PR4: Professional games for energy efficiency maximisation

This document is also available in German, Greek, Hungarian, Lithuanian, Romanian and Spanish

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Abbreviations

AR   Augmented Reality

CEMS   Community of European Management Schools

DGBL   Digital game-based learning

ESE   Environmental Sustainability Education

VR   Virtual Reality

WCAG   Web Content Accessibility Guidelines

1. Introduction

Background

Young people will have to deal with the effects of current environmental decisions for a longer period of time than their elders, since they make up a large portion of the world's population. These choices and how well they have addressed issues like resource depletion, biodiversity loss, and persistent radioactive wastes will also have an impact on future generations. Youth can actively contribute to protecting and improving the environment. People are able to alter their way of life and how it impacts the environment. By implementing eco-friendly practices, recycling various materials, and conserving resources like water and electricity, they can achieve greater environmental sustainability in their homes, schools, and youth organisations. Getting young people involved in environmental protection has the potential to influence their parents, relatives, and families in addition to directly affecting the attitudes and behaviours of the youth.

The youth are the foundation of a country. Their bravery and well-being have the power to alter the course of society. Sadly, we now have young people who are more interested in locations that are not helpful to them or the country as a whole. Instead, they opt to use drugs and play video games all day long. They party and basically live it up during the nights. Instead of improving themselves or finding employment, an increasing number of young men in this age range are spending their days playing video games in front of their televisions at home. They lack ambition, and even if they do have dreams, they lack the motivation to try to fulfil them. The topic of environmental protection is broad. Everybody is concerned about climate change and global warming as environmental problems get worse every day, but local and national environmental issues receive less attention. Since reducing pollution is the first step in protecting the environment, young people can contribute to waste reduction by paying attention to small details in daily life, like remembering not to bring extra plastic bags when shopping. In actuality, there are numerous additional suggestions for a greener environment.

Youth workers are becoming more and more important in tackling environmental issues. They have the ability to promote sustainable practices and positive change as future stewards. But it's possible that the conventional educational system doesn't give them all the resources they need to comprehend and deal with challenging environmental issues.

2. Guide on environmental issues for young workers

Purpose of the game guide

This game guide's primary objective is to bridge the knowledge gap on environmental issues among young workers. With the help of a selection of captivating and useful non-formal education games, this guide seeks to equip youth workers with the information and abilities required to understand the complexities of the environment. Additionally, it aims to motivate employers to acknowledge the importance of non-formal education in encouraging environmentally conscious behaviour among their staff.

The guide aims to be a catalyst for positive change by combining theoretical underpinnings, useful guidelines, and illustrative examples. By the time it's all through, readers ought to understand the value of non-formal education and be inspired to support its incorporation into youth workers' professional development.

Scope and target audience

This guide's scope is broad, covering youth workers, educators, and employers who work with young people to help them develop professionally. It covers a range of non-formal education topics specifically designed to fulfil the educational requirements of youth workers. The guide provides a comprehensive resource, ranging from comprehending environmental issues to incorporating energy efficiency practices and green deal approaches.

The intended audience consists of people and organisations looking for creative ways to involve and instruct youth workers about environmental issues. This guide is meant to be a flexible and useful tool for educators who want to improve their curricula and employers who want to support the professional development of their staff.

Significance of non-formal education in green initiatives

In order to promote sustainable development and green initiatives, non-formal education is essential. Although non-formal education offers a more flexible and diverse range of learning opportunities outside of traditional classroom settings, formal education offers a more structured framework for learning. The importance of non-formal education is especially clear when considering environmental preservation and sustainable practices.

Regardless of age, socioeconomic status, or educational background, non-formal education is frequently more accessible to a wider range of people. In order to ensure that everyone has the chance to take part in environmental education programs, inclusivity is crucial in raising awareness about green initiatives among different societal segments. Practical knowledge and practical experience are necessary for green initiatives. Non-formal education techniques give people real-world experiences through workshops, field trips, and community service. These encounters not only deepen comprehension but also give participants the tools they need to incorporate eco-friendly behaviours into their everyday lives.

Communities frequently host non-formal education, which promotes a feeling of shared environmental responsibility. Programs for environmental education that are centred in the community promote cooperation, shared knowledge, and the creation of regional solutions to environmental problems. The local community benefits greatly from this grassroots strategy for promoting sustainable practices. Environmental conservation is a dynamic field with constantly changing problems and solutions. Because of its inherent adaptability, non-formal education can react swiftly to shifting environmental concerns. Because of this flexibility, educational programs can now include the most recent discoveries in science, technology, and creative problem-solving.

Attitudes and actions regarding the environment may be influenced by non-formal education. A sense of environmental responsibility and stewardship can be ingrained in participants through non-formal education by keeping them emotionally and intellectually engaged. This change in perspective is essential for developing a sustainable mindset and motivating people to incorporate eco-friendly behaviours into both their personal and professional lives. Green initiatives require ongoing education and flexibility in response to emerging problems. Through encouraging people to stay up to date on environmental issues, advancements in sustainable technologies, and best practices, non-formal education fosters lifelong learning. Building a society that is long-term adaptable to environmental challenges requires this constant learning.

By completing gaps in the environmental curriculum and offering real-world experiences that might be difficult to duplicate in a traditional classroom setting, non-formal education enhances formal education. An approach to environmental education that is more comprehensive and all-encompassing is produced by incorporating non-formal education into formal educational systems.

For all these reasons mentioned above we have selected to develop the GENTLY game further including questions that give back informational material on green practices especially for young workers. In the following chapter the methodology followed will be analysed.

3. Methodology followed by the project

Need analysis

Understanding the learning needs of youth involved in environmental education, especially in the areas of green deal initiatives, energy efficiency, and environmental protection, is made possible in large part by the needs analysis carried out for the GENTLY project. With funding from Erasmus+, GENTLY is committed to introducing young people to game-based learning processes and methodologies because it sees them as effective tools for enabling them to become effective change agents.

In order to ensure a diverse and representative understanding of the learning needs within the field of environmental education, the multinational nature of this needs analysis is crucial. Our goal in reaching the six different partners' countries is to record a variety of viewpoints, experiences, and subtleties of context. This wide sampling guarantees that the educational games created as a result are suited for a worldwide audience while also deepening our understanding of the subject. Environmental issues transcend national boundaries, and a global perspective enables us to recognize and tackle the diverse environments in which youth workers function. We aim to develop a nuanced understanding of the learning needs by incorporating participants from various countries, taking into account cultural, regional, and demographic factors that may affect the educational requirements of youth workers. The GENTLY project aims to create a common understanding of environmental issues by bridging diverse learning landscapes through the lens of multinational collaboration. A more inclusive and comprehensive approach to environmental education is made possible by the diverse insights that participants from various nations have gained, which reflect the range of realities that youth workers face globally.

Participants actively shape a global narrative about the learning requirements of youth workers involved in environmental education by taking part in the survey, rather than just adding to a local understanding of the subject. By utilising a multinational approach, GENTLY's educational games and methodologies are guaranteed to be both customised and globally applicable, enabling youth workers to effect positive change on a global level.

Conducted Research

The GENTLY project's needs analysis was conducted using a thorough and detailed methodology that revolved around the distribution of an extensive survey. This survey functioned as a crucial tool, purposefully crafted to elicit important insights into the varied learning requirements of youth actively involved in environmental education. The questionnaire's design skillfully combined inquiries about demographic details with insightful questions meant to assess participants' knowledge of energy efficiency techniques, environmental issues, and green deal strategies.

Overview of questionnaire structure:

1) **Demographic information**

   The first section of the questionnaire inquired for basic demographic information, such as age, gender, place of residence, and highest degree of education attained.

2) **Professional context**

   Participants were asked to share their perspectives on their professional context, going beyond demographic data. This included information about their work environment, commute, mode of transportation, and how they incorporated smart devices into their daily tasks. These elements were essential to comprehending the realities of their everyday existence and how they could interact with environmental factors.

3) **Environmental practices**

   The environmental practices of the participants constituted a substantial segment of the questionnaire. This section explored the concrete behaviours and habits that support or undermine sustainable living, ranging from the use of plastic or disposable items to recycling practices and awareness levels. Participants were also questioned about where they got their information about recycling, which helped to provide a more complex picture of the ways in which people become environmentally conscious.

4) **Climate change and corporate responsibility**

   The questionnaire covered corporate responsibility and awareness of climate change. Participants were asked to consider the annual carbon footprint of their workplace, whether they would be willing to make changes to reduce emissions, and what specific changes they

believed were necessary to reduce emissions. The opinions of the participants regarding corporate environmental responsibility were revealed in this section.

5) **Impact of climate change**

A crucial component of the questionnaire was determining how participants' work performance was affected by climate change. The purpose of this section was to document the concrete consequences that environmental changes have had on their professional lives in order to promote awareness of the potential effects that climate-related issues may have on job satisfaction and productivity.

6) **Solution and practices**

The last section of the survey asked participants about how they felt about addressing climate change. This section sought to identify the proactive steps that participants thought to be successful, from personal tactics to workplace procedures. Furthermore, information on the kind of heating and cooling systems utilised at their place of employment gave them access to useful data on patterns of energy use.

This survey was carefully planned to complement the main objectives of the GENTLY project. The main goal was to determine the participants' complex learning requirements in the context of environmental education, with an emphasis on developing game-based learning strategies that would effectively meet these needs.

The multinational application of this research methodology was one of its distinguishing characteristics. With the deliberate goal of capturing response variations influenced by cultural, regional, and educational factors, a multinational approach was taken. The research methodology sought to develop a more global and nuanced understanding of the learning needs of youth workers in the field of environmental education by involving participants from a variety of backgrounds. As participants from different nations shared their viewpoints, the research design demonstrated the GENTLY project's dedication to inclusivity and universality in tackling the problems presented by environmental concerns. The dataset was enhanced by this multinational lens, which promoted a more comprehensive comprehension of the various experiences, viewpoints, and methods linked to environmental education among youth workers worldwide.

The foundational building block for developing customised educational games later on is the data gathered by means of this strong multinational approach. These game-based learning projects will be structured, with goals, and content that are informed by the insights obtained from the questionnaire responses. The dedication to diversity and the range of viewpoints

gathered provide the foundation for educational games that genuinely connect with the various experiences of youth workers around the globe.

Cross-countries research results

The total number of participants in the questionnaire research was 137 people. More specifically, 19 people from Cyprus, 10 people from Germany, 15 people from Greece, 28 people from Hungary, 30 people from Lithuania, 15 people from Romania and 20 people from Spain. The survey centred on their views and behaviours concerning energy conservation and environmental preservation within the context of the "green deal." This joint investigation produced insightful information about common patterns as well as unique features among these European countries.

Demographic characteristics
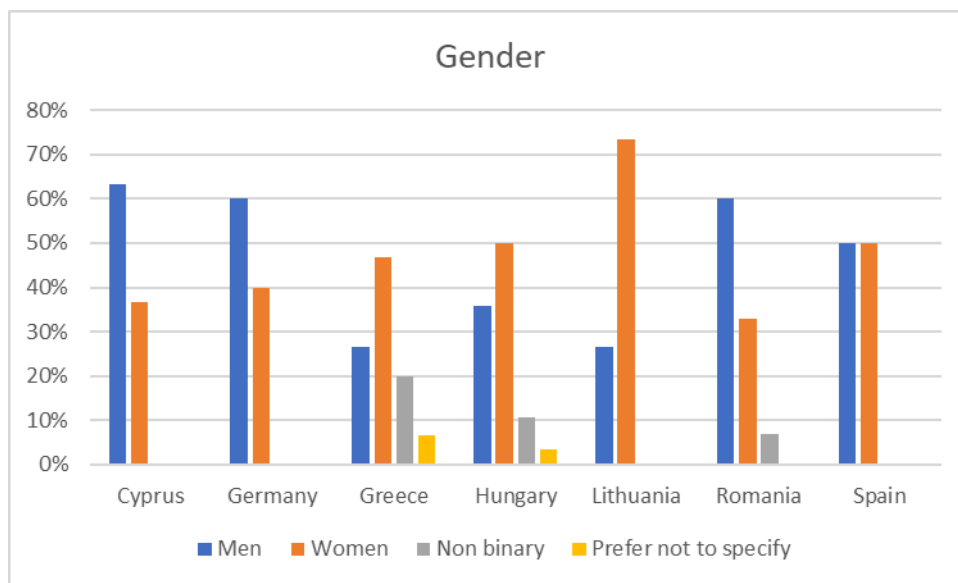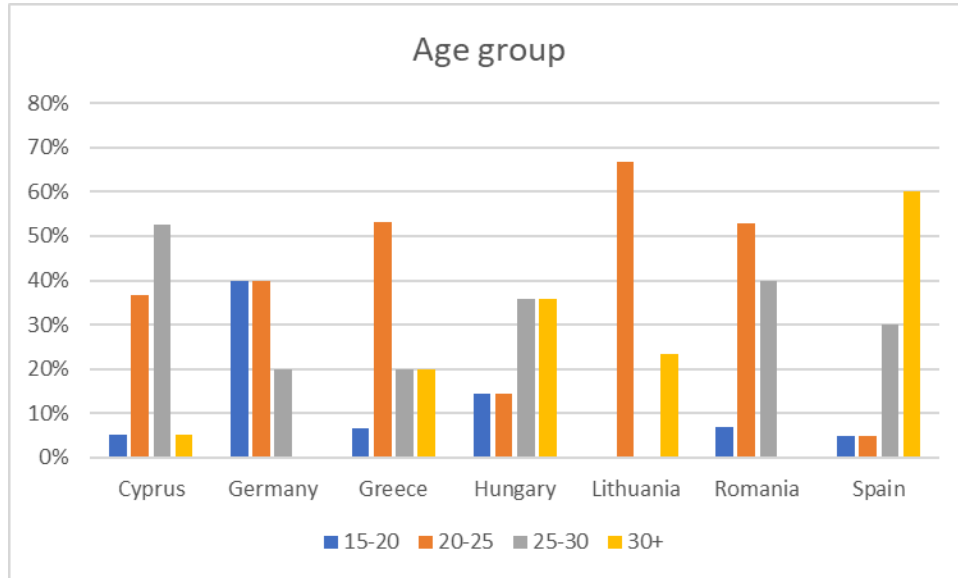
The sample population, which includes a wide range of ages from 15 to 35, highlights how young the workforce is that is being examined. Respondents demonstrated a well-educated group with the majority having bachelor's or master's degrees. The diversity of age groups and educational backgrounds, notwithstanding minor gender imbalances, presents a complete picture of the young professional landscape.

Work environment and commuting patterns

Where do you work?

