires an integrating understanding of natural resources availability, management, and preservation across all ecological levels. It also involves recognizing that even small daily actions can contribute to resource conservation and help mitigate pollution. The platform integrates a series of game design elements, including realistic storytelling and meaningful decision-making scenarios, which encourage players to reflect on their choices and their impact on the construction of a responsible society. The interactive nature of digital games gives immediate and contextualized feedback, while collectible badges, a point system, and a visible progression bar enhance engagement by allowing players to track their advancement throughout the game. The design of this educational tool, based on the principles of Digital Game-Based Learning (DGBL; Prensky, 2005) and grounded in Self-Determination Theory (SDT, Deci & Ryan, 2017; Ryan, 2023), was chosen for its demonstrated ability to make learning accessible and explore the motivational processes. The conceptual framework proposed through *Play It Cool* could serve as a conceptual model for the design and evaluation of other gamified learning platforms in sustainability education. By explicitly linking game design elements to the satisfaction of the basic psychological needs outlined by SDT, as summarized in Table 1, the framework offers theoretically grounded design

criteria that can guide future interventions. Grounded in Self-Determination Theory (SDT), its design illustrates how autonomy-supportive choices, competence-oriented feedback, and narrative elements fostering relatedness could enhance motivation and engagement. These criteria may inform both the development of similar platforms and the empirical examination of how specific game mechanics support autonomy, competence, and relatedness in diverse educational settings.

Practical Application

Play It Cool emerges as a uniquely valuable platform for rigorous academic inquiry into the efficacy of gamification in environmental education. Its design naturally facilitates an in-depth examination of the motivational, emotional, and social processes that underpin effective learning in this crucial domain. A key research objective will involve a direct comparative analysis of the platform's effectiveness against a non-gamified counterpart offering identical environmental educational content. This comparative study is critical for discerning the specific contributions of gamification to student motivation, engagement levels, and ultimately, learning outcomes within the context of sustainability education.

While the current version of *Play It Cool* does not natively support real-time, synchronous multiplayer collaboration for individual tasks, this limitation is partially addressed through the integration of community challenges. These challenges are designed to cultivate a strong sense of teamwork and collective responsibility, as individual scores contribute directly to collective goals. In addition, the platform's flexible structure, which allows for both solo play and same-device collaborative participation, offers valuable opportunities for future research. Specifically, comparing the effects of different play modalities could yield insights into how varying levels of social interaction influence collaborative learning processes in digital environments. Such an investigation may help clarify the impact of interaction on knowledge acquisition and attitudinal change regarding environmental issues.

Finally, to truly unlock a comprehensive understanding of the psychological processes involved in gamification, a mixed-methods research approach is highly recommended. This involves integrating both qualitative and quantitative research designs. *Play It Cool's* architecture is particularly well-suited for this, offering the potential to seamlessly integrate into diverse research frameworks. Quantitative methodologies could be employed to rigorously measure learning gains, engagement metrics, and behavioral changes, while qualitative approaches could provide rich, nuanced insights into players' subjective experiences, perceptions of challenge and feedback, and the social dynamics of collaborative play. This dual

approach promises to yield a more holistic and robust body of evidence regarding gamification's true impact on environmental education.

Conclusion

In conclusion, while this version of *Play It Cool* was developed to examine gamification dynamics through the lens of Self-Determination Theory (SDT), recent conceptual advancements within SDT underscore that the mere presence of game design elements could be insufficient to foster motivation and promote learning (Rigby, 2023; Van Roy & Zaman, 2017). Rather, it is the extent to which these elements are thoughtfully designed to support the satisfaction of specific basic psychological needs within the activity that is critical (Deci & Ryan, 2017). Consequently, future research should prioritize investigating how the elements and principles that contribute to the enjoyment of games can be effectively integrated into design of learning activities (Deci & Ryan, 2017), in order to develop increasingly effective need-supportive designs (Rigby, 2023) for gamified experiences aimed at promoting sustainability and pro-environmental action. Understanding how game elements can be strategically aligned with learners' psychological needs remains crucial for designing impactful gamified interventions — especially in domains like sustainability, where long term behavioral change is essential.

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