Game Based Learning for Raising Environmental Consciousness

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Abstract
This paper presents the results of the European Project GENTLY. Within the framework of the project an educational board game with a complementary digital version has been collaboratively designed, developed and tested with young people across Europe. A multidisciplinary approach with experts from seven European countries has been followed with the goal to raise young people's knowledge and awareness of climate change issues and green deal practices. The target group were young people, including a dedicated concept for addressing the visually impaired. Game-based learning (GBL) can empower young people, make them aware of environmental threats and train them on practices for energy efficiency. This paper presents the methodology followed, the results achieved and the lessons learned from the testing and piloting of the developed environmental game. The feedback received was encouraging and in their majority the participating persons recognised that awareness on the environmental issues and motivation to act against the adverse effects of climate change is significantly increased through the game.

Keywords: Gamification, Game-Based Learning, Serious Games, Environment, Sustainability, Climate Change

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Introduction

The project GENTLY has started with the goal to raise awareness especially from the young generation around the environmental deterioration and the climate change. The European Green Deal, which has been formulated from the European Commission (2019) has set als objective towards the first climate-neutral landmass by 2050. Furthermore GENTLY focuses on three out of seventeen sustainability goals that have been defined by the United Nations (2015) namely goal number 4 'Education', goal number 12 'Sustainable consumption and Production patterns' and goal number 13 'Taking urgent action to compact climate change and its impacts'.

The young generation will be affected the most by the next decades from the consequences of environmental deterioration. That includes several environmental challenges to face such as the overpopulation which increased the demand on diminishing resources,, the accumulation of waste which trigger health risks for the humans, the ocean and air pollution which destroys ecosystems, the global warming with disastrous consequences for our planet and the loss of biodiversity which can potentially lead to a breakdown of our ecosystem.

The current research focused on bringing young people closer to the problems, statistical data and possible adverse measures for understanding all these challenges and taking actions in the future to adapt and encounter all the adverse effects. The method chosen is based on game based learning , as it is advocated as a non-formal education method which can simplify complicated contents, enhance retention of knowledge and motivate individuals to act based on their knowledge. Sousa et al. (2023) by making a systematic review of board games report on their huge potential both on psychological and cognitive level by supporting individuals in the learning process. Games for raising the level of knowledge in all educational levels are reported increasingly in the literature, where also the positive effects of using them are highlighted. Kurisu et al. (2021) report on the development and testing of board games with university students in Japan while in northern Taiwan Liu and Chen (2013) reported positive effects on learning with card games at the 5th grade of elementary school.

GENTLY has worked on the concept, development and pilot testing on a board game for the youth with the aim to raise their environmental awareness. Special focus has been also placed on how to adapt it for the visually impaired so as to make it accessible to as much as possible young people.

Methodology

Our efforts have been started by conducting an initial online survey for reaching out to young people in European countries.The designed questionnaires have been delivered to all seven countries of the participating partners (Germany, Lithuania, Spain, Hungary, Greece and Cyprus) and were addressed to young people around the following topics:
- knowledge and awareness of young people on environmental issues,
- how environmental pollution impacts their life locally, nationally, and in the international level,
- how they relate to climate change in different contexts,
- how to best engage and participate in actions to tackle this problem locally and internationally,
- how they relate to green deal practices,
- how they can use the EU practices for maximizing the energy efficiency,

- the role of youth education and of different educational means in tackling environmental pollution.

Scope of the survey was to create an image of the knowledge of the youth around environmental issues and policies, use the results as an input for the game and also tackle their expectations and needs. We have designed 3 questionnaires targeted to young people, young workers and young people with visual impairments. All of them have been translated into the native language of the seven countries (Germany, Lithuania, Hungary, Spain, Romania, Greece and Cyprus) where they have been delivered. Data has been collected anonymously.

Mavroudi et al. (2022) by reporting the effect that card games can have conclude that they can significantly foster constructive discussions and improve awareness among the persons playing. As the main scope of the GENTLY project was to inform and educate, the selected format has been decided to be a game with informative cards. The content of the cards was around environmental issues and problems faced in Europe.