How far do you have to go to work?
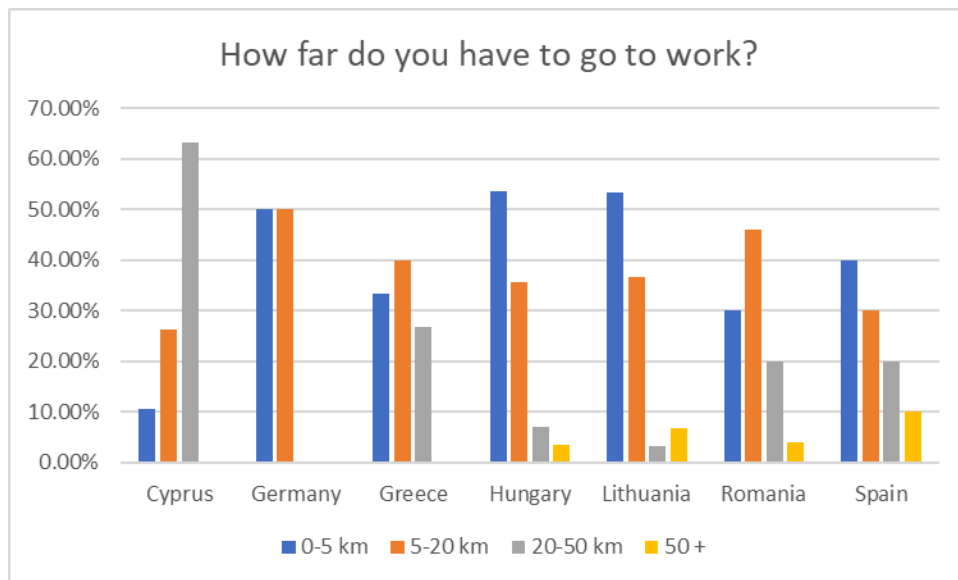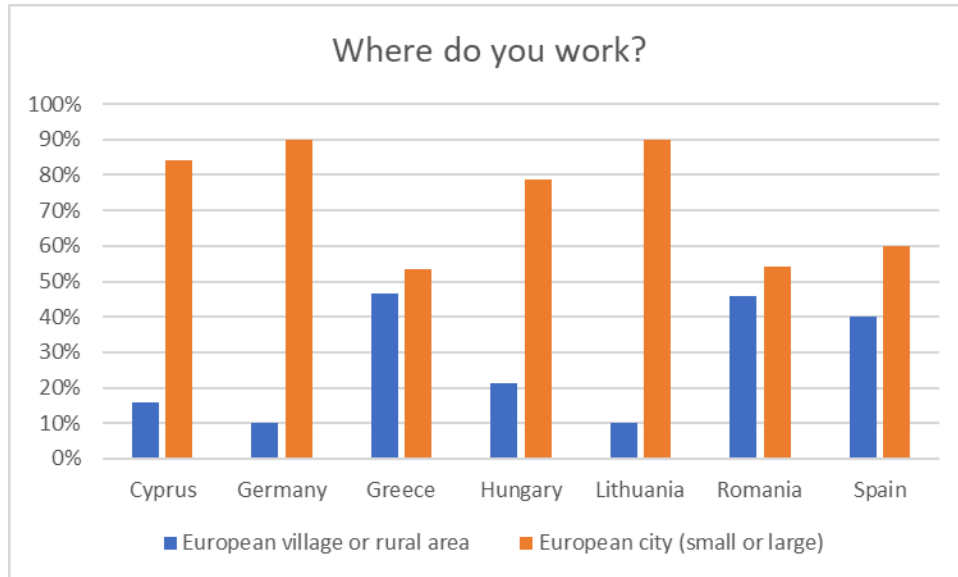
Most of the respondents established themselves professionally in the dynamic urban environments of Europe, but a significant portion came from rural or village communities. The spectrum of commuter behaviours, which reflect lifestyle decisions, included everything from short-distance bike rides to lengthy car commutes. Given the environmental impact of daily

commutes, the prevalence of car usage points to a potential focal point for sustainable transportation initiatives.

Technology integration
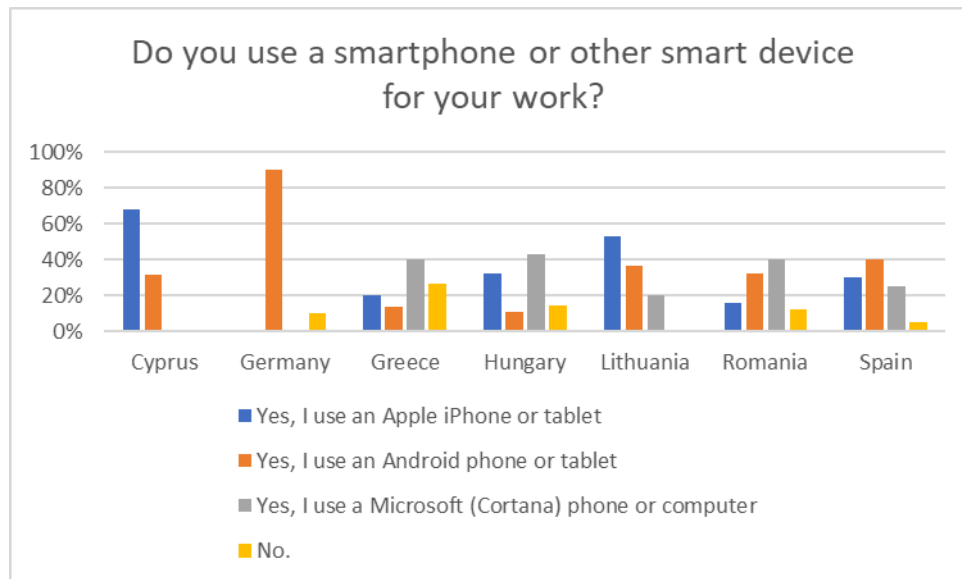
The widespread use of smartphones, which are primarily made up of Android, iPhone, and Microsoft tools, highlights how technology is integrated into everyday life. Understanding this tendency toward tech-savvy behaviour is essential to developing workplace policies and environmental education programs that make the most of digital tools and platforms.

Disposable items and recycling practices

How did you gain knowledge about recycling?

Use of disposable items and recycling rate
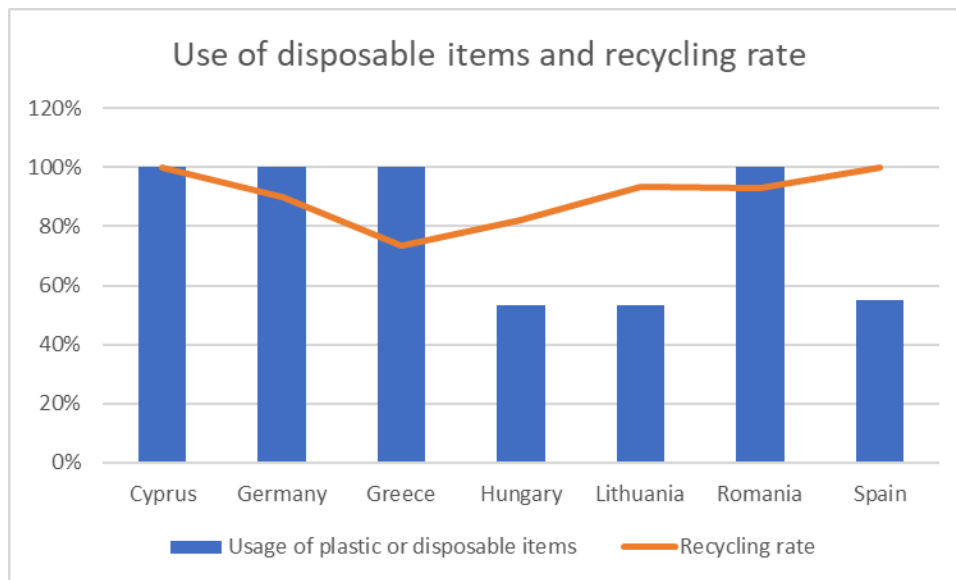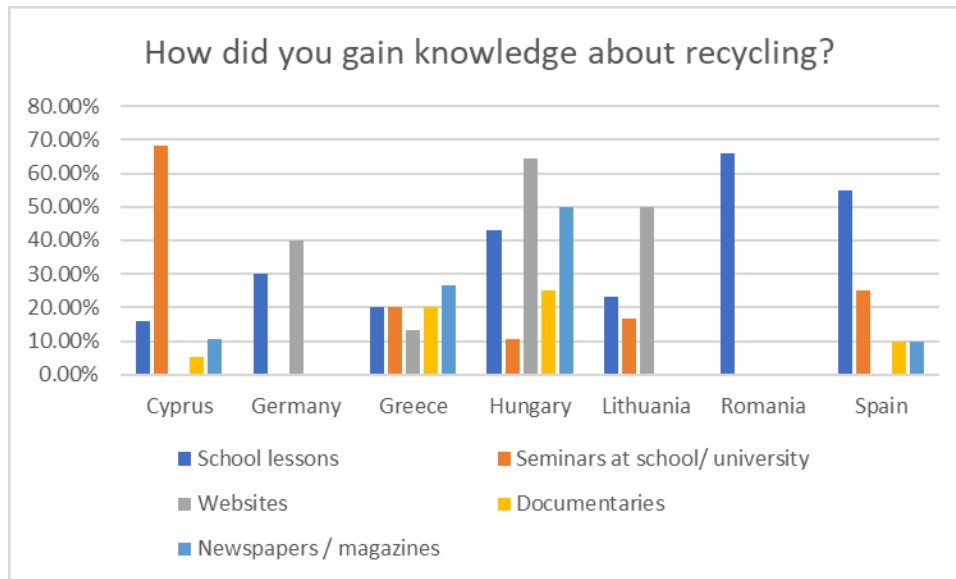
The widespread use of disposable items, which has increased awareness of single-use plastics and their environmental implications, was a common theme among these European countries. Nonetheless, the remarkably high recycling rates among participants indicate an openness to adopting environmentally conscious practices. This trend provides a strong basis for customised

education campaigns that highlight the promotion of sustainable alternatives and the decrease in the use of throwaway items.

Corporate sustainability and carbon footprint considerations

Coutning annual carbon footprint in companies and willingness to change

Which of the following items are recyclable?
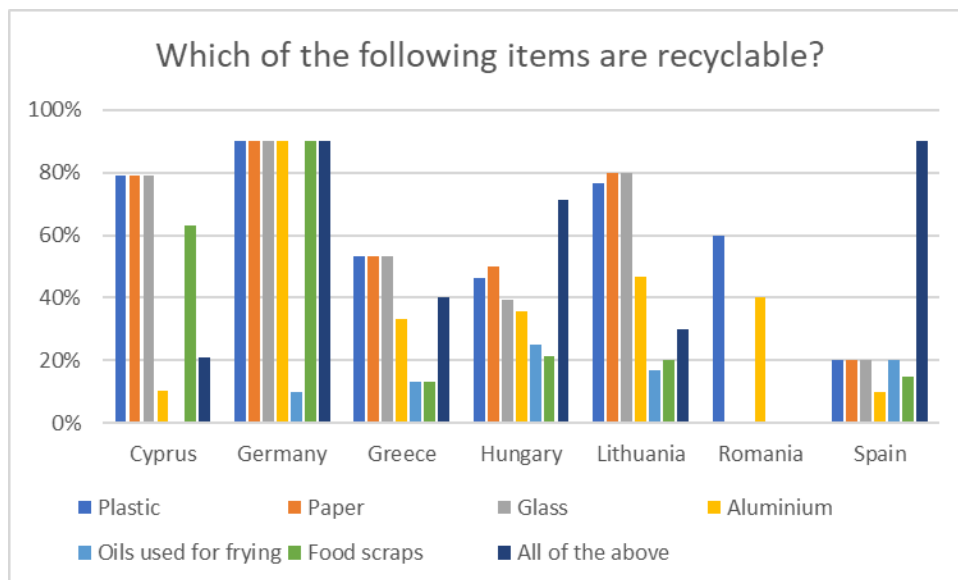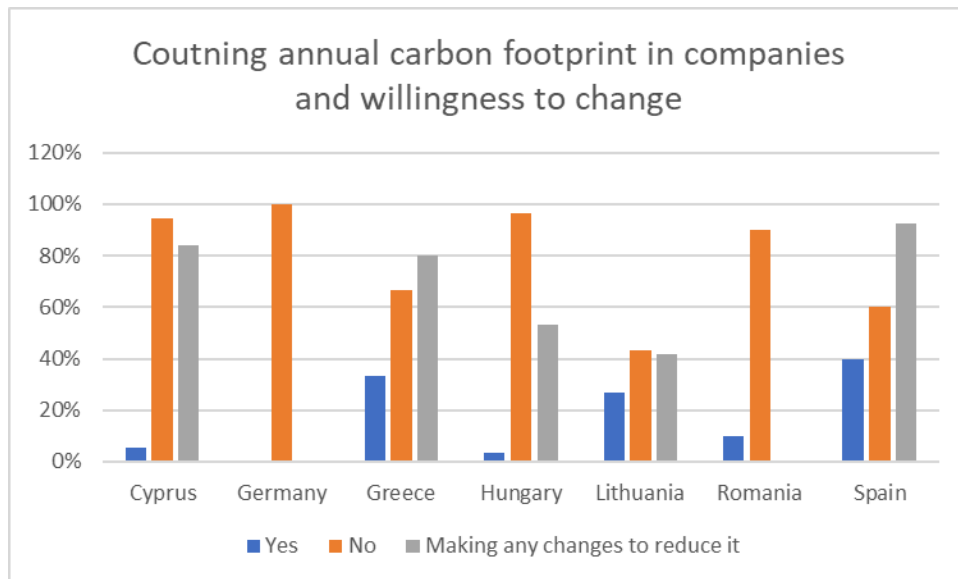
The respondents showed a readiness to accept modifications meant to lower carbon emissions, even though only a small percentage of them calculated their company's annual carbon footprint. This points to a sluggish interest in corporate sustainability initiatives, indicating the need for greater education and organised workplace initiatives to speed up the adoption of greener practices.

Climate change perception and mitigation strategies
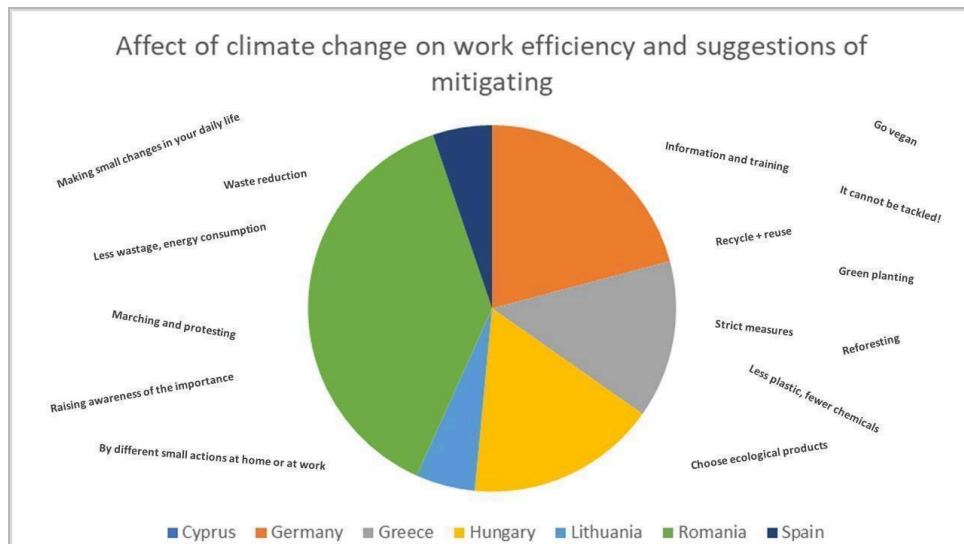
Even though a significant number of respondents did not believe that climate change would have an immediate effect on their ability to do their jobs, they all agreed that proactive measures were necessary. A fertile ground for focused educational interventions is highlighted by suggestions for mitigating climate change, which range from lifestyle modifications to awareness campaigns. This creates opportunities for the youth workforce to take the lead in contributing to climate action.

Conclusion

The combined information gathered from the survey carried out in Cyprus, Hungary, Lithuania, Spain, Germany, Romania, and Greece provides a detailed overview of the attitudes and behaviours young workers have toward the environment in these various European contexts. A broad demographic range appeared, comprising a dynamic 15–35 age group, with a majority of

educated individuals with bachelor's or master's degrees. The complex interactions between work settings, commuting habits, and demography capture the complexity of the European professional scene. Remarkably, the survey revealed a noticeable tendency among younger employees to adopt eco-friendly behaviours. Interestingly, there was conflicting information about the frequency of using throwaway items and the recycling procedures that followed. Even though disposable items were commonly used, high recycling rates indicated a predisposition towards eco-friendly behaviour. This dichotomy emphasises the necessity of focused educational initiatives that support reducing the use of throwaway items and promoting sustainable alternatives.

