

# Education for Sustainability through Gamification

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## Abstract

The study explores the intersection of sustainability education and gamification, focusing on the application of the "Green Walker" board game in educational settings. It addresses the role of educational institutions in sustainability education, methodological approaches to sustainability education, and the significance and efficacy of gamification in enhancing learning motivation and cognitive skills. The empirical research concentrates on the outcomes of implementing the "Zöld járőr" game in schools, examining its impact on students' sustainability consciousness and attitudes. The findings indicate that gamified educational tools significantly contribute to reinforcing sustainability knowledge and fostering environmentally responsible behaviours among students. The research underscores the importance of integrating sustainability education with gamification in education and highlights the potential benefits of game-based learning for developing sustainability competencies.

**Keywords:** sustainability, green education, gamification

In the 21st century, sustainable development, raising environmental awareness and protecting ecosystems are key priorities that will shape the global community's environmental, social and economic future. The challenges are significant and wide-ranging, but there is scope to slow progress and conserve remaining resources. Hungary has actively contributed to sustainability efforts from the beginning, and in 2015, it included sustainability as a key competence in the National Core Curriculum, highlighting the importance of environmental sustainability education for future generations. Education and awareness-raising start with the youngest age groups, who are open to the world and easily absorb information that is relevant to them in an understandable way, thus enabling the long-term integration of sustainability knowledge and skills. Environmental

education starts in an institutional setting in the preschool and primary school years (Dudok, 2021; Szilágyi & Dudok, 2022). For Generation Z and Alpha, the need for a sustainable future and environmental awareness is a real issue that can become part of their everyday activities and shape their thinking. One of the most effective settings for environmental education is the environment itself, such as zoos, wildlife parks and national parks, which offer a wealth of opportunities for learning through experience. They can provide formative experiences that help develop and reinforce a sense of responsibility for each other and the living world. Environmental empathy education also becomes a tool for complex personal development. Through zoo pedagogy and experiential education, students can leave their comfort zone and gain in-depth knowledge of the nature around them (Ács, 2007; Barnes, 2002; Csajka & Csimáné, 2019). Gamification, a key method for the current generation, is highly effective in capturing attention, increasing motivation and promoting active participation. Its integration into the educational process is essential. The use of gamification allows learners to acquire new knowledge and skills in a playful way, making the learning process more effective and enjoyable.

Our research aims to investigate the effectiveness of education for sustainability through gamification. The research will investigate the students' thinking about sustainability and its development through the "Zöld járőr" board game.

### **Education for sustainability**

Sensitisation is one of the most effective educational strategies for teaching sustainability, aiming to introduce children to nature and make them love it (Randler et al., 2005; Tran, 2011). One of the most effective complementary approaches is to teach children outdoors, where they can learn from their own experiences, facilitating the exploration and understanding of cause and effect. Research has shown that this also positively affects problem-solving methods and helps long-term memorisation and the development of social skills (Benefield et al., 2006; Randler et al., 2005; Mónus, 2020). Formulated the method of sensitisation in four steps: 1) focus attention on a small problem, 2) start sensitisation at an early age (kindergarten, primary school), 3) provide opportunities for nature experiences and experiences, 4) link nature experiences and experiences to classroom teaching (Randler et al., 2005).

The emergence of the need for environmental education first highlighted the rapid destruction of our natural environment linked to economic and social systems. There are many ways of linking sustainability education and teaching

within schools, but it is up to school leaders and teachers to ensure this is achieved. For example, educational posters on sustainable development can be displayed on school premises or related texts can be developed in lessons and discussed in workshops (Dudok, 2021).

The integration of sustainability education into education in Hungary started with the 2012 and 2020 amendments to the National Core Curriculum (NAT), which emphasise the need to teach sustainable development (Oktatási és Kulturális Minisztérium, 2012, 2020). The NAT requires teaching sustainability at all school levels, emphasising its multidisciplinary nature, which permeates the curricula of natural sciences, social sciences and arts.

In the context of sustainability education, particular attention will be paid to environmental awareness, resource efficiency, climate change, biodiversity conservation and sustainable consumption. These elements contribute to students' understanding of the ecological footprint and their ability to make responsible choices in their daily lives (Szűcs, 2018).

However, there are several challenges to implementing it in practice. On the one hand, teachers must be provided with specific training and in-service training related to sustainability education to have the appropriate knowledge and methodological tools (Kovács & Szőnyi, 2019). On the other hand, the success of sustainability education depends mainly on students' motivation, interest and attitude, which can be challenging due to different interests and prior knowledge differences.

