

Utilizing Educational Gaming to Foster Sustainability Awareness in Corporate Settings

Ilias Karachalios

¹National Technical University of Athens, School of Civil Engineering, Department of Water Resources and Environmental Engineering, NTUA Campus, Heroon Polytechniou str. 9, 15780, Zographou, Athens Greece, Hydraulics Building, Greece
Email: [Ilias.karachalios\[at\]hotmail.gr](mailto:Ilias.karachalios[at]hotmail.gr)

Abstract: *The integration of digital gamification into corporate environmental strategies represents a novel approach to fostering sustainability awareness among employees. This study delves into the design, development, and implementation of an educational game for the VINCI group in Greece, aiming to enhance the corporate environmental culture. The game incorporates various environmental challenges and sustainability practices, encouraging employees to engage in eco-friendly behaviors within a corporate context. Initial feedback indicates a positive reception among participants, suggesting increased awareness and a shift towards sustainable practices. The study underscores the potential of gamification as an effective tool in corporate environmental education, offering insights into its design, implementation challenges, and the impact on corporate sustainability culture. This case study contributes to the broader discourse on the role of digital games in environmental education and corporate sustainability initiatives.*

Keywords: Environmental Gamification, Digital Educational Tools, Corporate Sustainability, Employee Engagement

1. Introduction

Overexploitation of natural resources, driven by the need for technological progress, has catalyzed development at the expense of the environment. The early phases of industrialization brought pollution that was localized, yet as industry expanded and human activities increased, these environmental challenges escalated to a global scale, demanding a global response and integrated management. The repercussions of industrial activities, such as the release of endocrine-disrupting chemicals, have profound impacts on both human and environmental health, necessitating a broader perspective on urbanization and industrial practices [1]. Furthermore, the cumulative effect of industrial processes contributes to overarching environmental burdens, with global warming being a central concern [2], necessitating international cooperation and policy development to mitigate these impacts. Sustainability is tightly linked to the respect of resources like energy and the environment, vital for continuous societal development while preserving these resources for future generations [3].

Sustainable development aims to protect the environment while ensuring we don't deplete resources for future generations [4]. Sustainable development aims for a balance between environmental integrity, economic development, and societal well-being [5]. This balance necessitates changes in individual behaviors and societal values [6]. In the context of our ever-changing world, the urgency of reforming education with a focus on sustainable development is underlined [7].

Education for Sustainable Development (ESD) emerges as a necessary tool for this shift, providing solutions and suggesting methods for citizens to shape a sustainable future ensuring high life quality [8]. Traditional ESD approaches aim at behavior modification, a measurable and describable goal unlike the abstract concept of action capacity, which is acquired through practice [9], [10].

There is a clear and urgent need for innovative strategies in environmental education [11]. Some studies underscore the significance of designing and implementing educational advancements for sustainable development [7], [12] and others provide evidence on the knowledge and views of students [13] and teachers [14] towards environmental related issues, highlighting the educational impact on environmental consciousness.

Recognizing the need for a different approach, organizations are increasingly incorporating sustainable development models to inform and educate their workforce [15]. These models are instrumental in guiding employees towards practices that align with environmental, economic, and social imperatives [6]. Recently, Digital Game Based Learning (DGBL) has emerged, connecting Game Based Learning (GBL) with digital games, resonating with modern workers who prefer inductive reasoning and interactive content with multiple information streams [16], [17]. Thus, DGBL serves as an effective tool for transforming learning in the new generation where traditional educational methods are less successful [16].

This paper contributes to the discourse by presenting an intervention through the design and implementation of an educational game aimed at enhancing corporate environmental culture, an initiative prompted by the collective insights of these previous studies.