The integration of technology and everyday life, exemplified by the widespread utilisation of smartphones and digital instruments, represents a crucial avenue for the dissemination of environmental literacy. Developing programs that take advantage of digital platforms fits in with the youthful workforce's tech-savvy attitude and provides a useful means of transferring sustainable behaviours. A minority that calculates their company's carbon footprint in the context of corporate sustainability points to a potential growth area. Nonetheless, a positive trajectory is indicated by the readiness to embrace adjustments meant to lower carbon emissions as well as the understanding of the necessity of taking preventative action against climate change. Workplaces become strategic spaces where environmental responsibility is cultivated through initiatives that go beyond individual practices.

The results highlight particular areas that require improvement, particularly raising corporate sustainability awareness and encouraging more environmentally friendly modes of transportation. Digitally enhanced, customised education programs show potential in tackling these issues. Furthermore, the variety of preferences for heating and cooling in offices offers a platform for investigation into sustainable alternatives and promotion of energy-efficient solutions. The collective analysis concludes with a young workforce that is aware of environmental issues and ready for positive change. The opportunities for focused interventions and workplace initiatives that have been identified provide the framework for developing a more sustainable and ecologically conscious workforce throughout these European countries. Through the integration of education, technology, and corporate involvement, a comprehensive strategy for forming environmentally conscious professionals is made possible.

4. The theory behind Game-Based Learning

Game, gamification, serious games and game-based learning

According to Cheng et al. (2015)[1], a game is an organised play with objectives, rules, and challenges that is played for entertainment. First used in 2008, the term "gamification" has become more and more relevant since the 2010s. Gamification is distinguished from games by its serious intent. Although definitions of gamification vary, they typically centre on one of two things: the process of gaming and game-like experiences in serious contexts, or game elements and mechanics. Gamification is defined as the "use of game elements in non-game contexts" by Deterding et al. (2011, p. 11)[2]. Levels, points, badges, leader boards, avatars, quests, social graphs, and certificates are a few examples of game elements (Zainuddin et al., 2020)[3]. Gamification is defined as "the intentional use of game elements for a gameful experience of non-game tasks and contexts", combining these various viewpoints to provide a possible standard definition. Long before the gamification research field emerged at the start of the decade, gamification mechanics were already in use. Examples of these mechanics include rewards and loyalty programs in marketing and grades in schools. Perhaps as a result of less expensive technology, the tracking of personal data, the game studies movement, and the general popularity of video games as a medium, the concept has been applied and modified more recently to a variety of contexts, including the workplace, health, and education in general (Seaborn & Fels, 2015)[4].

Serious games and game-based learning are two other ideas that are closely connected to gamification. According to Qian and Clark (2016)[5], game-based learning is the process of achieving predetermined learning objectives through game play and content while also incorporating challenges and problem-solving areas that give players—who are also learners—a

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[1] M.-T. Cheng, J.-H. Chen, S.-J. Chu, S.-Y. Chen, The use of serious games in science education: A review of selected empirical research from 2002 to 2013, Journal of Computers in Education, 2 (3) (2015), pp. 353-375, 10.1007/s40692-015-0039-9

[2] S. Deterding, D. Dixon, R. Khaled, L. Nacke, From game design elements to gamefulness: Defining "gamification Proceedings of the 15th international academic MindTrek conference on envisioning future media environments - MindTrek '11 (2011), pp. 9-15, 10.1145/2181037.2181040

[3] Z. Zainuddin, S.K.W. Chu, M. Shujahat, C.J. Perera, The impact of gamification on learning and instruction: A systematic review of empirical evidence, Educational Research Review, 30 (2020), 10.1016/j.edurev.2020.100326

[4] K. Seaborn, D.I. Fels, Gamification in theory and action: A survey, International Journal of Human-Computer Studies, 74 (2015), pp. 14-31, 10.1016/j.ijhcs.2014.09.006

[5] M. Qian, K.R. Clark, Game-based learning and 21st century skills: A review of recent research, Computers in Human Behavior, 63 (2016), pp. 50-58, 10.1016/j.chb.2016.05.023

sense of accomplishment. The goal of game-based learning is to instruct. It is predicated on a complete game, sometimes referred to as a serious game. Serious games, as defined by Abt (1970)[6], go beyond simple entertainment and are meant for a range of serious applications, such as industry, training, or stimulation (Alsawaier, 2018;[7] Connolly et al., 2012[8]). While gamification as a broader concept only uses game components and applies them to the real world, serious games and game-based learning are different from gamification in that they are fully functional games (Deterding et al., 2011)[9]. However, all of these concepts share the idea of using positive gameful experiences for serious purposes instead of focusing on entertainment, such as education or behaviour change.

Effects and outcomes of gamification, serious games and game-based learning

Researchers generally distinguish between behavioural outcomes, (cognitive) learning outcomes, and either affective outcomes, motivational outcomes, or both. This is the case when examining the results of gamification, serious games, or game-based learning. As in Bloom's taxonomy of educational objectives (Bloom, 1956),[10] motivational outcomes are occasionally also categorised as a subcategory of affective outcomes. The fact that games are seen as motivators is one of the reasons gamification, serious games, and game-based learning have gained so much traction. According to Reeve (1996),[11] motivation describes all internal processes that give behaviour its energy and direction and explains the "why" behind human behaviour. According to Keller (2008),[12] motivation is a theoretical concept that appears in behaviour and has the potential to produce favourable cognitive outcomes like better learning and achievement. High-quality motivation, such as intrinsic motivation, is linked to better

[6] C.C. Abt, Serious games, The Viking Press (1970)

[7] R.S. Alsawaier, The effect of gamification on motivation and engagement, International Journal of Information and Learning Technology, 35 (1) (2018), pp. 56-79, 10.1108/IJILT-02-2017-0009

[8] T.M. Connolly, E.A. Boyle, E. MacArthur, T. Hainey, J.M. Boyle, A systematic literature review of empirical evidence on computer games and serious games, Computers & Education, 59 (2) (2012), pp. 661-686, 10.1016/j.compedu.2012.03.004

[9] Op. cit.

[10] B.S. Bloom Taxonomy of educational objectives: The classification of educational goals, D. McKay (1956)

[11] J. Reeve, Motivating others: Nurturing inner motivational resources, Allyn and Bacon (1996)

[12] John M. Keller An integrative theory of motivation, volition, and performance, Technology, Instruction, Cognition, and Learning, 6 (2) (2008), pp. 79-104

outcomes in the educational setting than low-quality motivation, such as motivation via extrinsic rewards.

In addition to motivation, the psychophysiological concept of affect comprises valence, which is an assessment of the subjectively experienced state, and arousal, which is a measure of activation and can be used as a stand-in for motivation (Harmon-Jones et al., 2013).[13] Additional affective outcomes of gamification, serious games, and game-based learning that are linked to the valence dimension include positivity regarding the game or the gamified subject, enjoyment, immersion, and flow. Positive behavioural outcomes are consistently associated with the motivating effects of gamification, serious games, and game-based learning in a variety of contexts, including education, employee training (Obaid et al., 2020),[14] software development, innovation, or energy conservation (Johnson et al., 2017).[15] These include social collaboration and teamwork, engagement and participation, and quantifiable performance improvements in work and academic tasks. Due to these benefits, gamification is being used more and more in a variety of use cases to encourage behavioural change. Examples of these use cases include knowledge transfer, physical activity and pro-environmental behaviour.

Focus on Game-Based Learning

A compelling case that aims to disrupt established learning paradigms encourages game-based learning to become a paradigm-shifting approach in education. This creative teaching strategy was born out of the realisation that traditional methods might not adequately convey the complexities of some subjects, especially ones with as many facets as environmental issues, energy efficiency techniques, and green deal strategies. Game-based learning emerges as a guiding light of motivation, engagement, and improved comprehension as we work through the complexities of these problems. Unlike traditional teaching approaches, which frequently depend on students passively absorbing knowledge, game-based learning capitalises on people's innate desire for play and competitiveness. This change in strategy acknowledges that

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[13] E. Harmon-Jones, P.A. Gable, T.F. Price, Does negative affect always narrow and positive affect always broaden the mind? Considering the influence of motivational intensity on cognitive scope, Current Directions in Psychological Science, 22 (4) (2013), pp. 301-307, 10.1177/0963721413481353

[14] I. Obaid, M.S. Farooq, A. Abid, Gamification for recruitment and job training: Model, taxonomy, and challenges, IEEE Access, 8 (2020), pp. 65164-65178, 10.1109/ACCESS.2020.2984178

[15] D. Johnson, E. Horton, R. Mulcahy, M. Foth, Gamification and serious games within the domain of domestic energy consumption: A systematic review, Renewable and Sustainable Energy Reviews, 73 (2017), pp. 249-264, 10.1016/j.rser.2017.01.134

when educational content is presented in an engaging and interactive way, people—including youth workers in the context of environmental education—are more likely to engage with it deeply. The core components of gaming, like competition, challenges, and rewards, tap into the psychology of motivation, making learning an engaging and dynamic experience.

The capacity of game-based learning to meet each person's unique learning needs is its main advantage. Instead of being a single subject, environmental education is a range of related ideas and real-world applications. The unique platform that games offer allows players to explore, experiment, and learn by doing as theoretical knowledge blends seamlessly with real-world scenarios. Beyond rote memorization, this experiential learning approach fosters a profound and useful understanding of environmental challenges. Moreover, learning through games stimulates intrinsic motivation. Incorporating game elements, like objectives, points, and a feeling of advancement, encourages people to actively engage in the learning process. This dynamic of motivation is especially important when studying topics that require a higher level of environmental responsibility. By adding gaming elements to the educational process, students are transformed from being passive recipients of knowledge into active contributors who voluntarily devote time and energy to their own educational process.

Game-based learning, as opposed to traditional pedagogy, is a sign that educators are recognizing the changing needs of students in the contemporary educational environment. The educational response needs to be as dynamic as the pressing environmental issues. Game-based learning is an innovative approach that deviates from the traditional and is in line with the opportunities and challenges of the twenty-first century. It is evidence of the conviction that play and interaction, when integrated into education, can form a generation of people who are not only aware of the complexity of their surroundings but also possess the necessary skills and internal drive to deal with them.

Environmental sustainability education

Sustainable development has the potential to address numerous global issues, making environmental sustainability imperative for the present and future (Huckle, 2012)[16]. Environmentally friendly behaviours and attitudes can be altered with the support of Environmental Sustainability Education (ESE). As the world's premier organisation for education for sustainable development, UNESCO defines ESE as empowering students to create resilient

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[16] Huckle, John. (2012). Even more sense and sustainability. Environmental Education Research - ENVIRON EDUC RES. 18. 1-14. 10.1080/13504622.2012.665851.

and sustainable communities by overcoming obstacles and making wise decisions that protect the environment, the economy, and social justice.[17]

According to Huckle (2012),[18] ESE entails taking into account "dominant and alternative forms of technology and social organisation or political economy" in addition to "learning to value sustainable relations between people (social relations); between people and the rest of the biophysical world (environmental relations); between the elements that make up that non-human world (ecological relations)" (p. 35). Since K–12 students will be the future's citizens, it is also imperative to raise their awareness of sustainability (Buchanan, Schuck, & Aubusson, 2016;[19] Fielding & Head, 2012[20]). To be effective, ESE for young learners must result in long-lasting behavioural changes; raising awareness alone is not enough.

Games are a great way to help young learners change their attitudes and behaviours toward environmental sustainability. This is due to the fact that games give students the chance to demonstrate their environmental behaviours in secure, simulated environments where they can experiment, try different approaches, and pick up new behaviours all while testing themselves without worrying about making a mistake. Apart from meeting the needs of learners who are visual learners, multitaskers, and cross-media oriented, games in this digital age also help students who don't fit in well with the traditional school system. Indeed, there are a ton of free sustainability games online (Katsaliaki & Mustafee, 2015).[21] While numerous research studies have demonstrated the efficacy of games in fostering enduring attitudes and behaviours pertaining to environmental sustainability, there is a lack of games designed expressly for the purpose of sustainability education.

Sustainability education and game-based learning

Games have been employed as an educational tool for sustainability education for a number of reasons, such as their compatibility with good instructional design principles, their ability to

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[17] UNCESO, What you need to know about education for sustainable development, https://www.unesco.org/en/sustainable-development/education

[18] Op. cit

[19] Buchanan J, Schuck S, Aubusson P. In-School Sustainability Action: Climate Clever Energy Savers. Australian Journal of Environmental Education. 2016;32(2):154-173. doi:10.1017/aee.2015.55

[20] Fielding, K. S., & Head, B. W. (2012). Determinants of young Australians' environmental actions: The role of responsibility attributions, locus of control, knowledge and attitudes. Environmental Education Research, 18(2), 171–186

[21] Katsaliaki, K., & Mustafee, N. (2015). Edutainment for Sustainable Development: A Survey of Games in the Field. Simulation & Gaming, 46(6), 647-672. https://doi.org/10.1177/1046878814552166

incorporate situational learning by utilising real-world issues and scenarios, and their capacity to operate as intricate systems for comprehending environmental systems and the effects that various human actions can have on them. Through these lenses, a number of studies have looked at games for sustainability education.

Instructional design: In a study carried out in a city, Tucker and Speirs (2003)[22] gave residents compost bins and guides explaining how to use them in order to promote environmentally friendly practices for managing household waste. Using survey questionnaires, the researchers discovered that despite predispositions, environmental factors, and other interventions, improvements in cognitive awareness did not result in favourable behaviours. Playing games helps with the affective, behavioural, and cognitive aspects of an attitude in addition to the cognitive one. According to Friedlander et al. (2011),[23] who discussed the biological underpinnings of learning and memory formation in humans, learning is guaranteed when repetition, planned redundancies, multiple modalities, rewards, active engagement, and visualisations are used in instruction. Games are useful for spreading knowledge because they have these characteristics (Cheng & Annetta, 2012).[24] Simulated real-life scenarios in games can also foster empathy. Students demonstrated emotional engagement in an ESE game that centred around caring for a virtual pet (Yang, Chien, & Liu, 2012).[25] In order to maintain their cyber-pet's comfort, players had to operate electric appliances while using less energy.

Utilising both pre- and post-game questionnaires, the students' self-awareness regarding energy conservation was evaluated. An additional post-study survey evaluated their inclination towards energy conservation. In order to assess how students behave while using the system, video recordings of them interacting with the virtual environment were also utilised. According to the results, "participants were willing to decrease energy consumption by changing their current habits regarding the use of electric appliances and could obtain knowledge of energy conservation". The game addressed the affective component of learners' attitudes by eliciting empathy for a virtual pet, which helped learners apply their knowledge of energy conservation

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[22] Peter Tucker & David Speirs, 2003. "Attitudes and Behavioural Change in Household Waste Management Behaviours," Journal of Environmental Planning and Management, Taylor & Francis Journals, vol. 46(2), pages 289-307

[23] Friedlander, Michael & Andrews, Linda & Armstrong, Elizabeth & Aschenbrenner, Carol & Kass, Joseph & Ogden, Paul & Schwartzstein, Richard & Viggiano, Thomas. (2011). What Can Medical Education Learn From the Neurobiology of Learning?. Academic medicine : journal of the Association of American Medical Colleges. 86. 415-20. 10.1097/ACM.0b013e31820dc197.

[24] Cheng, Meng-Tzu; Annetta, Len, Students' Learning Outcomes and Learning Experiences through Playing a Serious Educational Game, Journal of Biological Education, v46 n4 p203-213 2012

[25] Yang, J., Chien, K.H., & Liu, T. (2012). A Digital Game-Based Learning System for Energy Education: An Energy Conservation PET. Turkish Online Journal of Educational Technology, 11, 27-37.

into energy-saving practices. Similarly, Tan and Biswas (2007)[26] used a game to teach students about ecological processes and a balanced ecosystem, utilising a discovery learning environment. Even though there were no clear objectives in the learning environment, they discovered that the students were actively involved in determining how long and how many fish they could keep alive. After a week, written post-tests with multiple choice and free-response questions were given, and the results demonstrated that the students had improved their conceptual understanding. Additionally, observations revealed that even after finishing their task, students remained extremely motivated and involved in the game to keep the fish alive. According to Katsaliaki and Mustafee (2015),[27] these immersive gaming environments not only offer cognitive knowledge but also address the affective aspect of attitude, which facilitates the transfer of knowledge into environmentally friendly behaviours.