The role of educational institutions is crucial for the successful implementation of sustainability education. Projects, programmes and hands-on activities in schools and kindergartens, such as environmental project weeks, green school programmes and research projects focusing on local environmental problems, contribute to raising awareness of sustainability (Nagy, 2020).

In line with European and international trends, there is a growing number of initiatives in Hungary to promote education for sustainability. International programmes related to sustainable development, such as UNESCO's Education for Sustainable Development (ESD) programme, also support Hungarian educational institutions in this field (UNESCO, 2017).

### **Education through gamification**

Gamification, i.e. the integration of game elements and game dynamics into educational processes, has received increasing attention in educational research

and practice over the last decade. With particular reference to the use of board games, these methods offer significant potential for motivating learning, developing cognitive skills and facilitating social interaction.

The essence of gamification is using playfulness, competition, rewards and other game elements in learning processes, thus increasing learners' motivation and interest (Deterding et al., 2011). Including board games in education is particularly beneficial as they help develop social skills such as communication, cooperation and conflict resolution (Qian & Clark, 2016). Traditional learning methods often prove insufficiently motivating for students in the digital age. Gamification offers new ways to make learning more exciting and interactive. Gamified learning promotes active participation, critical thinking and problem-solving skills (Hamari et al., 2014).

Successfully implementing gamification in education involves several steps. The learning objectives to be achieved through gamification must be clearly defined, board games and game elements must be selected according to the learning objectives, and games must be harmoniously integrated into the existing curriculum, ensuring that they support the learning objectives. Provide students continuous feedback and assessment throughout the learning process (Bellotti et al., 2013).

Gamification, particularly the use of board games, is beneficial in education for several reasons, as the playful elements and competition increase student interest and engagement. Board games promote communication skills and teamwork, requiring critical thinking, problem-solving, and decision-making. Furthermore, playful exercises can help students better understand and consolidate the learning material. This type of playful learning has significant potential to enrich educational processes, increase learner motivation and develop cognitive and social skills (Bellotti et al., 2013).

According to the NAT (National et al.), which will come into force on 1 September 2020, the maximum number of lessons per week in the sixth grade in Hungary is 28, so the maximum number of lessons per day is 7. Sixth-formers have twelve different subjects and physical education five times a week. They have four lessons a week in Hungarian language and literature and four lessons a week in mathematics. They study foreign languages 3 hours a week and history and science 2 hours a week. Once a week, they have ethics, vocal music, visual culture, technology and design, class teachers, and digital culture. Board games are included in the curriculum of three subjects: visual culture, foreign language and mathematics. The mathematics curriculum differs from the visual culture and

foreign language curricula, as the aim is not to create a board game but to develop thinking through an existing game. In the case of mathematics, the subject of logic and combinatorics is concerned with the development of logical thinking through board games. In the case of visual culture, the framework curriculum proposes board game creation in visual art phenomena under the theme of works and styles. For foreign languages, the framework curriculum proposes board games or the creation of board games for almost all subjects. In "Public matters", "Cross-curricular topics and activities", "English and language learning", and "Entertainment and playful learning", making and playing board games in group work appear as a suggested activity (Nemzeti alaptanterv, 2020).

### **Zöld járőr board game**

The National Crime Prevention Council has supported the Zöld járőr programme for many years, and the Crime Prevention and Education Centre Association is continuously developing it. The objectives of crime prevention are closely linked to education for sustainability because education is a means of developing values considered necessary for a sustainable future and directing attention to appropriate forms of behaviour that enable the development of attitudes towards safety. The programme's holistic approach to developing the necessary knowledge and skills strongly emphasises values and social competencies (Bűnmegelőzési Központ, 2017). Therefore, the pedagogical content of education for sustainability is inseparable from crime prevention, and the development of critical thinking, cooperation and social skills is accordingly addressed. Article 7 (2) of Government Decree 326/2013 included among the teacher competencies the authentic representation of the values of sustainability and the transfer of the associated attitudes (Wolters Kluwer, 2013). In the development of play, a key aspect was to strengthen the children's play culture and, according to the experiential pedagogy method, to make teaching experiential so that the student unobtrusively acquires new knowledge. Board games can also be used in education, where skills and abilities are developed unobtrusively, to teach sustainability and environmental awareness. The main aim of the game and the programme is to involve all participants in protecting the environment by working independently to detect environmental damage and to convey crime prevention messages to young people. To increase cooperation between the micro- and macro-communities involved and to develop the social skills of young people and their compliance with rules. The long-term goal should be to promote sustainability, health, environmental and social awareness, and crime prevention skills (Bűnmegelőzési Központ, 2017).