2. Design and Implementation

A serious game named "Sustainability GAMEQUIZ – VINCI edition" was developed for the company's group in Greece, designed to enhance sustainability awareness among its employees. This digital knowledge-based game was crafted for an educational day, aiming to instill a deeper understanding of sustainable practices within the corporate environment. Such serious games have been recognized as effective educational tools, merging learning with engaging gameplay, thus providing an innovative approach to corporate

Volume 13 Issue 3, March 2024

Fully Refereed | Open Access | Double Blind Peer Reviewed Journal

www.ijsr.net

training in sustainability [18]. This innovative approach to corporate training utilized both initial brainstorming from employees regarding sustainability and the group's strategic focus on sustainability topics derived from surveys and the sustainability report, following preliminary discussions with key company figures. A logo was designed specifically for this project, serving as a visual key for related initiatives, and digital platforms such as ZOOM and Kahoot were used to facilitate interactive participation.

2.1 Engagement through Gamification

2.1.1 Design and Implementation Strategy

The design of this educational digital game considered preliminary brainstorming on sustainability concepts from the employees and incorporated the VINCI group's strategic approach to sustainability.

This preparation phase involved leveraging insights from the company's sustainability report, aligning with frameworks such as the Global Reporting Initiative (GRI) standards, which are commonly utilized by organizations to disclose their environmental impact [19]. Additionally, direct inputs from key personnel were incorporated, ensuring the game's content was closely aligned with the organization's environmental goals, in line with the best practices for stakeholder engagement [20].

The development of a unique logo for the initiative and the use of digital platforms like ZOOM for video conferencing and Kahoot for the quiz made the experience accessible and engaging, fostering a high level of participation among the employees. Research has shown that digital platforms can significantly enhance the interactivity and engagement of corporate training [21], which is further evidenced by the success of gamification in workplace learning [22].

2.1.2 Participant Engagement and Interactive Learning

The activity commenced with participants, who had previously registered via email, logging in through the ZOOM platform to follow participation instructions. The game utilized a smartphone-accessible platform (Kahoot) for interactive engagement, allowing participants to answer quiz questions on sustainability topics. This phase was characterized by a set of ten knowledge questions related to sustainability, with participants given up to sixty seconds to respond to each multiple-choice question. The correct answers were revealed immediately after each question, followed by scientifically substantiated explanations provided by the game moderator, enhancing the learning experience by linking correct responses to comprehensive, factual information.

2.1.3 Outcome and Impact

The game's first phase concluded with the top four scoring participants advancing to the final round, which included a requirement for open cameras to foster a more engaging and connected experience. The overall process took approximately 50 minutes, concluding with a winner who received an electric bicycle from the company, symbolizing the commitment to sustainability. Notably, the accuracy of

answers improved significantly from the first round to the final, indicating an effective learning curve among the participants.

2.2 Behavioral Change and Educational Impact

The deployment of the digital game as an educational approach showcased the feasibility of achieving substantial educational content outcomes, at least at an introductory level, regarding corporate environmental policy and sustainability awareness through gamified learning techniques. This initiative allowed participants to acquire fundamental concepts, exposing them to diverse theoretical approaches, thereby sparking dialogues among colleagues to express personal perceptions and representations of sustainability. Additionally, participants were introduced to essential concepts related to sustainability and corporate social responsibility (CSR) practices of their own company.

A significant outcome of this activity was the enhancement of dialogue and reflection among employees about sustainability, indicating a shift in mindset towards more sustainable practices. The scientific approach and detailed organization of the activity, highlighted by participant feedback, played a crucial role in the effectiveness of the educational intervention. The coordination and prior collaboration with company executives were pivotal in fostering a positive environment and integrating individual actions into a cohesive strategy.

The evaluation further revealed the necessity for developing more practical examples of CSR and additional training sessions on sustainability topics. This points towards an ongoing need for dialogue and engagement with sustainability issues, suggesting that sustainability topics require repeated approaches, alternating between practical examples, theoretical discussions, and intermediary activities beyond formal training sessions, fostering reflection and opinion expression.