Characteristics of Game-Based Learning for Environmental Sustainability Education

As was already mentioned, ESE's emphasis on changing attitudes and behaviours is a good fit for the qualities of DGBL. This section reviews related research as well as literature on DGBL characteristics that are in line with the needs and objectives of ESE. Situated learning through real-world scenarios: It is essential for students to comprehend the dynamics of the world they live in in order to form enduring behaviours that will guarantee a sustainable future (Fabricatore & López, 2012)[28]. Games for environmental sustainability can influence the attitudes of young students who will be tomorrow's energy consumers by utilising real-world scenarios (Knol & De Vries, 2011)[29]. According to Gee (2008),[30] knowledge must be imparted through experience and placed in contexts that support students' development of situated understandings. He contends that the combination of immersion and guidance that games offer allows for situated learning. Furthermore, games facilitate behaviour testing and consequence observation, whereas

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[26] Op. cit

[27] Op. cit

[28] Fabricatore, C., & López, X. (2012). Sustainability Learning through Gaming: An Exploratory Study. Electronic Journal of e-Learning, 10, 209-222.

[29] Knol, E., & de Vries, P. W. (2011). EnerCities, a Serious Game to Stimulate Sustainability and Energy Conservation: Preliminary Results. E-learning papers, 25, 1-10.

[30] Gee, J.P. (2008). Social linguistics and literacies: Ideology in discourses (3rd ed.). New York: Routledge.

real-world settings make it difficult to test behaviour because environmentally unfriendly behaviour's effects don't show up until the issue is widespread (Arbuthnott, 2009)[31].

In the real world, making poor choices now could have disastrous long-term effects, and it is impossible to accurately predict how actions will affect people later on. However, in the virtual world of games, players can experiment, test theories in a secure setting, and fail forward without fear (Knol & De Vries, 2011).[32] Real-world scenario games have proven effective in fostering self-awareness about energy conservation techniques (Yang, Chien, & Liu, 2012)[33], ecological processes and balanced ecosystems awareness (Tan & Biswas, 2007)[34]. Games' realistic scenarios are realistic and evocative of the interconnectedness found in real-world settings.

Learning about how every action or behaviour can have an impact on every other part of a complex system is made easier for students to understand when playing digital games that are designed as complex systems to support sustainability education. For instance, in order to teach students about energy conservation, De Vries and Knol (2011)[35] created a game called Enercities that makes use of intricate systems to illustrate how interconnected the various contexts are. According to student self-reports, they applied what they had learned to energy-saving behaviours at home, like turning off lights, taking shorter showers, shutting off the TV, and adjusting thermostat settings.

Moreover, games fit in ESE because they can be played in both solo and group settings. Via the actions of opponents and other decision-makers, games can create virtual social societies where learners can practise their behaviours (Gee, 2007). Unlike in real environments, systems thinking will help learners think and understand the relationships between events and analyse the outcomes of behaviours in a matter of minutes. Because of this, games provide students options, aid in their decision-making and application of creative solutions, and allow them to observe how their choices affect a complex system. Players participate in cognitively taxing tasks, problem-solving, and decision-making within the context of "ill-structured problems, unpredictable circumstances, emerging system properties and behaviours, and non-linear development of events".

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[31] Arbuthnott, K.D. (2009). Education for sustainable development beyond attitude change. International Journal of Sustainability in Higher Education, 10, 152-163.

[32] Op. cit.

[33] Yang, J., Chien, K.H., & Liu, T. (2012). A Digital Game-Based Learning System for Energy Education: An Energy COnservation PET. Turkish Online Journal of Educational Technology, 11, 27-37.

[34] Op. cit.

[35] Op. cit.

Beyond traditional pedagogy

The idea of adopting game-based learning signifies a break from the constraints of conventional pedagogy, signifying an understanding that the changing face of education necessitates creative solutions. In particular, environmental education faces complex and multidimensional issues that go beyond the purview of traditional teaching strategies. As a dynamic force in education, game-based learning enters the scene and offers a novel viewpoint that goes beyond the confines of conventional wisdom. Information is usually disseminated in traditional educational settings in a linear fashion, with teachers teaching and students learning. However, a more participatory and hands-on learning approach is needed due to the complexity of environmental issues, energy efficiency measures, and green deal strategies. By introducing play, challenge, and competitive elements into the learning process, game-based learning introduces a paradigm shift. It acknowledges that when content is presented in an engaging and interactive way, people—including youth workers involved in environmental education—are more likely to connect with it deeply. Furthermore, this shift away from conventional pedagogy denotes a turn toward a more comprehensive view of education. Games offer a medium through which theoretical understanding melds with real-world application. Learners actively participate in scenarios, make decisions, and observe the immediate results of their actions rather than rote memorization of facts. Learning becomes an active investigation of the intricacies of the environment rather than a passive assimilation of knowledge due to the immersive nature of game-based learning.

Beyond the accepted norms, learners who engage in game-based learning experience a sense of intrinsic motivation. By including game elements like objectives, challenges, and a sense of accomplishment, it is possible to leverage the psychology of motivation. Due to the intrinsic joy and fulfilment that come from learning, students voluntarily devote time and energy to becoming active participants in their own educational journeys. This change from traditional approaches, which frequently depend on outside incentives, to intrinsic motivation signifies a change. The departure from conventional pedagogy also emphasises how flexible education is to meet the needs of the twenty-first century. The educational response must change as pressing global issues, such as environmental issues, become more prevalent. A manifestation of this evolution that meets the opportunities and demands of a contemporary, technologically advanced world is game-based learning. By using games as a teaching tool, education is transformed into a dynamic, captivating process that gives students a passion for solving real-world problems in addition to theoretical knowledge. The transition from conventional pedagogy to game-based learning signifies a recognition that specific subjects necessitate a

break from traditional linear teaching approaches. In order to develop a generation of people who are not only knowledgeable but also passionate and prepared to take on the difficult challenges of their fields, it recognizes the value of engaging, interactive, and enjoyable learning experiences. This shift demonstrates how education has been evolving constantly to meet the needs of a world that is changing quickly.

5. Guidelines for game development

Principles of designing educational games

The field of education has been progressively impacted by the swift advancements in technology. Even though technology is a big part of our lives, in order to make learning environments interesting, inspiring, and ultimately productive, they must be designed with young learner's environments in mind. Young people enjoy playing games, and over the years, a lot of academics have been interested in the idea of educational games. Researchers have been looking into the benefits of creating models of digital game-based learning (DGBL) environments as well as the use of games in educational settings as interest in serious games for learning has grown.

Teachers are being inspired to create their own learning environments by experimenting with digital technologies and gaming principles as a result of the growing interest in DGBL. However, there is a lack of information in the literature about comprehending the principles of DGBL development, which makes it challenging for experts to create and use digital games efficiently. When educators use short-form game genres, like drill-and-practice and puzzle games, it frequently leads to practices. These activities don't fully utilise the affordances of DGBL environments; instead, they are instructional practices with some gaming components, not learning environments. The addition of gaming components by itself does not ensure successful learning outcomes or address the issues with education that DGBL environments are meant to address. As a result, having a solid understanding of the fundamentals of digital game structure and development is necessary to create a productive DGBL environment (Gee, 2005)[36]. While technical expertise is not required to create an educational game, it is crucial to comprehend the building blocks required to create a learning environment that combines gaming and education in a well-balanced way. Excessive gaming can have a negative impact on learning outcomes, just as excessive learning content can make gaming dull and uninteresting. Educators find it difficult to strike a balance between these two elements because game design does not automatically follow pedagogical expertise (An, 2016).[37] While there are some successful examples of DGBL environments created by educators, more research is necessary to determine the best practices and strategies for creating educational environments that incorporate gaming elements. The principles and techniques that will support teachers in overcoming the

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[36] Gee, J. P. (2005). Good video games and good learning. Phi Kappa Phi Forum, 85(2), 33-37.
[37] An, YJ. A case study of educational computer game design by middle school students. Education Tech Research Dev 64, 555–571 (2016). https://doi.org/10.1007/s11423-016-9428-7

pedagogical challenges of fusing educational resources and entertainment elements to create successful and engaging DGBL environments can be identified from the examples of successful DGBL implementation.

Gamification and digital Game-Based Learning

The terms "gamification" and "DGBL" are sometimes used interchangeably when discussing the use of games in education, despite their distinct purposes. Determining the differences between gamification and DGBL is therefore crucial before delving into the topic of DGBL development guidelines. The use of game mechanics outside of a gaming environment is known as "gamification". Though gamification is a topic of great interest for educators (Nah et al., 2014),[38] marketing, business, management, and environmental initiatives have all embraced it quickly. Using interconnected game elements like leaderboards, badges, bonuses, point and levelling systems, and others is a traditional part of implementing gamification principles.

DGBL refers to methods for methodically using stand-alone games to improve students' learning experiences. These kinds of game-based learning exercises don't belong in a big gaming system with interconnected components; instead, they are separate from one another. DGBL is provided in certain instances through a gaming environment created especially for the subject matter (Arachchilage et al., 2016),[39] and in other instances, teachers modify an already-existing game to meet learning objectives even though the game was not created with learning in mind (Ranalli, 2008).[40] DGBL incorporates a game into the learning process, whereas gamification turns learning into a gaming event.

Both approaches encourage participation and long-term motivation in learning while pursuing comparable learning objectives. Although they take different approaches, gamification and DGBL environments aim to solve an educational problem while also inspiring and involving students. DGBL calls for a small-scale adaptation that can be customised to particular learning topics and units without the need to create a gamified system, whereas gamification requires the structure of the entire learning sequence to be adapted to the gaming system. As a result,

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[38] Nah, F. F. H., Zeng, Q., Telaprolu, V. R., Ayyappa, A. P., & Eschenbrenner, B. (2014). Gamification of education: A review of literature. In F. F.-H. Nah (Ed.), 1st International Conference on HCI in Business, HCIB 2014 (Vol. 8527, pp. 401–409). Cham: Springer International Publishing.

[39] Arachchilage, N. A. G., Love, S., & Beznosov, K. (2016). Phishing threat avoidance behaviour: An empirical investigation. Computers in Human Behavior, 60, 185-197.

[40] Ranalli, J. (2008). Learning English with The Sims: exploiting authentic computer simulation games for L2 learning. Computer Assisted Language Learning, 21(5), 441-455.

DGBL environments provide for more flexibility in how learning is implemented and modified to better meet the needs and learning objectives of specific students.

Tailoring games to address specific learning needs

A number of studies have been carried out recently to investigate the effects of gamification on learners' experiences and learning, as well as to apply gamification in education—that is, to change educational systems to better afford similar motivational benefits as games frequently do. While there is evidence that gamification generally improves learners' motivation and engagement in the learning process, there are also instances in which gamification has the opposite effect, discouraging or worsening learning outcomes for certain students. Simultaneously, research has demonstrated that in educational environments, the educational model (i.e., educational system or classroom) must be customised to each student's unique characteristics based on their varied attributes. Because of this, researchers think that personalising the gamification design could be one way to enhance the effects of gamification on the students' experience. As a result, a number of studies conducted recently have brought attention to the difficulties associated with customising gamification to each student's unique attributes.

These studies offer various approaches for customising those systems and look into the significance of doing so based on the unique characteristics of the students. People differ in their personalities, behaviours, and needs. These differences also affect how people interact with computer systems, with each other, and with their study routines. These differences are the basis for the idea of personalization in gamification. Ferro et al.'s (2013)[41] study, which is regarded as one of the first to address the personalization of gamification, provided a theoretical framework for understanding the connections between different personality types and traits. In addition, the authors described player typologies, assuming that this relationship would provide designers with a deeper understanding of the kinds of users for whom the gamified systems are intended. A more recent study examined the variations among the seven models of healthy eating behaviours that were developed for the various BrainHex gamer types. She also suggested two methods for creating convincing game designs. By offering a customised approach to better motivate a specific type of gamer, these approaches were designed to encourage the majority of players without discouraging any individual player. The first book on

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[41] Ferro, L S, Walz, S P, & Greuter, S (2013). Towards personalised, gamified systems: An investigation into game design, personality and player typologies. In Proceedings of the 9th Australasian conference on interactive entertainment: Matters of life and death (p. 7). ACM.

the topic, written by Oliveira and Bittencourt (2019),[42] was released more recently. It discusses the background of customised gamification in education and offers some methods for customising gamification depending on the gender and gamer types. To summarise, research on customised gamification focuses on determining students' unique characteristics and connecting them to the game elements that they prefer. Since this field of study is so new, the majority of studies do not provide in-depth analyses of the learning outcomes that students achieve on customised gamified educational systems.

Incorporating theory into game structures

As the success of educational games depends on their capacity to successfully transmit educational content in addition to their entertainment value, the task of integrating educational theory into the structural design of games is imperative. In order to make sure that the learning objectives are not overshadowed by the gaming experience but are instead fluidly woven into the gameplay, this process entails the careful integration of pedagogical principles. The alignment with accepted learning theories forms the foundation of this integration. Educational games are influenced by theories like constructivism and cognitivism, which highlight the mental processes involved in learning and allow students to actively construct their understanding through experiences. Designers can establish an atmosphere that encourages not just participation but also in-depth understanding and memory retention by firmly basing the game structures on these theories.

The carefully designed game structures promote problem-solving and active engagement, which is consistent with the experiential learning tenets. This method recognizes that people learn best when they are actively involved in worthwhile activities, particularly when it comes to environmental education. Whether they are interactive puzzles, role-playing games, or simulations, the game structures give students a place to experiment, explore, and make choices that will affect their learning process. Another aspect of integrating theory into game structures is the tactical application of feedback mechanisms. Based on behaviourist principles, prompt and helpful feedback is an effective tool for clearing up misconceptions, supporting good decision-making, and assisting students in developing a deeper comprehension of the material. The iterative feedback loop is a crucial component of the gaming experience, as it fosters a sense of advancement and ongoing enhancement. Moreover, the integration of scaffolding principles guarantees that the game structures cater to learners with varying

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[42] Wilk Oliveira, Ig Ibert Bittencourt (2019), Tailored Gamification to Educational Technologies, Springer Singapore, https://doi.org/10.1007/978-981-32-9812-5

proficiency levels. Games follow the zone of proximal development, where players are suitably challenged without feeling overwhelmed, by progressively escalating the difficulty of challenges and offering assistance when required. This scaffolded method keeps learners motivated by encouraging a feeling of accomplishment along the way.

Working memory capacity is taken into consideration in game structure design, which is closely related to cognitive load theory. Learners can concentrate on key ideas without being overloaded with details because information is presented in a way that prevents cognitive overload. This simplified method improves understanding and recall, which is consistent with the main objective of efficient knowledge transfer. Game structures that incorporate narrative components are an effective means of placing information in context. Scenarios and storylines, which connect theoretical ideas to practical applications, give the educational content a meaningful context by utilising the ideas of situated learning. This narrative integration strengthens the content's relevance in the larger context of participants' professional roles while also increasing engagement. It takes a careful balancing act and in-depth knowledge of educational principles and their real-world applications to integrate theory into game structures. Games designers can effectively create structures that bridge the gap between education and entertainment by adhering to established learning theories, encouraging active participation, offering constructive feedback, scaffolding challenges, managing cognitive load, and incorporating meaningful narratives. When this happens, instructional games have the potential to be an effective tool for engaging learners and helping them comprehend difficult concepts on a deeper level.

Diversity and inclusivity in game design

In order to recognize the necessity of creating a learning environment that reflects and respects the diverse backgrounds, experiences, and perspectives of the participants, diversity and inclusivity in the design of educational games are essential components. When it comes to environmental education, where local realities and global challenges collide, game designers must be committed to diversity and inclusivity.