Figure 1: Board Game

After the first research phase the game itself has been designed in a collaborative way with all partners and following a participatory approach. Ampatzidou and Gugerell (2019) consider participatory approaches suitable for lowering the risk of games failing due to blind spots and misinterpretations by the game designers. Mildner and Mueller (2016) show four different ways in which stakeholders can be involved in the game design process (1) as users, (2) as testers, (3) as informants, and (4) as design partners fully incorporated in a co-design process. In our case young people have been invited to use and play the game as testers giving feedback on how it can be improved. The same applied by testing the adapted form of the game with visually impaired people, where a school of blinds and an association of blinds has been contacted and invited in a special presentation event in order to provide useful suggestions. The final form that the game has taken is depicted in Figure 1.

The pawns developed for the game have a distinguished shape so that they can be even used by visually impaired persons. The material used is recyclable in accordance with the scope of the project. Pawns and dice used are presented in Figure 2.

Figure 2: Game Pawns

The game has been produced in three different formats: as an analogue board game, a digital version which can be played on the computer and a special version adapted for the visually impaired. The representation of countries within the project team in all corners of Europe facilitated the selection of relevant topics that are actual and of interest for each country.

The cards developed reflect environmental problems as well as green practices at the seven respective countries from where the project's partners were coming . They give information on how environmental pollution impacts everyday life on a local and national level, how they relate to climate change in different contexts, present actions and solutions to tackle the problem locally and internationally and relate to green deal practices. Young people from the seven participating countries have tested the game and given their feedback so as to revise and take into consideration suggestions on the design, implementation and rules. The game and its rules has been translated from english into spanish, lithuanian, romanian, greek, hungarian and german in order to reach as many young people as possible locally.

Digital Environmental Game

For transfering the game on its digital twin we selected to work with UNITY. Unity is a cross-platform game engine supporting a variety of platforms and giving the possibility to users to create both 2D and 3D environments.

The game created is a multiplayer game, allowing up to 4 persons to play simultaneously. Users after downloading and installing the game on their computer enter a virtual space where they can play it, applying the developed rules and playing with the cards as they are at their analogue version. It is available for Windows, Apple and Linux operating systems.

Impressions both from the virtual space and the game itself are given at Figures 3 and 4.

Figure 3: Virtual space for playing the Game

Figure 4: Digital GENTLY game

Accessibility and Inclusion for the Visually Impaired

Adapting the game for the needs of the visually impaired has been one of our priorities as we believe that inclusion and accessibility is important in order to include as many as possible. Physical game accessibility has been a research issue in the last years by many researchers. Heron et al. (2018) give a distinctive analysis on their eighteen month project concerning several so-called "hobbyist" board games and on how they can be adapted to be accessible for different kinds of impairments. Adaptations according to the respective impairment can widen the target audience of a board game and make them enjoyable also from people with impairments. A more in depth analysis targeted specifically to visually impaired persons is conducted from the Karolinska Royal Institute of Technology from Blomqvist and Jakabovivs (2023).

For making the game satisfactory for the needs of the visually impaired we have taken into consideration both the recommendations of these studies as well as from a school of blinds

and a blind association, which have been contacted. Suggestions that have been made were implemented to their big extent, the game was presented and subsequently received positive feedback. The needed adaptations that have to be made were the following:

A. Clear forms at the shape of the pawns. Game components need to have distinct shapes, textures and sizes to make them easily to identify by touch. Concerning the pawns it has been decided from the beginning of the project to give shapes that are clearly identifiable even by blinds. The material used to produce them was according to the scope of the project recyclable.

B. A larger, high contrast dice has been used with clear, tactile markings.

Figure 5: Tactile Dices

C. As the players need to be as much as possible autonomous by playing, it is needed to incorporate Braille on cards, game boards, and other written materials, such as the rules of the game. .Important details are needed to be conveyed through tactile information such as embossed symbols or textures. In our case both cards and rules were printed in Braille in an adapted suitable size.
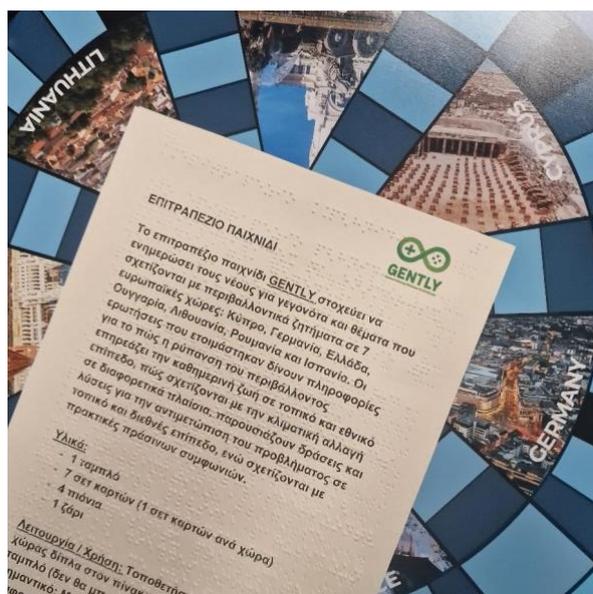
Figure 6: The rules of the game printed also in Braille