Research findings [22] highlight the efficacy of gamification in enhancing learning outcomes and engagement, supporting the methodological foundation of the "Sustainability GAMEQUIZ" initiative.

2.3 Encouraging Sustainable Practices through Educational Gaming

The activity was designed as a serious game to foster sustainability awareness among the company's employees in Greece. This effort was built on the data provided by an initial survey capturing employees' views and the strategic review of company's sustainability objectives, leading to a game that not only educated but also actively engaged its participants.

In developing the game, significant emphasis was placed on incorporating sustainability concepts relevant to the company group's operational strategies and environmental goals. Preliminary discussions with QHSE supervisor and Environmental Manager of the company, helped tailor the game's content to align with company's sustainability report

and broader environmental management practices. This bespoke approach ensured that the game was not just an educational tool but also a reflection of the company's commitment to sustainable development.

Utilizing digital platforms like ZOOM and Kahoot, the game facilitated interactive and engaging learning experiences. Participants were registered via email and connected digitally for a live presentation of the game instructions, followed by a quiz session that tested their knowledge on sustainability.

The structure of the educational game developed encompassed two distinct phases: an initial quiz session with general sustainability questions, followed by a final round for top scorers. This further drove competitive engagement and focused on deeper sustainability topics [23]. The phased approach not only maintained participant engagement but also fostered a gradual deepening of their understanding of sustainability issues, especially those pertinent to their roles within the company [24].

The design and implementation of the game serve as a pioneering example of how educational gaming can be effectively employed within corporate settings to promote a culture of sustainability. It bridges the gap between abstract sustainability concepts and their practical application in the workplace, setting a benchmark for future educational initiatives aimed at fostering environmental stewardship among employees. The effectiveness of such educational gaming in corporate training has been supported in the literature, indicating a positive influence on sustainability awareness and behavior [25], [26].

In conclusion, the "Sustainability GAMEQUIZ – VINCI edition" underscores the transformative potential of digital game-based learning in enhancing corporate sustainability culture. Through strategic gamification and a focus on interactive learning, the initiative not only heightened employees' awareness and practices concerning sustainability but also highlighted the effectiveness of engaging educational tools in advancing corporate environmental strategies.

3. Evaluation

3.1 Evaluation Methodology

The assessment of the activity was conducted through an anonymous questionnaire, which participants were invited to respond to electronically via Google Forms. Upon the completion of the training, they were informed and notified electronically two days later to answer the questionnaire. This method follows best practices in survey methodology, ensuring anonymity and promoting a high response rate by providing a convenient and accessible means for feedback [27]. The use of electronic questionnaires for post-training assessment is supported by research indicating their effectiveness in gathering data on participants' learning outcomes, satisfaction, and suggestions for future improvements [28]. The questionnaire included demographic information (gender, position, company) and 9 questions (7 closed-ended and 2 open-ended). Approximately 5 days were

provided for its completion.

3.2 Results

Out of the total 58 participants, 30 responded to the questionnaire, resulting in a 51.7% response rate, which is considered very satisfactory. The sample consisted of 30 participants, 18 men and 12 women.

16 of these participants work at the company Gefyra, 1 at Gefyra Operation, 7 at Olympia Odos, and 8 at Olympia Odos Operation, with the majority being office employees, technicians, or engineers. Therefore, further analysis could assist in drawing conclusions by company within the group.

Regarding the question, "To what extent do you believe that the activity you participated in fulfilled its intended purpose?" nine (9) participants answered, "very much" and fourteen (14) answered "much".

In response to "How satisfied were you with the flow and presentation?" eleven (11) participants answered, "very much" and fifteen (15) answered "much" while the remaining four (4) answered "fairly"

When asked "How satisfied were you with the content of the questions?" five (5) participants responded, "very much" sixteen (16) responded "much" eight (8) responded "fairly" and there was one participant who responded "slightly." The specificity of some questions likely posed a cognitive challenge to some participants without implying a lack of engagement or learning.