When designing more inclusive and diverse learning games, these following steps are important to be taken:

1. **Mapping of the learners**

   Knowing the learners is the first step towards creating learning games that are more diverse and inclusive. Who do they represent? What are their objectives, driving forces, obstacles,

and histories? How do they learn most effectively? What perspectives, values, and interests do they have? How do they play and obtain games? To obtain information and understanding about the students, one can employ a variety of techniques, including personas, surveys, interviews, and user testing. This will assist the educator in developing educational games that are appropriate, meaningful, and pertinent to their needs.

2. **Choosing the right content**

The variety of learners and the subjects the educator wishes to cover should be reflected in the content of your learning games. Prejudices, biases, and inaccurate information that could harm or exclude particular learner groups should be avoided. The cultural, linguistic, and ethical ramifications of your content should also be taken into account. How will the students view and understand the material? What impact will the content have on their feelings, thoughts, or actions? How will the material fit in with what they already know, think, or value? Content should be selected with accuracy, appropriateness, and consideration for both the educator's learning objectives and the learners'.

3. **Designing for accessibility**

The degree of accessibility of the learning games determines how well they work for users with various abilities, disabilities, or impairments. All learners, regardless of their physical, sensory, cognitive, or emotional conditions, should be able to access the learning games. To make sure the learning games are readable, functional, and robust, you should adhere to the Web Content Accessibility Guidelines (WCAG) and the universal design principles. Additionally, one ought to give their learners' choices and alternatives so they can modify your learning games to fit their interests and requirements.

4. **Using diverse representation**

The way one represents and incorporates various groups of people in the learning games—be they based on gender, race, ethnicity, age, religion, sexual orientation, or disability—is known as representation. To recognize and celebrate the diversity of learners and the wider community, incorporate diverse representation into the learning games. It's best to stay away from marginalising, tokenism, and appropriating particular social groups. To make sure that the people the educator wants to represent in the learning games are real, courteous, and powerful, they should also involve and consult with them.

5. **Encouraging interaction and collaboration**

Learning games should facilitate interaction and cooperation between learners so they can talk to each other and with the game itself. To build a feeling of community, belonging, and engagement among students, you should promote interaction and teamwork in your learning games. To encourage respect, understanding, and mutual learning, the educator should also assist the students in reflecting, talking, and providing constructive criticism. Designing learning games with the social, emotional, and cognitive skills necessary for inclusive and diverse learning in mind is a good idea.

6. **Evaluating and iterating**

Evaluating and iterating your design is the final step towards creating learning games that are more diverse and inclusive. It is recommended that the educator tests the learning games on students and gather input and statistics regarding their usability, accessibility, engagement, satisfaction, and learning outcomes. In order to find any holes, problems, or areas for improvement, they should also evaluate and consider your design choices and process. After that, they should apply their discoveries and understandings to enhance their learning games, and they should keep going until they reach the intended objectives.

In game design, diversity and inclusivity signify a dedication to producing instructive materials that speak to a wide range of users. Through the consideration of demographic, linguistic, cultural, accessibility, and gender factors, game designers help to foster an environment for learning that honours and respects the participants' varied identities and experiences. By doing this, educational games transform from effective teaching tools into platforms that honour human diversity and promote a shared understanding of the pressing global issues we face.

6. Types of outdoor games

Debates on environmental issues

In educational games, debates are a very useful tool that provide players with an engaging way to explore the nuances of environmental issues. Debates stimulate critical thinking and deeper understanding by modelling real-world situations and encouraging participants to participate in organised discussions. The range of environmental issues discussed in these discussions, from sustainable development to climate change, reflects the complexity of the problems that participants may face in their line of work. Debates' capacity to foster critical thinking abilities is one of their main advantages. Instead of being passive information consumers, participants actively conduct research, evaluate the available data, and formulate persuasive arguments. Through this process, they not only get a better understanding of environmental issues, but they also develop the analytical abilities needed to make wise decisions. Debates' structured format gives participants a framework for examining the moral, social, and financial considerations that influence environmental decision-making.

Debates not only improve critical thinking but also play a big role in helping people become better communicators. The participants are required to present their points of view clearly and intelligently in response to those of the opposition. In addition to improving their ability to communicate ideas clearly, this debate process component fosters active listening skills and the ability to hold courteous, well-informed conversations—skills that are essential for productive teamwork in the workplace. Debates inherently involve competition, which increases motivation and involvement. In order to ensure a thorough understanding of the topics at hand and to delve deeply into environmental issues, participants are encouraged to prepare thoroughly for debates. Due to this competitive dynamic, learning becomes an active and participatory process in which participants actively add to the breadth and depth of discussions in addition to absorbing new information.

In addition to their academic advantages, debates give participants a feeling of empowerment. Encouraging people to voice their thoughts and participate in insightful conversations creates a participatory learning environment. As individuals start to understand the clear connection between their choices and opinions and the larger impact on environmental issues, this sense of agency is essential in fostering a commitment to environmental stewardship. Debates also inspire participants to think about and value different viewpoints on environmental issues. A more holistic understanding is facilitated by exposure to a range of perspectives, which supports a thorough and nuanced approach to solving challenging environmental issues. Participants

learn how environmental issues are interconnected and how important it is to take a variety of factors into account when making decisions. Debates found in educational games offer a deep and comprehensive pedagogical approach. They do more than just pass along information; they create an environment that encourages participation, critical thinking, and the acquisition of necessary skills. Debates foster a generation of environmentally conscious individuals with the perspectives and skills necessary to make a positive impact in the real world by immersing participants in discussions on environmental issues. This helps to prepare participants for challenges they may face in their professional journeys.

The role of transformational learning in environmental education

Over the past 30 years, Jack Mezirow, the creator of transformative learning theory, has reformulated it and received constructive criticism from other academics. A fundamental shift in a person's perspective or frame of reference is at the core of Mezirow's transformative learning (Mezirow, 1991,[43] 1997[44]). Mezirow's 10-step model, which was first derived from his research on women's re-entry into higher education, results in a shift in meaning perspective that can be characterised as "a personal paradigm involving cognitive, conative, and affective dimensions" or "psychological structures with dimensions of thought, feeling, and will." "The structure of assumptions and expectations through which we filter sense impressions" is how Baumgartner (2012)[45] defines meaning structures and frames of references, which are currently synonymous. Frames of reference are created by mental habits that originate internally and show up as a viewpoint. Habits of mind are broad, general presumptions that affect how experiences in life are interpreted. A point of view is the external interpretation and causal attribution of events, and it is the manifestation of mental habits. The fundamental presumptions that support a person's worldview undergo a substantial shift, often through a disorienting event, which is at the core of the transformative learning theory.

According to Tisdell (2012),[46] there have been three significant and interconnected developments in the theoretical evolution of transformative learning that have changed the

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[43] Mezirow, J. Transformative Dimensions of Adult Learning. San Francisco: Jossey-Bass, 1991.

[44] Mezirow, J Transformative Learning: theory to Practice, New Directions for Adult and Continuing EducationVolume 1997, Issue 74

[45] Baumgartner L. M. (2012). Mezirow's theory of transformative learning from 1975 to present. In Taylor E. W., Cranton P., & Associates, The Handbook of Transformative Learning: Theory, Research, and Practice (pp. 99–115). San Francisco, CA: Jossey-Bass.

[46] EJ Tisdell: Themes and variations of transformational learning: Interdisciplinary perspectives on forms that transform. The handbook of transformative learning: Theory, research, and practice, 21-36

focus from being primarily educational and individualistic to one that encourages social responsibility and group action. Initially, "reflective discourse" replaced rational discourse (Mezirow, 2000, p. 10)[47], indicating the significance and potency of affective influences in critical reflection. As different forms of consciousness emerge as a result of critical reflection, presumptions and biases can be exposed (Brookfield, 2003).[48] Second, integrating critical theory and its emphasis on emancipation is becoming more and more important. Mezirow did not actively incorporate the active, liberation-based, power relations component to his initial thinking until others pointed out weaknesses and that it included a distinctly Western, middle-class bias. However, he did note the influence of Freire (1970)[49] in his model early in its formulation. His highly personalised and analytical theory of transformative learning was criticised, which resulted in a greater incorporation of the sociopolitical aspects of learning. Third, the theory now recognizes the significance of social context in learning, greatly expanding its individual cognitive focus. More modes of knowing and sensing, like emotions and imagination, are now included in the theory, along with a more ecological framework that encourages discussion of the roles played by power, race, gender, class, and culture as well as the relationship between individual development and social responsibility. According to current theories of transformative learning, this process involves exposing a person to learning scenarios that are potent enough to provoke a reflective reaction that includes realising how sociocultural influences affect one's worldview and persuading the person to question their own dominant worldview. The theory is now the basis of adult environmental education, which is part of the radical adult education paradigm that emphasises "collective conscientization, praxis, and action for social change" (Walter, 2009, p. 18).[50] This is due to the growing emphasis on the recognition of social context, the necessity of social action, and the growing calls among scholars of transformative learning to challenge hegemonic assumptions (Brookfield, 2003)[51]. According to this paradigm, people try to comprehend the relationships between socio-political and cultural systems and come up with solutions that involve both social and personal change.

The definition of adult environmental education is described as "an engaged and participatory process of political and social learning and not solely a matter of individual behaviour change

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[47] Mezirow, J., & Associates (2000). Learning as transformation: Critical perspectives on a theory in progress. Jossey-Bass.

[48] Brookfield, S. (2003). Putting the Critical Back into Critical Pedagogy: A Commentary on the Path of Dissent. Journal of Transformative Education, 1(2), 141-149. https://doi.org/10.1177/1541344603001002007

[49] Freire, P. (1970). Pedagogy of the oppressed. New York: Continuum.

[50] Walter P (2009) Philosophies of adult environmental education. Adult Educ Q 60:3–25. https://doi.org/10.1177/0741713609336109

[51] Brookfield, S. (2003). Putting the Critical Back into Critical Pedagogy: A Commentary on the Path of Dissent. Journal of Transformative Education, 1(2), 141-149. https://doi.org/10.1177/1541344603001002007

and information transmission... links between the environment and social, economic, political, and cultural aspects of people's lives.". The value of transformative learning theory in adult environmental education is clear from these definitions. It does this by first offering a theoretical and strategic foundation for supporting personal transformations toward sustainability, which is thought to encourage social engagement with environmental issues. Second, people discover that they are only one actor in a larger global scene, and that understanding the connections between people, communities, and the global society requires a multi perspective view of the environment. In order to lay the groundwork for an activist response, environmentally damaging frames of reference must be questioned and changed in the first two phases of adult environmental education.

Criteria for a transformative methodology in environmental education

As environmental education is called for to become more metamorphic, participatory, and hegemony-challenging, we think that environmental education can become more effective if four conditions, centred around transformative learning theory, are satisfied. These four requirements include creating an environmental education methodology that:

1. emphasises change over knowledge acquisition;
2. exposes behaviours in a real-world setting;
3. emphasises internal and external influences on contemporary environmental behaviour; and
4. incorporates an interactive approach to problem-solving that calls for a solution.

The overall objective of the criteria is to assist students in stepping outside of their comfort zone and realising how deeply ingrained their attitudes and behaviours are in their surroundings. We think that role-play simulations in a problem-solving setting hold potential as a methodology to instil pro-environment behaviour and foster transformative learning within environmental education. Cranton's (2002)[52] experimental learning and Thomas's (2009)[53] problem-solving approaches are combined in a role-play simulation approach to create a simulation that emphasises the magnifying of our ingrained environmental perspective as influenced by our social and relational environment. Several academic fields have employed

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[52] Cranton, P. in New Directions for Adult and Continuing Education, Volume 2002, Issue 93, Special Issue:Contemporary Viewpoints on Teaching Adults Effectively, "Teaching for Transformation, Spring 2002 Pages 63-72

[53] Thomas, I. (2009). Critical Thinking, Transformative Learning, Sustainable Education, and Problem-Based Learning in Universities. Journal of Transformative Education. 7. 245-264. 10.1177/1541344610385753.

role-play simulations as a means of fostering emotional and cognitive learning. In role-playing, students engage in active learning by "learning by doing" and then reflecting on their experiences. As the laboratory is for the natural sciences, role-play simulations seem to be particularly helpful for learning the social sciences as well because they allow students to gain practical experience and experimentation (Asal, 2005).[54] When properly designed and carried out, role-plays evoke authentic feelings as well as real-world problems and difficulties, making students uncomfortable when reflecting critically on the experience.

Our first criterion, which is a focus on change, is satisfied by role-play simulations because they promote experiences that prompt people to pause and reevaluate their preconceptions. The "disorienting event" (Mezirow, 2009, p. 19)[55] is a major component of transformative learning's power. Mezirow views this incident as being so disorienting and at odds with a person's worldview that it compels them to critically examine it because it challenges their mental habits (Mezirow, 1997).[56] Permanent change is required for environmental adult transformation, and this calls for experiences that are startling enough to cause introspection. In situations where educators feel that traditional teaching formats will not produce the desired level of learning, role-plays are frequently employed. Participants are able to watch and consider their behaviour because role-plays are reflective and interactive, which can be an eye-opening experience where they may have to deal with personal emotions. Our second requirement for environmental education is that it be implemented in a real-world setting. Real-world scenarios are frequently included in role-playing games. Although there are no teaching strategies that can "guarantee" transformative learning, Cranton (2002, p. 66)[57] makes the case that experimental learning may have this effect. Real-world simulations can be used in experimental learning. Learning can transform into a change in behaviour when done in a group context. Students are frequently asked to consider their own presumptions regarding a particular experience. Students can learn that there are various viewpoints regarding real-world experiences by recognizing these presumptions (Mezirow, 1997).[58] Real environmental problems can attract attention and analysis, particularly when they are personal and local.

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[54] Asal, V. (2005). Playing games with international relations. International Studies Perspectives,6, 359–373

[55] Mezirow, J. (2009). Transformative learning theory. In J. Mezirow, & E. Taylor, & Associates, (Eds.), Transformative learning in practice (pp. 18–32). San Francisco, CA: Jossey-Bass

[56] Mezirow, J Transformative Learning: theory to Practice, New Directions for Adult and Continuing EducationVolume 1997, Issue 74

[57] Cranton, P. in New Directions for Adult and Continuing Education, Volume 2002, Issue 93, Special Issue: Contemporary Viewpoints on Teaching Adults Effectively, "Teaching for Transformation, Spring 2002 Pages 63-72

[58] Mezirow, J Transformative Learning: theory to Practice, New Directions for Adult and Continuing EducationVolume 1997, Issue 74

Real-world learning necessitates the recognition of multiple factors. For instance, Prakash and Waks (1985, p. 88) [59]contend that "a conception of self-actualization in which each person's good depends on the common good" must be acknowledged in transformative learning. While it is important to validate each person's experience, people also need to understand that other people do, in fact, have perspectives that may differ from their own and that these perspectives should be respected. Although challenging to achieve, this is essential for environmental sustainability to take place. According to Nieto and Bode (2007)[60] experiences that alter people's perspectives on the world and give them the confidence to take action to better their environment and their place in it are considered transformative learning. Furthermore, "environmental activism provides a framework for expanding our comprehension of the emotional state." (Kovan & Dirkx, 2003, p. 102).[61] Emotions play a significant role in one's experience and are connected to the environments in which people live and learn. Participants' affective responses can be influenced by role-play simulations based on real-world issues, which can help them see environmental issues as intricate and multifaceted. Both external and internal influences on behaviour must exist in order to meet our third criterion. The "inner world" of the learner is a major focus of transformative learning. Because our inner worlds are greatly influenced by our surroundings, they can be fragmented and frequently do not correspond with the outside world (Mezirow, 1997).[62] Our perception of ourselves and the world around us is constantly shaped by our relationships, culture, roles, and upbringing. Role-playing games allow us to interact with both the outside world and our inner selves. People need to grasp this intersection of inner and outer in order to fully interpret their experiences. Without this, our beliefs and presumptions are not questioned or challenged. It is possible for participants to learn how to explain themselves, and the process is frequently both uncomfortable and cathartic. An approach to problem-solving is required for our fourth criterion. Thomas (2009)[63] argues that a problem-based learning paradigm, which emphasises skill building, encourages active learning, and stimulates critical thinking through the use of real-world problems, should be applied to environmental education. Paradigms for solving problems frequently set opposing viewpoints against one another in the pursuit of a solution. In

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[59] Prakash, M. S., & Waks, L. J. (1985). Four conceptions of excellence. Teachers College Record, 87(1), 79-101.