The game was tested with teachers of a school for visually impaired, facilitators, students, and guests. According to the feedback received it was playable and easy to understand and play with. The interactions were smooth and participants enjoyed both the content and insights it offered in relation to environmental challenges and climate change.

Lessons Learnt

By developing the game we have followed the principles of iterative game design and a participatory approach by involving users in order to make it more enjoyable and friendly to young people. The improvements made were related to the rules, time needed to accomplish a successful game round, the design of pawns, dice and cards especially in respect to inclusion and accessibility for visually impaired.

Playtesting at the early stages of developing the game from an initial small group of test users has helped a lot to assess the interactions, evaluate the fun factor of the game, observe the emotional responses and make necessary adaptations. At the later final stages the refinements were related mostly on the coherence and grade of difficulty of the set of questions as well as the general flow of the game.

Conclusion

The feedback received from the training and evaluation events as well as from the dissemination activities was in the majority positive and enthusiastic. Young people had fun, reported that they learnt new things and were eager to play it with their friends and families. This feedback was applied also for the digital one as well as the version dedicated to the visually impaired.

Based on our experience from developing and testing the GENTLY game our conclusion is that non-formal learning through the developed game promotes energy efficiency practice, provides motivation for everyday practices and volunteering, educates the youth and makes available information and insights on green practices that can be used both at the everyday life as well as in working spaces. At the same time fosters an understanding of environmental

danger and empower them to become active citizens. Used not only in educational settings but as an entertainment it can achieve significant effects and support life-long learning.

Acknowledgement

References

Ampatzidou, C.; Gugerell, K. (2019). *Participatory game prototyping—Balancing domain content and playability in a serious game design for the energy transition*. CoDesign 2019, 15, 345–360.

Blomqvist L. and Jakabovivs L. (2023). *Board Games beyond Sight. Inclusive Board Game Design with Focus on Visual Impairment*, Master of Science Thesis TRITA-ITM-EX 2023:322, KTH Royal Institute of Technology.

European Commission (2019). *The European Green Deal*, Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, Brussels, 11.12.2019, COM(2019) 640 final.

Heron, M.J., Belford, P.H., Reid, H. et al. (2018). *Eighteen Months of Meeple Like Us: An Exploration into the State of Board Game Accessibility*. Computer Games Journal 7, 75–95 (2018). https://doi.org/10.1007/s40869-018-0056-9

Kurisu, K., Okabe, H., Nakatani, J., and Moriguchi, Y. (2021). *Development of board game to encourage life cycle thinking, and trial with university students in Japan*. Cleaner Respons. Consump. 3:100033. doi:10.1016/j.clrc.2021.100033

Liu, E. Z., and Chen, P.-K. (2013). *The effect of game-based learning on students' learning performance in science learning—a case of "conveyance go."*. Procedia Soc. Behav. Sci. 103, 1044–1051. doi:10.1016/j.sbspro.2013.10.43

Mavroudi, A., Almeida, T., Frennert, S. et al. (2022). *A card game for designing activities for technology-enhanced learning in higher education*. Educ Inf Technol 27, 2367–2383 (2022). https://doi.org/10.1007/s10639-021-10668-z

Mildner, P., & Mueller, F. F. (2016). *Design of Serious Games*. In R. Dörner, S. Göbel, W. Effelsberg, & J. Wiemeyer (Eds.), Serious Games: Foundations, Concepts and Practice (1st ed., pp. 57-82). Springer. https://doi.org/10.1007/978-3-319-40612-1_3

Sousa C, Rye S, Sousa M, Torres PJ, Perim C, Mansuklal, SA and Ennami F. (2023). *Playing at the school table: Systematic literature review of board, tabletop, and other analog game-based learning approaches*. Front. Psychol. 14:1160591. doi:10.3389/fpsyg.2023.1160591

United Nations (2015). *Transforming our world: the 2030 Agenda for Sustainable Development*, General Assembly United Nations, A/RES/70/1, 25 September 2015.

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