Regarding the question "How satisfied were you with the technical specifications/infrastructure of the activity?" nine (9) participants answered, "very much" fifteen (15) answered "much" and six (6) answered "fairly" The technical infrastructure of educational games is evaluated because it is a fundamental parameter for the game's ease of play, and the results indicate that the way it was technically designed worked very positively.

To the question, "How much did the activity keep your interest and motivation for participation high?" fifteen (15) participants answered, "very much" ten (10) answered "much" three (3) answered "fairly" and two (2) answered "slightly"

When asked, "Do you think that this specific activity would have worked better if it had been conducted in person?" seventeen (17) participants disagreed, and thirteen (13) agreed. This suggests that the majority found value in the activity's setup and did not consider the online format merely a necessity.

When asked how likely they would be to recommend this activity to colleagues who didn't take part, most participants gave a rating of 7 to 10, indicating strong recommendation, with 10 being the most frequently chosen option.

Open-ended questions allowed participants to express their positive impression during their participation. Responses included the speaker's quality, the comprehensive presentation, continuous interest, immediacy in relation to results, participant engagement, interactivity, smooth flow, the method of conducting the game (combination of computer/phone), which presumably achieved its goal of assimilating correct research outcomes and positive reception of environmental practices, explanation of answers, and group participation.

Some suggestions for improvement included better preparation and organization, avoiding specialized questions that rely on chance, more participation, fewer general questions, possibly adding another intermediate stage depending on the number of participants and available time, timely communication of participation process, and questions possibly focusing on definitions to be more educational for many. The right answer in some numbers was a matter of luck. Finally, in the final, questions were used that concerned the two companies (2 for Olympia and 1 for Gefyra) which might have determined the winner. Although not significant and certainly not intentional, it would be better to avoid such instances.

These insights and feedback highlight the importance of thoughtful questionnaire design, effective communication, and the balance between educational content and engagement in educational activities.

4. Conclusions

This specific activity highlighted the effectiveness of utilizing educational gaming techniques in raising awareness about sustainable development (SD) and environmental policies. Engaging participants with key concepts through interactive gaming has proven to foster a deeper understanding and facilitate discussions among colleagues, this method helps everyone get a clearer and more practical understanding of sustainability issues [29]. Moreover, introducing participants to fundamental sustainability principles and real-world applications of SD within their company significantly contributes to a comprehensive learning experience [30].

The accurate planning and organization of the educational activity were pivotal to its success, underscoring the critical role of scientific attention and structured design in educational interventions [31]. The experience derived from this initiative underscores the importance of coordination and collaboration between trainers and company executives, which is fundamental in creating a conducive learning environment and effectively integrating various educational strategies [32].

Additionally, the assessment of the educational activity underscored the need for more practical examples of SD and the importance of ongoing training sessions on sustainability issues. This reflects the necessity for environments that not only foster but encourage the expression of personal opinions, particularly on complex topics such as SD [33]. The cyclic approach of alternating between practical examples and

theoretical insights, coupled with activities outside the formal training sessions, is crucial for promoting reflective learning and a deeper understanding of sustainability[34].