[60] Nieto, S., & Bode, P. (2007). Affirming diversity: The sociopolitical context of multicultural education (5th ed.). Allyn & Bacon.

[61] Kovan, Jessica & Dirkx, John. (2003). "Being Called Awake": The Role Of Transformative Learning In The Lives Of Environmental Activists. Adult Education Quarterly - ADULT EDUC QUART. 53. 99-118. 10.1177/0741713602238906.

[62] Mezirow, J Transformative Learning: theory to Practice, New Directions for Adult and Continuing EducationVolume 1997, Issue 74

[63] Thomas, I. (2009). Critical Thinking, Transformative Learning, Sustainable Education, and Problem-Based Learning in Universities. Journal of Transformative Education. 7. 245-264. 10.1177/1541344610385753.

order to solve problems effectively, people must take into account and think about different viewpoints, even if they don't agree with them. Because it purposefully brings people together to work toward solving real problems in a process-oriented and reflective way that ties the target of inquiry (i.e., purpose) to specific contexts, a particular methodology called action learning has repeatedly demonstrated its efficacy in the learning process (Plauborg, 2009)[64]. The approach fosters critical reflection and insight through the use of pertinent questions. Similar in nature, role-play simulations take things a step further by having participants act out a viewpoint that differs from their own.

Role-play simulations as a potential transformative methodology

Role-play simulations have the potential to facilitate transformative learning, so we think there is room for more study and conversation about them in the context of adult environmental education. As was already mentioned, earlier studies in other fields have demonstrated how well the methodology works to support learning that is more significant and long-lasting. Nonetheless, our survey of the literature indicates that there aren't many articles or research specifically looking at the application of role-play simulations in environmental education. One study offers an illustration of how these kinds of experiences may promote transformative learning: Paschall and Wüstenhagen (2012)[65] Climate Change Policy course for management students in the "Community of European Management Schools" shortly CEMS (CEMS) network. We will give an overview of their course, show how it satisfies our four requirements for transformative methodology in environmental education, and explain why we have chosen this course. This eight-week course comprises conventional classroom knowledge-based learning, which forms the basis for a two-day intensive role-play at the course's conclusion that involves other CEMS institutions. In part, by consulting with delegates to the United Nations Framework Convention on Climate Change, the role-play simulation was created to resemble real-world international climate change negotiations. The goal of their transdisciplinary approach is to educate students on the political and scientific aspects of climate change as well as how it relates to business and management. The role-play incorporates elements such as plenary sessions, working groups, coalition building, media relations, resolution drafting, and final resolution voting that are comparable to actual international climate negotiations.

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[64] Plauborg, H. (2009). Opportunities and limitations for learning within teachers' collaboration in teams: perspectives from action learning. Action Learning: Research and Practice, 6(1), 25–34

[65] Paschall, M., & Wüstenhagen, R. (2012). More Than a Game: Learning About Climate Change Through Role-Play. Journal of Management Education, 36(4), 510-543. https://doi.org/10.1177/1052562911411156

Students were placed in various "countries" at the start of the course, which would be portrayed in the role-play. The majority of their knowledge-based learning in the classroom was devoted to studying environmental issues that are significant to each of their respective nations. Students gained knowledge of the sociopolitical aspects of environmental climate change in addition to scientific and environmental research during this learning process. In addition to learning about the fundamentals of climate change science, each student also gained knowledge of the various needs, concerns, and viewpoints that exist in each nation. All of this was done in advance of the two-day role-play. In the first plenary session of the role-play, conflict and opposing viewpoints were immediately apparent. Delegates from low-lying islands and Africa were particularly outspoken, demanding swift changes to climate policy, while those from wealthier nations were more concerned with protecting their countries' economic interests. The power dynamics between industrialised and developing nations were clearly defined in the first few moments. Furthermore, because the various nations and their coalitions had different ideas about the course of the negotiations, a deadlock was quickly reached. However, in comparison to the preceding eight weeks of classroom instruction, Paschall and Wüstenhagen observed that students' comprehension of environmental issues significantly improved with the role-play. The impact was profound, with students gaining alternative perspectives, some even developing a critical view of their home countries. These experiences led to tangible behaviour changes, as seen in quotes expressing a heightened awareness of environmental impact and a commitment to offsetting emissions during travel.

Prakash and Waks' (1985)[66] quote encapsulates the outcome, emphasising the need to consider both internal and external influences on behaviour. Participants, advocating for countries other than their own, learned the significance of acknowledging diverse perspectives and understanding the self-interests of each country involved in the negotiation. Incorporates interactive problem-solving.

Paschall and Wüstenhagen (2012)[67] adopted an action learning approach in their role-play, aiming for a lasting impact. Modelled after real United Nations negotiations, the simulation demanded a resolution, mirroring the challenges of real-life negotiations. Negotiation skills and managing real emotions were essential for participants to reach a satisfactory conclusion. This problem-solving/action learning method aligns with Belanger's (2003)[68] idea that environmental

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[66] Prakash, M. S., & Waks, L. J. (1985). Four conceptions of excellence. *Teachers College Record*, *87*(1), 79-101.
[67] Op. cit.
[68] Bélanger, P., New Directions for Adult and continuing Education, Special Issue: Environmental Adult Education: Ecological Learning, Theory, and Practice for Socio environmental Change "Learning environments and environmental education"Volume 2003, Issue 99, Pages: 79-88

education is most meaningful within an interactive community. Reflection on experiences within the role-play and real-life situations related to the theme allows participants to understand the emotions felt and decisions/actions taken. In summary, climate change role-play illustrates the potential for transformative learning in adult environmental education. Participants, adopting roles, inherently adopt perspectives, fostering an affective response in an interactive learning setting conducive to reflection. This intensive experience integrates traditional and nontraditional learning methods, enabling a comprehensive examination of both internal and external influences on environmental attitude and behaviour.

Designing fun and motivating activities

The learning process becomes an engaging and joyful journey when entertaining and stimulating activities are incorporated into educational games. This method recognizes that when participants actively participate in the learning process rather than merely receiving information, engagement levels increase. Through the incorporation of a playful element, games can serve as a dynamic and enjoyable medium for exploring complex environmental concepts. Designing enjoyable and inspiring activities requires careful consideration of relevance. A sense of connection is fostered by making sure the activities are relevant to the participants' experiences and in line with the educational goals. Engaging in activities that establish connections between the game's content and actual situations helps participants understand how environmental concepts apply to real-world situations, which amplifies the learning experience's overall impact.

The core of enjoyable and inspiring activities is variety. Games that offer a variety of activities, including creative exercises, problem-solving tasks, and interactive simulations, accommodate various learning styles and keep players interested. In addition to keeping learning engaging and dynamic, diversity also takes into account the various ways that people interact with the information. Adding gamification elements to instructional games is one smart tactic. Adding components like point systems, badges, and rewards adds a motivating and competitive element. Encouraging factors include rewarding participation, setting goals, and engaging in friendly competition. These gamification components stimulate positive learning environments and a sense of accomplishment by leveraging the psychology of motivation. Engaging in virtual field trips to investigate environmental challenges, managing virtual ecosystems through interactive simulations, or working together to solve problems that mimic real-world situations are examples of relevant activities that combine enjoyment and motivation. Innovative and exciting challenges can be added, such as coming up with sustainable practices or designing

eco-friendly solutions. Furthermore, involving participants in outdoor activities such as nature walks or community clean-up initiatives fosters a direct connection between them and the environment, thereby augmenting the enjoyable and experiential aspects of the learning process. The goal of incorporating enjoyable and stimulating activities into educational games is to foster an environment where learning becomes an active pursuit rather than just a means of amusement. Games are a potent tool for igniting a passion for environmental stewardship and providing participants with the knowledge and zeal to tackle real-world challenges because they capitalise on people's intrinsic motivation and add enjoyment to the learning process.

There are following some proposed fun and motivating activities related to environmental education that can be integrated into educational games:

1) **Eco-simulation game**

   Participants take on the role of environmental managers in this virtual simulation. They decide on resource distribution, waste control, and sustainable practices using a dynamic, interactive platform. The game gives players immediate feedback and illustrates how their decisions affect the environment. In a safe, virtual setting, this activity provides practical experience in managing and mitigating environmental challenges.

2) **Environmental scavenger hunt**

   On an outdoor adventure, participants search for and gather objects associated with environmental sustainability. Finding recyclable materials, eco-friendly products, or natural elements can all be part of the scavenger hunt. By actively seeking out and identifying sustainable elements in their surroundings, participants in this activity are encouraged to explore, observe, and develop a deeper connection with the environment.

3) **Green innovation challenge**

   Teams are tasked with coming up with creative, environmentally friendly solutions to deal with particular environmental problems. They must plan, organise, and present their ideas during this creative exercise. Teams can suggest ideas for conserving resources, cutting waste, or utilising renewable energy. In addition to encouraging creativity, the challenge instils a sense of purpose in solving long-term issues with practical applications.

4) **Community clean-up challenge**

   Participants plan and take part in a cleanup effort for the community. This practical, hands-on activity entails tidying up trash and litter in nearby parks, neighbourhoods, or

natural areas. In addition to encouraging environmental stewardship and community involvement, the challenge motivates participants to actively improve the cleanliness and aesthetics of their surroundings.

5) **Nature journaling**

People capture their observations, ideas, and reflections about their interactions with nature in a nature journal. During outdoor activities, participants can jot down details about plants, animals, weather patterns, or personal reflections. This contemplative exercise promotes mindfulness, a relationship with nature, and the growth of an environmental consciousness that goes beyond the game's duration.

6) **Sustainability pledge challenge**

Participants design and start a campaign in their workplace or community to make sustainability pledges. Creating and carrying out programs that support sustainable practices is the task at hand. Participants can plan workshops, start awareness campaigns, or persuade people to live more sustainably. Along with encouraging environmental responsibility, the campaign also develops a sense of group action and community involvement.

7) **Green team challenge**

Teams compete in a series of tasks involving sustainable practices, energy efficiency, and environmental knowledge. The learning process is gamified by this friendly competition. The challenges can take the form of tests, puzzles, and practical assignments that gauge participants' knowledge of green practices and their capacity to apply them in different contexts.

8) **Carbon footprint calculator game**

To determine their individual or workplace carbon footprint, participants use an interactive carbon footprint calculator. After the assessment, they play a game in which they have to choose how to lessen their carbon footprint. There might be scenarios in the game about changing lifestyles, energy usage, and modes of transportation. Through this exercise, participants are urged to reduce their environmental impact by making well-informed decisions.

9) **Upcycling workshop**

Participants in this practical workshop create useful items by creatively repurposing discarded materials. In addition to encouraging participants to think creatively about waste reduction, the activity promotes upcycling. By transforming discarded materials into works of art, furnishings, or useful objects, participants can promote sustainability and creativity.

10) Environmental debate tournament

This activity, which is structured like a tournament, has participants assume roles that represent various environmental issue viewpoints. Teams participate in debating issues like climate change, conservation, and sustainable development by putting out arguments and rebuttals. This exercise develops research, critical thinking, and communication skills while inspiring participants to learn more about the nuances of environmental issues.

To create a dynamic and enjoyable learning experience that encourages participants to actively explore and engage with environmental concepts, these activities can be modified and incorporated into educational games.

7. Setting up games

Logistics and preparation

Organising and planning are two essential components of using educational games in the context of environmental education. To guarantee that the learning process is smooth, interesting, and productive, successful implementation of these activities necessitates meticulous planning, careful consideration of logistics, and thorough preparation. Understanding the target audience and their unique needs is the first step in planning and logistics. It is easier to adapt educational games to participants' preferences and make sure the content is relatable and relevant when the age group, educational background, and cultural diversity are known. When creating activities that participants find meaningful, taking these factors into account is essential to creating a more memorable learning experience. Another crucial component of logistics is the selection of the location. The setting should support the nature of the educational games, whether they are played outside or indoors. Indoor spaces offer a controlled environment for discussions and simulations, while outdoor settings can augment the experiential aspects of some activities. For a flawless execution, it is essential to evaluate the venue's logistical needs, including seating arrangements, technology accessibility, and safety precautions.

During the planning and logistics stage, communication must be done effectively. Participants should be informed in advance of all schedules, expectations, and clear instructions. By doing this, you can guarantee that everyone is in agreement and establish the framework for proactive participation. By giving them pre-game materials, like guidelines or introductory readings, participants are better prepared for the learning process and are encouraged to take a more informed and active role. Aspects related to logistics also include the accessibility and upkeep of any equipment or supplies needed for the games. Whether using printed materials, digital platforms, or props, making sure that everything is available and in working order helps to ensure that the activities are carried out smoothly. A pre-event checklist can be very helpful in making sure that everything you need is ready for the event.

The following are relevant preparation and logistics activities:

1) **Introduction workshops**

    Organise workshops to acquaint participants with the instructional games, learning goals, and event logistics. In order to foster a positive and informed environment, this preparatory

session may incorporate icebreakers, team-building exercises, and an outline of the game mechanics.

2) **Venue walkthroughs**

To acquaint organisers and facilitators with the layout, do walkthroughs of the space prior to the event. This guarantees that logistical factors like tech setup, seating configurations, and emergency exits are taken care of beforehand.

3) **Technology testing**

To identify and fix any possible issues, test any digital platforms or technology included in the games. Before the event, make sure that the audiovisual systems, online platforms, and presentation equipment are all operating as intended.

4) **Participants briefing materials**

Give participants thorough briefing materials ahead of time. This can include rules, expectations, and any readings or other materials that are pertinent. To enhance focus and engagement, mentally and emotionally preparing participants for the educational games is beneficial.

5) **Facilitator training sessions**

Organise facilitator training sessions to make sure they are knowledgeable about the logistics, educational goals, and facilitation strategies. This gives facilitators the ability to lead participants skillfully and handle any unforeseen difficulties that may arise throughout the event.

6) **Logistical run-throughs**

Run through the logistics of the event in a simulated manner. Testing activity setups, resolving any bottlenecks, and fine-tuning the schedule are all included in this. Reviewing the logistics enables any problems to be found and fixed before the event.

Careful planning and precise logistics are critical to the success of educational games in environmental education. Organisers can foster an atmosphere that encourages active learning and engagement by considering the needs of the participants, selecting suitable locations, communicating clearly, and leading pertinent training sessions. The suggested activities support an all-encompassing strategy for planning and logistics, guaranteeing the smooth and effective implementation of instructional games.

Materials and resources

There are a few important factors to take into account when using educational games in the field of environmental education. These factors include materials and resources. The terms "materials and resources" refer to a broad range of components, including interactive tools, digital platforms, printed materials, and real props. The selection of resources ought to be in line with the educational games' learning objectives and take into account the participants' varied needs. Digital platforms can improve interactive simulations and collaborative online components, but tangible props like recyclables, art supplies, or natural specimens may be needed for hands-on activities.

Worksheets, guidelines, and informational handouts are examples of printed materials that are useful tools for giving participants more details and direction. Properly crafted materials not only bolster the instructional material but also act as concrete takeaways for players, extending the learning process well beyond the games' duration. If digital platforms and technological resources are used, they should be thoroughly chosen and thoroughly tested beforehand to guarantee a smooth integration into the educational games. Whether using interactive applications, online collaboration tools, or presentation software, the resources selected should improve the efficacy and general engagement of the learning process. Furthermore, it is imperative to take into account the accessibility of these resources for every participant in order to foster an inclusive environment.