### *Introducing the Zöld járőr board game*

In addition to the game board, three different types of cards are included in the game: (1) picture animal cards, which give different essential and exciting information about an animal; (2) knowledge-building question cards, which include six different tasks and questions, (3) luck cards, which are responsible for good mood and cooperation. The board game includes several game options that can be used to convey information and show action patterns to children.

Good communication skills are essential to understanding and answering the tasks on the knowledge-building cards, but the game also requires decision-making in certain situations. Players can choose between transport modes, assessing their advantages and disadvantages. Players can establish a priority order, deciding how each animal is returned to its habitat, which is crucial for increasing social awareness. The game allows one to override self-interest and prioritise another animal's survival.

The game starts with players drawing five animal cards. On the back of the cards, they look at the location of the animal's habitat, as the task is to transport it to the zoo of the continent where it lives, where it will be adequately cared for and, if possible, returned to its original habitat. Domesticated or ubiquitous animals can be deposited at any zoo, and animals marked with the logo of the Szeged Wildlife Park can be transported there. Players receive a token for each animal they bring home. Moving around the board is done by adding the numbers thrown out of the two dice. During the game, stepping onto the "ecological footprint" fields, knowledge-enhancing question cards are read out with various tasks. The game ends when everyone has brought home their five animals.

### **Research Methodology**

Participants were first asked to fill in a (self-developed) paper-pencil-based questionnaire. The questionnaire covers sustainability and environmental awareness and also examines how board games can be used to teach students and deepen their knowledge by learning playfully. The questionnaire is divided into three parts; the first block asks demographic questions, the respondent's favourite subject and whether they have covered the environment in any of their lessons. In the second part of the questionnaire, there are open-ended questions on the respondent's knowledge of the environment. The open-ended questions aimed to discover how aware students are of sustainability as a concept and whether they know what they can do to create a sustainable environment. The respondent could express their knowledge of the question in short sentences; if they were

unclear about the meaning, they could leave the question unanswered – the third part of the questionnaire focused on the environmental sensitivity of the respondents. Respondents were asked to rate their attitudes towards nature on a five-point Likert scale. Data were collected in two groups per school. The questionnaires were administered at each institution during the break between classes, giving students 15 minutes to complete the questionnaires. The survey was conducted in two parallel classes in the schools participating in the study. One class was the experimental group, and the other was the control group. The input and output measures were the same for each group, but there was no sustainability education in the form of play between the two measurements for the control group. In the experimental groups, immediately after the completion of the input measurement, a playful session was conducted using the Zöld járőr board game as part of a lesson. Three days after the lesson, the pilot group completed the questionnaire. The control group did not receive any sessions after completing the input measure and also completed the output measure after three days.

Eighty-nine primary school pupils in the sixth grade, 45 girls and 44 boys, participated in the survey. Of those surveyed, 41 were attending a rural school. The gender and the place of residence of the respondents were an essential aspect of the research, as previous research has shown that girls and people living in cities are more environmentally aware and sensitive than boys and people living in rural areas (Berglund et al.,2015). The ages of the students ranged between 11 and 13 years. The sample is not representative, and our results refer to all samples studied.

Table 1. *Number of students in experimental and control groups (N=89)*

	Experimental group	Control group
City School	25 persons	23 persons
Rural school (1)	5 persons	5 persons
Rural school (2)	16 persons	15 persons

## Results

44.94% of respondents are fully engaged in creating a sustainable environment. 6.74% disagreed or strongly disagreed with this statement. Table 2 also shows that 26.96% of the respondents stated that they can learn about sustainability not only at school. Concern about running out of clean water was expressed by 43.82% of

the respondents, while 5.61% were not concerned about it. 50.56% of respondents agree that construction deprives animals of their natural habitat. 59.55% of respondents strongly agree that enforcing rules and preventing crime is essential, with only 2.24% disagreeing with this statement. As for the statement that people have the right to change the natural environment to suit their needs, 44.94% of respondents strongly disagreed, while 31.46% strongly agreed or agreed. In the last statement, whether people care a lot about the environment, 64.04% of the respondents could not decide whether they agreed or disagreed; those who disagreed or strongly disagreed were 21.34% of the respondents.