References

- [1] J. Patel, H. Chaudhary, S. Panchal, T. Joshi, and R. Joshi, 'Endocrine-Disrupting Chemicals and Hormonal Profiles in PCOS Women: A Comparative Study between Urban and Rural Environment', *Reprod. Toxicol.*, p. 108562, 2024.
- [2] M. Chaitanya, S. Arora, R. S. Pal, H. S. Ali, B. M. El Haj, and R. Logesh, 'Assessment of Environmental Pollutants for Their Toxicological Effects of Human and Animal Health', in *Organic Micropollutants in Aquatic and Terrestrial Environments*, Springer, 2024, pp. 67–85.
- [3] Y. Obata, K. Takeuchi, Y. Furuta, and K. Kanayama, 'Research on better use of wood for sustainable development: quantitative evaluation of good tactile warmth of wood', *Energy*, vol. 30, no. 8, pp. 1317–1328, 2005.
- [4] P. Salehi and M. Khalaj, 'Studying the economic and environmental effects and results of adding a new railway line to the rail transport network', *J. Environ. Sci. Stud.*, vol. 9, no. 3, pp. 9124–9114, 2024.
- [5] F. ul Amin, Q. Ji, W. ul Amin, and A. Amin, 'Integrating Blockchain Technology in Supply Chain Risk Management for Sustainable Development', in *Environmentally Sustainable Production: Research for Sustainable Development*, Springer, 2024, pp. 199–226.
- [6] I. de Soysa, E. Moe, and S. R. Saether, 'Egalitarian governance and the green energy transition: an empirical test of 46 industrial economies, 1990–2020', *Environ. Dev. Sustain.*, pp. 1–22, 2024.
- [7] Α. Γομάτος, Π. Αναστασοπούλου, Α. Καραχασάνη, Η. Καραχάλιος, Π. Ρόμπολας, and Σ. Αρμακόλας, 'Σχεδιασμός, Υλοποίηση και Αξιολόγηση Επιμόρφωσης για την Εκπαίδευση στην Αειφόρο Ανάπτυξη.', in *11ο Πανελλήνιο Συνέδριο της Παιδαγωγικής Εταιρείας Ελλάδας «Βασική και συνεχιζόμενη εκπαίδευση των εκπαιδευτικών σε ένα σύνθετο και μεταβαλλόμενο περιβάλλον»*, Πάτρα, 2018, pp. 239–249. [Online]. Available: <https://xisynpee.events.upatras.gr/Πρακτικά/>
- [8] United Nations Educational, Scientific and Cultural Organization, *UNESCO roadmap for implementing the global action programme on education for sustainable development*. Unesco Paris, 2014.
- [9] R. A. Hart, 'Children's participation: From tokenism to citizenship', 1992.
- [10] K. Schnack, 'Action competence as a curriculum perspective', *BB Jensen K Schnack V Simovska Eds*, 2000.
- [11] I. Karachalios, K. Plakitsi, V. Hatzinikita, I. Kalavrouziotis, L. Gomatos, and P. Sakellariou, 'Secondary education teachers' views on issues related to wastewater and solid waste management.', *Eur. J. Educ. Stud.*, vol. 10, no. 9, Aug. 2023, doi: 10.46827/ejes.v10i9.4963.
- [12] S. Armakolas, P. Robolas, I. Karachalios, P. Anastopoulou, and L. Gomatos, 'Constructing and implementing an OER regarding sustainability issues in vocational education', *Educ. J. Univ. Patras UNESCO Chair*, 2019.