For educational games to be implemented successfully in the context of environmental education, pertinent materials and resources are necessary. In order to improve the educational process, accommodate a variety of learning preferences, and provide participants the means by which to actively engage with environmental concepts, these resources have been carefully chosen and thoughtfully incorporated. These resources could be:

1. **Prop kits for interactive activities**

    Prop kits are carefully assembled collections of tangible items meant to support interactive activities. For example, a recycling project could involve scissors, glue, markers, and other craft supplies along with a variety of recyclable items. With the help of these kits, users can actively engage in activities that promote a tactile and kinesthetic understanding of environmental concepts. These props' tangible quality gives the educational process a sensory component that helps make abstract ideas more relatable and memorable.

2. **Printed educational materials**

Worksheets, instructions, and informative handouts are examples of printed materials that are useful tools to go along with the educational value of the games. These resources can provide participants with extra details, detailed instructions, and reference materials to use both during and after the games. Effectively designed print materials help create a thorough and well-structured learning environment by giving participants concrete takeaways that reinforce important environmental concepts.

3. **Interactive digital platforms**

A dynamic and captivating element is added to educational games by utilising interactive digital platforms, such as educational apps, online simulations, or collaborative tools. These platforms can support interactive learning, data visualisation, and real-time collaboration. For instance, in an online simulation, users could be able to investigate virtual ecosystems or practise their environmental knowledge through interactive tests. In addition to satisfying the tech-savvy tastes of contemporary students, interactive digital platforms can raise the general level of engagement and efficacy of instructional games.

4. **Audiovisual presentations**

In order to hold participants' interest and effectively communicate complex information, visual components are essential. When combined with multimedia components like photos, videos, and infographics, audiovisual presentations can be powerful instruments for introducing important ideas, showcasing real-world examples, and offering visual aids for discussions. Presentations that are well-designed support a multimodal learning environment, accommodating a range of learning styles and improving the general retention of environmental information.

5. **Virtual Reality (VR) or Augmented Reality (AR) tools**

Adding VR or AR tools to instructional games adds a creative and engaging element. Participants may gain a more experiential and realistic understanding of some concepts by interacting with virtual or augmented environments pertaining to environmental topics. For instance, participants could use augmented reality to superimpose environmental data onto actual locations or virtually tour a contaminated area that is undergoing environmental restoration. With the innovative approach these tools provide, participants can become more engaged and feel a stronger connection to environmental issues.

6. **Online collaboration tools**

Online collaboration tools are essential for encouraging teamwork and communication among participants in virtual or hybrid settings. Group communication, file sharing, and collaborative document editing platforms facilitate easy communication between users, building a sense of community and mutual education. These tools ensure that learning experiences are not limited by physical boundaries by supporting the collaborative aspects of educational games, particularly when participants are geographically dispersed.

7. **Environmental data and case studies**

The content of educational games is enhanced through the provision of pertinent environmental data, case studies, and real-world examples. Participants can apply theoretical knowledge to real-world scenarios as they analyse and discuss contemporary environmental challenges. Including current data gives the learning process a dynamic and up-to-date aspect that keeps participants interested and connected to environmental issues that exist in the real world. This strategy promotes critical thinking and gives participants the ability to use what they've learned to address current environmental issues.

The success of educational games in environmental education is greatly influenced by the choice and incorporation of pertinent materials and resources. These resources have been carefully selected to support a variety of learning styles, correspond with learning objectives, and provide a thorough and stimulating learning environment. By giving participants the tools to actively investigate and comprehend environmental concepts, the suggested materials and resources help them develop a stronger bond with the material and create a more memorable learning experience.

Outdoor space considerations

When utilising outdoor spaces in educational games for the purpose of environmental education, intricate considerations arise. In addition to providing participants with an opportunity to engage with nature and experience real-world scenarios, the outdoor environment is a dynamic and multifaceted setting that can significantly enhance the learning experience. Including outdoor areas for educational games requires a thorough evaluation of the selected site. Whether it is held in a nearby park, natural area, or specially designed outdoor learning centre, the venue should be perfectly in line with the goals of the activities. An environment as liberating as the outdoors promotes mobility, discovery, and hands-on involvement, making learning more dynamic and experiential. The effective integration of outdoor spaces is heavily dependent on logistical factors. The space must be assessed by the

organisers to make sure it can support the activities that are scheduled, taking into consideration elements like seating configurations, accessibility, and the availability of necessary supplies. Evaluating the outdoor venue's ability to accommodate both planned and unplanned activities is essential for a comprehensive learning experience.

It's important to consider the facilities and amenities that are offered in the outdoor area. The availability of facilities, safety, and other essentials enhances participants' general comfort and wellbeing. Sufficient preparation guarantees that the outdoor setting transforms into a stimulating educational backdrop, reducing the possibility of disturbances and enabling players to completely engross themselves in the instructive games. The exposure of outdoor spaces to natural elements is one of their distinguishing characteristics. Weather-related considerations must be taken into account by organisers even though this offers a novel and authentic learning context. To ensure everyone's safety and enjoyment, backup plans should be in place for inclement weather, such as heavy rain or extremely high temperatures. By taking this proactive stance, it is ensured that the educational games can adjust to the unpredictable nature of outdoor settings.

The following are relevant activities that make the most of outdoor areas:

1) **Nature walks and observations**

   A fundamental activity that inspires people to investigate and study the environment is taking a nature walk. Participants set out on a journey to identify local flora and fauna, investigate ecosystems, and see how interconnected nature is, escorted by environmental experts or educators. Participants gain a deep understanding of the biodiversity and ecological processes in their environment through close observation.

2) **Outdoor simulations and games**

   The outdoors offer a realistic setting for role plays and simulations that immerse participants in actual situations. In a roleplay, for example, participants might take on the role of environmental stewards charged with making decisions regarding resource management, conservation tactics, and land use. The outdoor environment adds to the scenarios' realism and makes it possible for participants to apply abstract concepts in a dynamic and engaging way to real-world scenarios.

3) **Eco-friendly demonstrations**

   Participants can see sustainable practices up close when eco-friendly demonstrations take place outside. Waste reduction tactics, renewable energy installations, and organic

gardening methods are a few examples of demonstrations. A deeper understanding of sustainability is fostered by transforming the outdoor setting into a living laboratory where participants can see, touch, and experience eco-friendly practices.

4) **Collaborative outdoor projects**

Collaborative outdoor projects foster a sense of shared environmental responsibility and teamwork among participants. Projects can include making eco-friendly installations, organising tree planting campaigns, or cleaning up communities. These practical initiatives empower participants and foster a sense of group action in addition to aiding in environmental conservation.

5) **Outdoor debates and discussions**

Organising talks and debates outside gives intellectual conversations a revitalising and motivating twist. To study and discuss environmental issues, participants can congregate in a natural amphitheatre or in designated discussion areas. The natural setting fosters critical thinking, open communication, and the exchange of differing viewpoints, all of which improve the educational process.

These activities are made to take advantage of the special features of outdoor environments, giving participants a comprehensive and engaging learning experience. These outdoor-based activities use nature—whether through direct interaction with it, dynamic simulations, practical demonstrations, group projects, or candid conversations—to strengthen participants' connections to environmental ideas and promote a sense of duty and care.

Safety measures

Participant safety and well-being is a fundamental element that needs to be given top priority during the planning and implementation of events. Safety precautions cover a wide range of topics, from mental and psychological health to physical safety. The learning environment may introduce extra variables in outdoor settings, so organisers need to do thorough risk assessments and set up procedures to deal with any issues that may arise.

The first step in ensuring physical safety is a thorough assessment of the selected location. Potential dangers like uneven ground, tripping hazards, or potentially dangerous natural features must be noted by the organisers. To reduce these risks and give participants a safe environment, appropriate signage, barriers, and preventative measures should be put in place.

The weather is a major factor in participant safety when it comes to outdoor activities. It is important to have backup plans in case of inclement weather, such as heavy rain, intense heat, or freezing temperatures, to make sure that everyone is safe and ready. Participant well-being is enhanced by having access to shelter, hydration stations, and provisions for extreme temperatures. Safety from an emotional and psychological viewpoint is equally important. It is important to consider potential triggers and emotional reactions when designing activities. In order to create an atmosphere where participants feel free to express themselves and participate in discussions without worrying about being judged, facilitators must be welcoming and supportive.

When it comes to educational games that are used in the context of environmental education, it is critical to prioritise safety measures in order to protect participants' overall health and enjoyment. These safety precautions take a holistic approach, taking into account participant emotional and psychological well-being, weather-related emergencies, and physical safety. The procedure starts with a thorough examination and risk assessment of the selected location. The organisers carry out a comprehensive assessment, spotting possible dangers like uneven ground or places where people could trip and fall. By putting in place suitable barriers, signage, and preventative measures, risks are reduced and participants are provided with a safe environment. Because they understand how weather affects safety, event planners create detailed plans for inclement weather. This guarantees that participants are suitably attired and protected and includes preparations for inclement weather, intense heat, or cold. The general comfort and well-being of participants is enhanced by offering access to shelter, distributing weather-appropriate gear, and having alternate indoor spaces available.

Protocols for emergency response are essential components of safety precautions. In order to enable prompt responses, organisers lay out precise protocols for handling accidents or unanticipated events, along with communication strategies. Basic first aid is taught to facilitators and event staff, and emergency services are easily accessed in case of unanticipated circumstances. Participants receive thorough briefings detailing safety precautions, emergency protocols, and behavioural guidelines prior to participating in activities. Effective communication guarantees that participants are prepared to safely navigate the learning environment and are aware of any potential risks. The process of briefing others helps everyone understand safety procedures.

Ensuring the emotional and psychological safety of participants requires the creation of an inclusive and supportive environment. In order to promote an environment that values respect, empathy, and candid communication, facilitators are essential. The learning environment is kept

positive by fostering an environment where participants are encouraged to express themselves without worrying about being judged. By giving facilitators the abilities and information required to properly supervise activities, facilitator training strengthens safety precautions even more. Training sessions equip facilitators to proactively manage the learning environment by covering safety protocols, risk assessment procedures, and emergency response plans. In summary, safety precautions are an essential commitment to the welfare of players in educational games as well as a necessary procedural requirement. Through the consideration of physical, weather-related, and emotional safety, organisers establish a secure learning environment that enables participants to fully immerse themselves in the life-changing power of environmental education games.

Facilitation techniques

Communication strategies

The initial stage in developing a communication strategy is to clearly state your goals and objectives. Before starting any educational games, the organisers need to make clear what the activities' main goals are, what kind of learning outcomes they hope to achieve, and how these projects relate to the larger objectives of environmental education. This clarity creates a shared understanding of the educational journey and prepares the ground for participant engagement. Transparent and inclusive communication is crucial during the planning stage. It is the responsibility of the organisers to inform participants about the format of the games, the order in which the activities are to be completed, and any necessary preparations. By ensuring that participants are informed and ready, this proactive communication helps to ensure that the educational games are implemented smoothly and efficiently.

Using efficient communication techniques is essential to developing a dynamic and interesting learning environment when it comes to educational games for environmental education. These tactics consist of a complex process that starts with the precise formulation of aims and objectives. Through clear communication of the overall goal and the educational games' connection to environmental education, organisers foster participant buy-in and create a shared understanding of the significance of the learning journey. Clear planning communication also makes the preparatory stage better by making sure everyone knows the format, order, and steps that need to be taken. This transparent communication maximises participants' capacity to participate in the planned educational games actively and meaningfully while also fostering a

sense of readiness among them. Effective communication is greatly aided by facilitators, who act as central figures directing participants. The provision of contextual information for every task, clear instructions, and attentiveness to participants' needs all combine to create a communication dynamic that supports a positive learning environment. The success of the instructional games as a whole depends on the interaction between the facilitator and the participants.

Using technology into communication adds a level of accessibility and immediacy. Using real-time channels for communication, organisers can disseminate announcements, distribute additional materials, and encourage continuous participation. By using technology, participants can access resources, ask questions, and engage virtually, expanding the learning experience beyond the boundaries of the educational games. Creating feedback channels is an essential component of communication plans. Organisers encourage a sense of participant agency by giving participants a platform to voice their opinions, offer insights, and offer feedback on the educational process. By guaranteeing the relevance and efficacy of upcoming educational games, this iterative feedback loop helps to continuously improve their design and execution. An enriched and participatory learning environment is created in educational games for environmental education through the use of the successful communication strategies discussed, which range from clearly defining goals and open communication during planning to engaging facilitators, integrating technology, and providing feedback mechanisms. These tactics not only help activities run smoothly but also encourage cooperation and a feeling of common goal among participants, organisers, and facilitators.

Engagement of participants

The design phase is where engagement strategies start, when planners carefully create activities that speak to participants' interests and support the main objectives of environmental education. Through the integration of gamification, storytelling, and interactive elements, organisers craft an engrossing framework that captivates participants and stimulates their active engagement. Facilitators play a critical role in encouraging participant engagement. In addition to acting as mentors, facilitators also act as exhorters, urging participants to engage in the activities with passion. An effective facilitation style encourages excitement and engagement among participants and is characterised by clear communication, positive reinforcement, and flexibility in response to the dynamics of the group.

Using a variety of learning styles increases participant engagement even more. Participants' diverse needs are met by educational games that take into account their preferences for interactive, kinesthetic, visual, and auditory learning. This inclusive approach maximises engagement and comprehension by enabling individuals with diverse learning styles to fully immerse themselves in the learning process. Additionally, a smooth integration of technology can increase participant engagement. The integration of interactive platforms, virtual reality, or gamified elements in educational games offers a contemporary and dynamic learning environment to participants. These innovations in technology not only accommodate modern tastes but also infuse the learning process with freshness and excitement. Facilitating teamwork and group dynamics is an additional aspect of engaging participants. Including tasks that require collaboration, problem-solving, and group decision-making not only increases participant engagement but also builds a sense of community. Learning in a social setting makes for a more fulfilling and interesting educational experience.

The customised planning of activities is the first key tactic. It is fundamental to design experiences that speak to participants' interests and make a clear connection to the larger objectives of environmental education. Organisers create a dynamic framework that not only captures participants' attention but also encourages their active involvement in the learning process by incorporating elements of gamification, storytelling, and hands-on experiences. One of the main factors influencing participant engagement is the facilitator. Participants are incentivized to actively engage in the educational games by their motivational facilitation styles, which are typified by transparent communication and flexibility in response to group dynamics. Beyond providing direction, the facilitator's job is to instil a sense of excitement and camaraderie among the participants.

Acknowledging and meeting the needs of various learning styles is another essential component of engaging participants. Educational games that combine visual, aural, kinesthetic, and interactive elements are inclusive and let players with different learning styles engage with the material to the fullest extent possible. This all-encompassing strategy improves understanding and engagement by taking into account the various ways that people learn. The incorporation of technology enhances participant engagement even more. Virtual reality, gamification, and interactive platforms are seamlessly integrated to give the learning environment a modern, dynamic touch. These tech improvements, which are in line with modern tastes, help to keep players' interest and excitement levels high during the instructional games.

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Debriefing participants

Debriefing is crucial because it can turn the educational game from a collection of exercises into an engaging educational experience. It acts as a link between the player's experiential gaming experience and their cognitive comprehension of the underlying ideas. Participants are assisted in thinking back on their experiences, expressing their insights, and making connections between them and more general environmental education goals through debriefing.

Enabling the conversion of experiential knowledge into practical learning is one of debriefing's main functions. Debriefing facilitates a more in-depth examination of the environmental concepts incorporated into the activities by asking participants to discuss their observations, difficulties encountered, and tactics used during the game. Through this introspective process, players can place theoretical knowledge in the context of the game's realistic, real-world scenarios. Additionally, debriefing fosters an open, cooperative learning environment. Participants can listen to differing points of view, share their own, and work together to make sense of the experiences. Participants' sense of community is fostered as well as understanding is improved by this cooperative exchange. Debriefing sessions turn into exchanges of knowledge where one person's insights broaden the group's collective understanding.