Table 2. *Attitudes of survey participants towards the statements listed (N=89)*

	1	2	3	4	5
<b>1. Sustainable environment</b>	3	3	21	22	40
<b>2. In school only</b>	24	33	23	6	3
<b>3. No worries-clean water</b>	39	16	20	9	5
<b>4. Construction deprives animals</b>	1	8	13	22	45
<b>5. It is essential to follow the rules</b>	0	2	8	26	53
<b>6. Man is free to shape</b>	9	31	21	10	18
<b>7. They care a lot about the environment</b>	3	16	57	10	3

In the survey's outcome measure, we also examined respondents' attitudes towards the environment, sustainability and safety awareness, separating the control and experimental groups. This is presented in Table 3, where the left-hand table indicates students who were engaged and the right-hand table indicates students who were not.

These show that 76% of the pilot group is concerned about creating a sustainable environment, and 6.52% disagree. The control group's percentages are as follows: 71.41% indicated that they strongly agree and agree to create a sustainable environment, and 25.58% indicated that they both agree and disagree. None of the respondents thought they disagreed. Student responses were very mixed on whether they could learn about sustainability only at school. Of the group interviewed, 36.95% thought they disagreed with this statement, compared to 27.9% of the control group who thought they only agreed.

Table 3. *Participants attitudes towards the statements listed in the second questionnaire measurement by experimental (N=46) and control group (N=43)*

	Experimental group					Control group				
	1	2	3	4	5	1	2	3	4	5
<b>1. Sustainable environment</b>	2	1	8	14	21	0	0	11	19	13
<b>2. In school only</b>	17	11	11	3	4	12	16	13	1	1
<b>3. No worries-clean water</b>	18	12	6	3	3	17	6	8	8	4
<b>4. Construction deprives animals</b>	0	1	6	15	24	2	1	11	9	20
<b>5. It is essential to follow the rules</b>	0	0	5	15	26	0	2	6	11	24
<b>6. Man is free to shape</b>	9	13	17	4	3	7	14	10	9	3
<b>7. They care a lot about the environment</b>	5	10	27	3	1	5	7	21	6	4

At the starting point before the sessions, we compared the two groups and asked them for their views on areas of sustainability. We found that at baseline before the session, there was no significant difference between the groups. A two-sample t-test showed that members of the two groups had similar views on the importance of protecting the environment, following rules, taking action to change nature, building, sustainability, clean water and a sustainable environment (all  $p > 0.164$ ), i.e. the baseline was the same in all cases.

After the session, we examined the groups' opinions separately, along with the same questions. We found that those not participating in the board game session did not significantly change their opinions on sustainability issues (all  $p > 0.294$ ).

However, based on the Paired-sample t-test, we found differences in the pre and post-intervention conditions in the group administered the intervention. Table 4 presents the mean scores and corresponding standard deviations of the students who received the board game intervention pre- and post-intervention condition. After performing the statistical test, we can see that there were two cases of significant change; these are marked with \*. One of these areas is the topic of dealing with the environment. Those who participated in the game have a more realistic view of the problem afterwards and are more likely to think that more should be done about the issue ( $t(45)=2.050$   $p=0.046$ ). Furthermore, those who also participated in the game think that people have less of a right to change the natural environment after the game than they thought before it ( $t(45)=-0.488$   $p=0.019$ ).

Table 4. Perceptions of intervention participants (N=46) on sustainability issues before and after the intervention.

	First		Second	
	Average	Source	Average	Source
<b>1. Sustainable environment*</b>	2,96	0,842	2,67	0,845
<b>2. In school only</b>	4,46	0,751	4,46	0,69
<b>3. No worries-clean water*</b>	3,02	1,308	2,54	1,11
<b>4. Construction deprives animals</b>	4,17	0,996	4,36	0,795
<b>5. It is essential to follow the rules</b>	2,17	1,12	2,26	1,27
<b>6. Man is free to shape</b>	1,98	1,16	2,07	1,18
<b>7. They care a lot about the environment</b>	4	1,135	4,11	1,05

Comparisons were also made by place of residence on issues relating to sustainability. We divided the sample into two groups by place of residence: an urban group (N=48) and a rural group (N=41).

A two-sample t-test found that before the session, i.e. at the first measurement, urban and rural students were statistically similar in thinking about the importance of environmental protection, following rules, actions to change nature, sustainability, clean water and a sustainable environment (all  $p > 0.276$ ). However, they think significantly differently about the issue of construction depriving animals of their natural habitat ( $t(87)=3.189$   $p=0.002$ ). Those living in rural areas ( $M=3.78$   $SD=1.01$ ) perceive the issue as less important, i.e., feel less that animals' habitats are being taken away than those living in cities ( $M=4.46$   $SD=0.988$ ).

However, using the Paired-sample t-test, we found that the number of points for living in the countryside increased significantly on the second measurement ( $t(40)=-2870$   $p=0.007$ ). Thus, building in the countryside was significantly more important on the second measurement ( $M=4.12$   $SD=1.005$ ) than on the first ( $M=3.78$   $SD=1.013$ ).