- [13] I. Karachalios, K. Plakitsi, V. Hatzinikita, and I. Kalavrouziotis, 'Knowledge and Attitudes of high school students in Greece towards waste management', in *6th distance education e-learning International Summer School and Workshop on "Wastewater and Biosolids Management" (WWSS21)*, Patras 26-31 July 2021, 2021, p. Patras 26-31 July 2021, ISBN: 978-960-611-012-2, p 48–51. [Online]. Available: <https://wastewater2021.eap.gr/e-proceedings/>
- [14] I. Karachalios, I. Kalavrouziotis, K. Plakitsi, V. Hatzinikita, L. Gomas, and P. Sakellariou, 'Knowledge & Attitudes of secondary education teachers and students regarding waste management in Greece', 2023, doi: 10.13140/RG.2.2.28733.23521.
- [15] S. Chisumbe, C. O. Aigbavboa, E. Mwanamo, and W. D. Thwala, 'Conceptual Framework Underpinning Urban Housing Development', in *A Neoliberal Framework for Urban Housing Development in the Global South*, Emerald Publishing Limited, 2024, pp. 127–154.
- [16] M. Prensky, 'Digital game-based learning', *Comput. Entertain. CIE*, vol. 1, no. 1, pp. 21–21, 2003.
- [17] R. Van Eck, 'Digital game-based learning: It's not just the digital natives who are restless', *Educ. Rev.*, vol. 41, no. 2, p. 16, 2006.
- [18] J. K. Kavota, L. Cassivi, and P.-M. Léger, 'A Systematic Review of Strategic Supply Chain Challenges and Teaching Strategies', *Logistics*, vol. 8, no. 1, p. 19, 2024.
- [19] 'GRI - Standards'. Accessed: Mar. 07, 2024. [Online]. Available: <https://www.globalreporting.org/standards>
- [20] R. E. Freeman, *Strategic management: A stakeholder approach*. Cambridge university press, 2010.
- [21] M. Sailer, J. U. Hense, S. K. Mayr, and H. Mandl, 'How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction', *Comput. Hum. Behav.*, vol. 69, pp. 371–380, 2017.
- [22] J. Hamari, J. Koivisto, and H. Sarsa, 'Does gamification work?—a literature review of empirical studies on gamification', in *2014 47th Hawaii international conference on system sciences*, Ieee, 2014, pp. 3025–3034.
- [23] J. Schell, *The Art of Game Design: A book of lenses*. CRC press, 2008.
- [24] K. Becker, Becker, and James, *Choosing and using digital games in the classroom*. Springer, 2017.
- [25] H. Fischer *et al.*, 'F. 3 Game4Change—Using Playful Learning in Next Generation Entrepreneurship'.
- [26] D. Luan, H. Cao, and T. Qu, 'An analysis of the tripartite evolutionary game for building the ecological security barrier in the Bohai Sea under the threshold of land-sea integration', *Front. Mar. Sci.*, 2024.
- [27] J. R. Evans and A. Mathur, 'The value of online surveys: A look back and a look ahead', *Internet Res.*, vol. 28, no. 4, pp. 854–887, 2018.
- [28] M. P. Couper, 'New developments in survey data collection', *Annu. Rev. Sociol.*, vol. 43, pp. 121–145, 2017.
- [29] A. Wiek, L. Withycombe, and C. L. Redman, 'Key competencies in sustainability: a reference framework for academic program development', *Sustain. Sci.*, vol. 6, pp. 203–218, 2011.
- [30] C. Hopkins and R. McKeown, 'Education for sustainable development: an international perspective', *Educ. Sustain. Responding Glob. Chall.*, vol. 13, pp. 13–24, 2002.
- [31] Z. Fadeeva and Y. Mochizuki, 'Higher education for today and tomorrow: university appraisal for diversity, innovation and change towards sustainable development', *Sustain. Sci.*, vol. 5, pp. 249–256, 2010.
- [32] M. Barth and M. Rieckmann, 'Academic staff development as a catalyst for curriculum change towards education for sustainable development: an output perspective', *J. Clean. Prod.*, vol. 26, pp. 28–36, 2012.
- [33] K. Shephard, 'Higher education for sustainability: seeking affective learning outcomes', *Int. J. Sustain. High. Educ.*, vol. 9, no. 1, pp. 87–98, 2008.
- [34] S. Sterling, 'Transformative learning and sustainability: Sketching the conceptual ground', *Learn. Teach. High. Educ.*, vol. 5, no. 11, pp. 17–33, 2011.

Author Profile



Ilias Karachalios is a Research Associate at the National Technical University of Athens, specializing in Environmental Management and Education. With a rich academic background, he holds a Ph.D. in Environmental Education, a MSc in Environmental Conservation Management from, a Med in Special Education, and a Diploma in Environmental Management. He has made significant contributions to the field through his involvement in a variety of EU funded projects. His research interests span across special, vocational, and inclusive education, focusing on environmental sustainability, waste management, and non-formal education methods. With over a decade of experience in educational and research settings, Dr. Karachalios has developed a notable portfolio of project management, policy development, and educational innovation, dedicated to fostering environmental awareness and action.