Debriefing is also essential for reiterating the connection between the experiential activities and the main objectives of environmental education. Participants are assisted by facilitators in making links between the game's experiences and the more general ideas of sustainability, environmental preservation, and energy efficiency. Through this process, participants are better able to internalise the concepts they have learned and how they apply to their real-world

situations. Debriefing is crucial because, at its core, it can take the educational game from a set of exercises into a fully immersive learning environment. Das Debriefing entwickelt sich zu einem entscheidenden Werkzeug, um den Einfluss von Bildungs Spielen auf das Verständnis der Teilnehmer und die Anwendung von Umweltkonzepten zu optimieren, indem es Reflexion fördert, kooperatives Sinnverstehen unterstützt und Verbindungen zu allgemeineren Zielen der Umweltbildung verstärkt.

Structuring post-game discussions

The dedication to ensuring that game reflections and takeaways purposefully align with educational goals is at the heart of an effective debriefing. Key orchestrators, facilitators lead participants through an organised reflection process that goes beyond narrating experiences and dives deeper into the examination of underlying environmental concepts. Creating a secure and welcoming atmosphere is clearly the first important step in organising conversations after games. This fundamental stage promotes open communication among participants as they freely exchange ideas, viewpoints, and candid reflections on their gaming experiences. By establishing a positive and nonjudgmental tone, facilitators foster an environment of trust and transparency that is necessary for productive dialogue. A methodical approach to debriefing entails purposefully posing queries that encourage introspection and critical thought. Using well-chosen questions, facilitators encourage players to reflect on their own decision-making, analyse the effects of their choices, and draw links between game experiences and more general environmental concepts. This deliberate probing leads players to a deep comprehension of the ideas woven throughout the game.

In addition, organising post-game talks requires encouraging participants to actively participate. Fostering a collaborative learning environment is achieved by encouraging them to actively listen, answer questions, and share their perspectives. This dynamic of sharing knowledge among all members of the group improves individual comprehension while also adding to the overall experience. Adding multimedia or visual aids to the debriefing process is one way facilitators can improve it. In addition to providing participants with a visual anchor to refer to during discussions, visual representations serve to summarise complex concepts, emphasise important points, and show the connections between game actions and real-world implications.

Facilitating post-game discussions with a structured framework also helps participants arrive at practical conclusions. The role of facilitators is to help participants translate their thoughts into practical lessons that can be applied in everyday situations. This revolutionary step guarantees

that the educational game gives players real-world insights and skills related to energy efficiency and environmental sustainability, in addition to imparting knowledge. To summarise, the optimization of educational games for environmental education necessitates the methodical organisation of post-game conversations. In order to make sure that the debriefing process turns into a catalyst for meaningful learning and the real-world application of environmental concepts, facilitators play a crucial role in creating a safe and inclusive environment, encouraging active engagement, asking insightful questions, incorporating visual aids, and directing participants toward actionable insights.

Extracting learning points

The key to making sure that players absorb the core environmental ideas that the educational game aims to impart and don't just interact with it, is the extraction of learning points. Taking on the role of guides, facilitators skillfully steer conversations toward the identification of major conclusions, overarching themes, and the real-world applications of learned information in both personal and professional contexts. One essential aspect of this process is getting players to think back on the decisions they made during the game and to weigh the pros and cons of those choices. By means of this facilitated contemplation on cause-and-effect relationships within the game context, facilitators cultivate a deep comprehension of the environmental principles that are intrinsically linked to the activities.

Furthermore, the process of extracting learning points broadens its scope by creating links between the game's simulated scenarios and the larger picture of environmental challenges and sustainability objectives. Participants are skillfully guided by facilitators to make connections between the simulated experiences and real-world problems related to energy conservation, environmental preservation, and sustainable practices. This intentional link highlights the potential impact of the learned information on resolving urgent global concerns and increases its relevance. To extract learning points, facilitators use a variety of interactive techniques like brainstorming sessions, group discussions, and cooperative exercises. These dynamic approaches promote a shared understanding and collective ownership of the acquired knowledge by not only empowering participants to actively contribute to the synthesis of insights but also by diversifying perspectives.

The process of extracting learning points serves as a crucial link that smoothly connects the regulated setting of the educational game to the unpredictable difficulties encountered in real life. Throughout the game, facilitators skillfully assist players in distilling overarching themes and

useful insights. They then position this knowledge as a catalyst for making informed decisions in both their personal and professional lives. In conclusion, the key to the success of educational games for environmental education is the extraction of learning points. Through their skillful direction and skillful connection-making, facilitators are invaluable in helping participants to distil deep insights, pinpoint important takeaways, and forge strong links between game experiences and practical applications. In addition to supporting learning objectives, this transformative process gives participants the real-world knowledge and abilities they need to successfully navigate the complex terrain of environmental sustainability.

Encouraging reflection and action

Encouraging reflection is a transformative step that helps players understand the game's environmental concepts and internalise the wider consequences of their decisions and experiences. In order to encourage participants to think critically about how the lessons they have learned relate to their personal values, professional obligations, and larger societal roles, facilitators are essential in creating a reflective mindset. Moreover, this reflective process includes thinking about how the learned material might be applied in the actual world. It is suggested that players consider how the environmental ideas and tactics they have learned in the game can be applied to practical projects in their homes, workplaces, or communities. In order to match the game's lessons with players' roles as change agents in the field of environmental sustainability, facilitators assist this envisioning process.

Reflective contemplation naturally leads to the encouragement of action. After considering the experiences they had in the game and their wider ramifications, participants feel equipped to take proactive measures to adopt eco-friendly behaviours. Facilitators assist participants in developing concrete plans and in identifying particular actions, rules, or programs that can be implemented to promote energy efficiency and environmental preservation. The debriefing environment's collaborative nature can be used by facilitators to promote group action. The activity prompts participants to think about how their combined efforts can increase the impact of individual actions, promoting a commitment to working together to address environmental challenges and a sense of shared responsibility. Individual reflections are transformed into a common environmental stewardship ethos by this collective dimension.

Furthermore, the promotion of introspection and action goes beyond short-term adjustments to include cultivating an attitude of ongoing development and adaptation. Acknowledging that the pursuit of environmental sustainability entails an iterative process of learning, reflection,

and responsive action, participants are guided to view their actions as part of an ongoing journey. To sum up, facilitators enable participants to consider the broader ramifications of their experiences, imagine practical applications, and take proactive steps toward environmental sustainability through their guidance. Instilling a proactive mindset and reinforcing the educational objectives, this process positions participants as agents of positive change in the field of environmental stewardship.

Illustrative examples

Sample game scenarios

Through the influential lens of gamification, sample game scenarios can reveal a tapestry of varied and immersive experiences that have been painstakingly crafted to facilitate environmental education. These scenarios serve as excellent resources because they are templates that give educators and facilitators a flexible toolkit that they can use to create engaging, interactive, and instructive games. One especially interesting scenario takes place in the corporate simulation setting, where participants assume the roles of employees in an eco-friendly company. Participants in this dynamic scenario must make decisions about energy use, waste management, and sustainable practices that are reminiscent of real-world difficulties. By means of these decision-making procedures, participants navigate the complex terrain of corporate environmental responsibility, acquiring significant understanding of the obstacles and tactics utilised by entities dedicated to ecological stewardship.

In a different immersive scenario, participants take on roles in a neighbourhood facing environmental challenges while fully immersed in a community-based context. The game is played as a cooperative project in which players work together to solve community problems like energy conservation, green spaces, and waste disposal. In addition to encouraging collaboration and group problem-solving, this scenario instils a strong sense of local environmental stewardship by highlighting the significant role that each person plays in the wellbeing of their immediate surroundings. A third sample game scenario puts players in the role of representatives from various nations negotiating environmental policies, taking a more expansive, global view. This scenario, which is placed in a global context, encourages a sophisticated comprehension of how environmental issues are interconnected globally. As they struggle to come to an agreement on sustainable practices, participants acquire a more nuanced understanding of the importance of global cooperation in tackling urgent environmental issues.

These sample game scenarios are characterised by their adaptability and scalability. Designed to accommodate a wide range of learners and learning goals, educators and facilitators can tailor scenarios according to participants' interests, backgrounds, and the environmental themes they want to focus on. These scenarios fit in well with a variety of learning environments, including interactive workshops, formal classrooms, and extensive training sessions. In addition to being flexible, the scenarios also include aspects of cooperation, competitiveness, and strategic

decision-making, which boosts player interest and motivation. The interactive features of these scenarios not only make learning enjoyable, but they also support the retention of environmental concepts and knowledge through hands-on learning. These scenarios provide educators and facilitators with flexible and dynamic tools that enable them to design immersive learning experiences that engage learners from a variety of backgrounds. These scenarios, which can be set in fictitious corporate, community, or global contexts, aim to cultivate a generation of environmentally conscious change agents by teaching participants cooperative problem-solving skills and a proactive mindset in addition to environmental awareness.

Case studies of successful implementations

The case studies that follow will offer a detailed look at effective uses of educational games in the context of environmental education. These case studies shed light on actual situations in which the incorporation of gamification has engaged participants and promoted a deep comprehension of environmental concepts.

An example of the powerful impact of gamification in formal education settings can be seen in the first case study, which shows how an environmental education game was incorporated into a high school curriculum. Teachers carefully incorporated the game into lesson plans, customising it to meet particular learning goals. In order to address issues with waste minimization, energy conservation, and sustainable practices, students were submerged in simulated scenarios. This implementation was successful, as evidenced not only by increased student engagement but also by observable changes in environmental behaviours and increased awareness. As active participants in their education, students internalised sustainable practices' practical applications in addition to absorbing theoretical knowledge, which helped them develop a sense of environmental responsibility.

A second case study demonstrates how an environmental education game was incorporated into a corporate training program in the business world. Employees could use the game as a virtual platform to make decisions about workplace resource management, carbon footprint reduction, and eco-friendly initiatives. The immediate improvement in the company's environmental practices was not the only benefit of this implementation. Enhanced staff morale and a common sense of accountability for the company's sustainability were further manifestations. Employees who actively participated in the game not only developed a stronger comprehension of environmental concepts, but they also came to share a commitment to promoting sustainable practices in their professional setting.

The third case study, which focuses on community outreach, shows how a gamified approach can help inform locals about environmental issues. In order to motivate the community to actively engage in waste reduction programs, green space preservation, and energy-efficient practices, organisers used interactive challenges and activities. Multiple indicators of this implementation's success include the improved sense of community, increased environmental consciousness, and continued participation in ongoing sustainability projects. The gamified approach sparked a shift in community attitudes toward more sustainable living practices by making learning fun and interactive.

These case studies highlight how adaptable educational games are in a variety of contexts, including corporate training, community outreach initiatives, and formal education settings. They stress gamification's versatility as a tool for addressing particular learning objectives and encouraging behavioural change, as well as its capacity to have a long-lasting effect on participants' awareness of environmental issues. Furthermore, the positive outcomes that arise from these case studies demonstrate the extensive advantages of gamification in environmental education. Beyond merely dispensing information, games' experiential and interactive elements foster a deeper level of engagement and motivate players to take an active role in their own education. This transition from receiving information passively to actively participating helps people understand environmental issues more deeply and develops a sense of personal accountability for sustainable practices. Gamification encourages people to actively participate and become stewards of environmental sustainability in both their personal and professional lives, going beyond simply imparting theoretical knowledge.

Lessons learned from previous games

The knowledge gained from prior environmental education games offers a useful road map for improving and streamlining upcoming game-based learning projects. These observations, which emphasise the complex relationship between gamification and environmental awareness, are grounded in real-world experiences. The strategic alignment of game objectives with particular learning outcomes is one of the core lessons. The story, mechanics, and intended educational objectives of a successful environmental education game are all seamlessly connected. This alignment guarantees that players will enjoy themselves while playing the game and will also absorb important environmental ideas and concepts. Fostering a profound and long-lasting understanding of environmental issues is largely dependent on how well entertainment and education are integrated into the game structure.

Another important lesson that comes from the iterative nature of game development is the significance of ongoing assessment and improvement. Important roles in this iterative process are played by participant feedback, continuous engagement level monitoring, and evaluations of the effectiveness of the instructional content. Learning from previous games creates a dynamic feedback loop that makes it possible for games to improve and better meet the wide range of learning requirements of players. One of the main themes of the lessons learned is how adaptable game design can be. The efficacy of customising game mechanics and narratives to the unique context and audience is demonstrated by popular games. Acknowledging participants' varied backgrounds and learning styles, whether in formal education settings, corporate training programs, or community outreach initiatives, guarantees that the gaming experience connects with its target audience and promotes deeper understanding and engagement.

Emphasis is placed on the lesson's recurrent and significant relevance to real life. When players are able to relate game scenarios to concrete, real-world consequences, they are more likely to become deeply involved with environmental concepts. Lessons learned highlight how the transformative power of educational games is enhanced by practical applicability, which builds a meaningful connection between virtual experiences and practical insights in participants' lives. Lessons emphasise that technology is more than just a tool for delivery; it emerges as a critical enabler. Multimedia, interactive components, and virtual platforms are seamlessly integrated to improve engagement and enrich the learning process as a whole. The impact of educational games is enhanced by the deliberate use of technology, which makes them more dynamic, immersive, and successful. The lessons emphasise how crucial it is to match instruction to learning objectives, participate in continuous assessment and improvement, embrace context-specific adaptability, infuse real-world relevance, and strategically integrate technology.

8. The GENTLY professional game for young workers

The goal of the multifaceted process that went into creating the board game for the GENTLY project was to provide young people with an enjoyable and interactive way to learn about environmental issues and green deal practices. This game, characterised as professional, can be used as a milestone linking education of youth workers with their employers as the latest ones have the opportunity to participate through interactive activities in real-life settings. For the development of the games, all the partners collaborated in order to conduct a research survey to identify the learning needs of youth workers regarding environmental issues, energy efficiency practices, and green deal approaches. In total, 137 people took part in the survey and the analysis of the data was conducted by A.S.E.L RO.

Subsequently, an extended version of the GENTLY board game has been developed, with questions that give information on applied green deal practices developed from companies in all countries that are represented in the consortium.

The goal of the board game is to impart practical, hands-on knowledge to youth regarding environmental issues and green deal practices. The game includes a board, pawns, dice, and card sets for every nation in the game. Each player chooses a colour for their pawn and places it on the board. Country cards are then placed next to the board, with questions unique to each nation on each set.

Players roll the dice during gameplay, moving their pawns in accordance. Players can respond to a question from the card of that nation by landing on its space. In order to collect one card per nation, players have to provide correct answers in order to earn cards. A player wins the game when they have all seven cards.

The board game created for the GENTLY project provides both effective means of bringing environmental issues to the attention of young people and inspire them to take action for a sustainable future. Players can investigate workable solutions offered by the green deal framework and gain knowledge about regional and worldwide environmental issues through interactive gameplay.

Additional material is the board and digital game reported as a result of PR2 focusing on more generic issues and problems around environmental concerns and climate change through Europe.

The annex includes the developed question cards for the professional game in English, German, Spanish, Lithuanian, Romanian, Greek and Hungarian highlighting the correct answer in each of them.

9. Annex

The appendix presents the question cards for the professional game in English, German, Spanish, Lithuanian, Romanian, Greek and Hungarian highlighting the correct answer in each of them.

English cards

https://gently4youth.eu/print/grid/en/worker

German cards

https://gently4youth.eu/print/grid/de/worker

Spanish cards

https://gently4youth.eu/print/grid/es/worker

Lithuanian cards

https://gently4youth.eu/print/grid/lt/worker

Romanian cards

https://gently4youth.eu/print/grid/ro/worker

Greek cards

https://gently4youth.eu/print/grid/gr/worker

Hungarian cards

https://gently4youth.eu/print/grid/hu/worker