In general, analysing the open-ended questions, students knew that sustainability as a concept is closely related to environmental protection, and in many cases, students' sensitivity to cutting down trees was reflected in their answers. However, it should be pointed out that in some cases, there were instances where some of the responses were not related to sustainability or pollution at all. The almost exact definition of sustainability was correctly answered by 26% of the respondents, e.g., protecting and preserving the environment for posterity. They

were saving to save life, wood and water for future generations. We consume only as much as necessary to preserve for the future. Of this 26%, 19% of respondents attend a rural school. Of the respondents, 13 students could not answer the question, leaving it blank. In many cases, the students who participated in the session (pilot group) knew the concept of sustainability in the output questionnaire. 47.83% of the respondents answered the concept of sustainability correctly, 39.13% of them knew that the concept was related to pollution and environmental protection and tended to write answers that could contribute to a sustainable environment. Students who did not participate in the session (control group) did not change their answers.

Regarding the answers on reducing pollution, 14 out of the students who filled in the questionnaires did not answer. Most students who responded thought the best way to reduce pollution was not to litter and to collect rubbish separately. The second most common response was to reduce air pollution, and most students were willing to use public transport or cycling to help reduce pollution. In urban schools, it can be observed that their answers are better explained than those of students in rural schools, and their answers show that they are more knowledgeable on the subject. Rural schools tended to give answers of a few words. It should be pointed out that pupils in urban schools had numerically more ideas on how they could help to reduce pollution. After the session, pupils in the experimental group of rural schools could write down many more ideas of what they could do to reduce pollution and elaborate on their ideas. They could write concrete examples of recycling and producing less rubbish. New concepts appeared in their answers, such as zero waste. The students in the pilot group, who were studying in urban schools, gave similar answers to those given before the session. Their answers included saving water, e.g., I do not litter or waste water and paper. I do not waste; I use less water and less energy. One pupil also mentioned the usefulness of participating in different environmental programmes. Five students who participated in the session did not answer this question. The responses of the students in the control group, with whom no peer learning session was conducted, changed little or not at all. Most of the answers mentioned littering and selective waste collection, as well as the importance of public transport and cycling. Of the respondents, two students did not relate their answers to the question, so they were not considered countable. Of the respondents, six students did not answer the question at all. Students from urban schools gave more extensive and varied responses to the question than students from rural schools.

In general, when asked why they think it is essential to protect animals, respondents were mixed. Students in rural schools mostly thought that protecting animals was important primarily because there is no food if there are no animals. This may be because more families in rural areas are involved in agriculture and animal husbandry and see animals as a source of profit. In urban schools, students tended to focus on the natural cycle, with many describing a concern that some species might become extinct. 21.87% of respondents said that protecting animals is essential to prevent species from becoming extinct.

In the second measurement, it was observed in the experimental group that students used the concept of sustainability as a response after the session. These answers were more characteristic of students from the urban school. After the session, students from rural schools saw animals as applicable, and responses such as the extinction of animals or the importance of the natural cycle appeared. The answers for the control group changed slightly compared to the first questionnaire. In the case of rural schools, students focused on the food produced by animals, while students in urban schools focused on the importance of the food chain. There were also some responses indicating attachment. Responses focusing on the relationship between humans and animals were common to both types of schools. These responses focused on emotions; for them, the animal is the bond.

### **Summary**

This paper examines the relationship between sustainability education and gamification, focusing on using the Zöld járőr board game. The role of educational institutions, methodological approaches to sustainability education and the relevance and effectiveness of gamification in improving motivation to learn and cognitive skills are analysed. The empirical part of the research will focus on studies conducted in the school setting and the pedagogical outcomes of the Zöld járőr board game, examining the impact of gamification activities on students' sustainability awareness and attitudes. The results show that gamification tools, such as the Zöld járőr board game, can significantly contribute to consolidating sustainability knowledge and developing environmentally conscious attitudes among students. The context analysis highlights the importance of successfully integrating sustainability education and gamification in education and the potential benefits of gamified learning in developing sustainability competencies.

The results showed that using the Zöld járőr board game significantly improved students' sustainability awareness and environmental attitudes. The gamified educational methodology positively impacted students' motivation, environmental knowledge and sustainability skills. The study highlighted that a

gamified learning environment can promote students' active participation and engagement in sustainability education, which contributes to developing environmentally conscious behaviours. The results support the potential benefits of gamification in education, particularly sustainability education.

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